Street Tree Inventory Report and Recommendations

City of Midland, TX

July 2011

TEXAS FOREST SERVICE
The Texas A&M University System

Contents

Credits

The Texas Sample Community Tree Inventory (TXSCTI) system and report was developed by Texas Forest Service (TFS). It is adapted from the i-Tree Streets computer model developed by researchers at the Center for Urban Forest Research, a unit of the USDA Forest Service's Pacific Southwest Research Station. The statistical equations used to compute Standard Error values and percentages were specifically drawn from the i-Tree Streets model, as published in the latest user's manual. For more information about all the i-Tree tools, go to www.itreetools.org.

Recommendations provided are the judgment of the Texas Forest Service forester(s) listed below, based on the data collected in cooperation with community staff or volunteers. Questions or comments should be directed to:

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Executive Summary

In July 2010, Texas Forest Service (TFS) foresters, Midland city staff, local Master Gardeners and Master Naturalists and Keep Midland Beautiful volunteers conducted a sample tree inventory of 198 randomly selected street segments covering 83.5 miles (14.6% of the total street miles maintained by the city).

Results include:

* Midland has approximately 11,919 public trees that occupy 20% of the sites available for street and median trees.
* The population is dominated by oak (29%) and pine (20%) species.
* Most trees are mid-sized with 35% of trees in the 7-12" diameter range and just 3% of trees larger than 24" diameter.
* More than 77% of street trees are in good condition and 74% require only routine care.
* An estimated 4,782 public trees and 6,307 private trees have limbs that encroach into clear zones above streets and sidewalks.
* Street trees in Midland are valued at more than $32 million and generate environmental and other benefits worth almost $878,000 each year.

Recommendations include:

* Begin a program of pruning to train and shape young trees.
* Favor trees other than live oak in street tree planting projects.
* Develop a systematic program to prune for safety clearance over roads, sidewalks and traffic signals.
* Develop an annual work plan for tree maintenance and planting.
* Continue to hold an annual Arbor Day celebration and involve local groups.

City Description

Located in Midland County, Texas, the city of Midland lies 60 miles east of the New Mexico state line. Midland, the county seat, is one of the two primary cities that make up the Midland-Odessa Combined Statistical Area.

Situated in the Permian Basin at the southern edge of the state's High Plains ecoregion, Midland was established in 1881 as the midway rail station between Fort Worth and El Paso. The region was predominantly grassland and by 1890 Midland had become a major cattle shipping center.

The discovery of oil in the Permian Basin in 1923 transformed the city into the economic capital of the West Texas oil fields. Petroleum and natural gas output continues to be a significant contributor to the economy. Census figures for Midland show steady growth over the last few decades: 59,463 in 1970, 70,525 in 1980, 89,443 in 1990, 94,996 in 2000, and 111,149 in 2010.

Midland is a family-friendly community with several sports complexes, parks and a nature center. Considered the gateway to the Big Bend region of Texas, the Midland International Airport serves much of West Texas and Southeast New Mexico. In 2008, the city was rated by the Milken Institute/Greenstreet Real Estate Partners as "America's Best Performing City." That same year, Midland also was named “Best City for Doing Business” by Inc.com.

Current Tree Management

Tree management in Midland is guided by a professional forester (Randy Myers) within the Parks & Recreation Department (PARD). The forester’s duties do include managing street trees, but such work is not always a top priority. Other duties include landscaping projects, holiday decorations, special events, equipment maintenance and a variety of other tasks. In 2011, an additional employee was assigned to the urban forester to help with tree care.

The PARD annual tree budget is approximately $25,000, allocated from the general fund for plant material only. Utility line clearance pruning is performed by private contractors through a separate budget. None of the wood waste generated from this activity is currently recycled. Tree-related safety and technical training for city staff is periodically provided by the TFS regional urban forester.

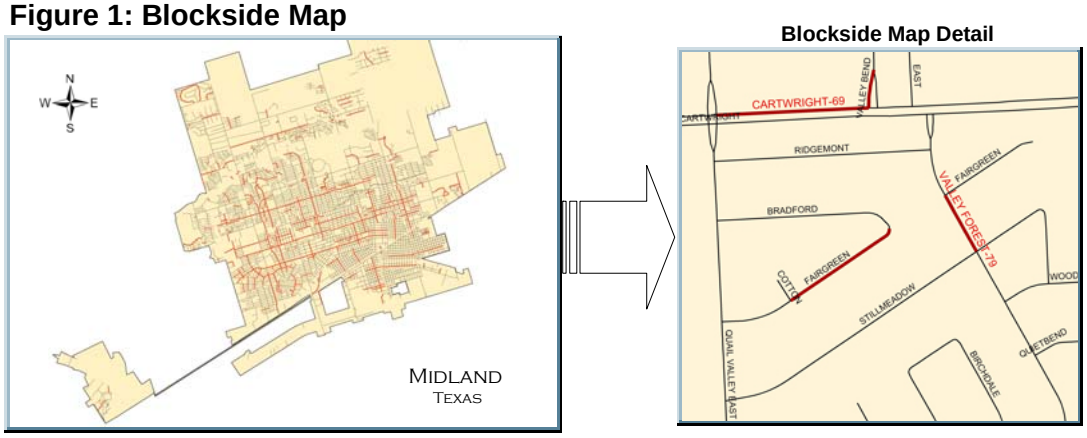
Midland also has a landscape ordinance for property undergoing development. It requires the planting of new trees throughout the property as well as a prohibition against removing trees from any public right-of-way. In 2010, PARD planted 192 trees as part of several beautification projects.

Keep Midland Beautiful is a key partner in various planting and tree care activities. TreeKeepers, a volunteer citizen group of Keep Midland Beautiful, is instrumental in assisting PARD staff with tree planting projects and an annual Arbor Day celebration. Midland is not yet a Tree City USA community, but holding a community Arbor Day ceremony is one of the four standards required for Tree City USA designation.

Inventory Methods

The Texas Sample Community Tree Inventory (TXSCTI) system is designed to provide city staff and community leaders with basic information about the street tree resource. TFS foresters identify and survey a 5-15% sample of street segments – or "blocksides" – (see Figure 1 below) and collect data on the trees they find there. This sample is not a substitute for a complete inventory of street trees, but instead is designed to help foresters make basic short- and long-term recommendations for managing this important community asset.

Figure 1: Blockside Map



Field data collection is limited to relatively few key measurements (see Appendix A for data collection form and definitions). Trees located within the public right-of-way (ROW) on both sides of a chosen blockside segment, as well as those within a center median, are evaluated for species, trunk diameter, general condition, maintenance needs and safety clearance. Private trees outside the ROW are evaluated solely for safety clearance. Blockside segments also are surveyed for available planting spaces, within the ROW and median, as well as within 30 feet of the roadway on private property since private trees in this zone also provide public benefits. All estimates provided in this report represent public ROW and median trees combined, unless specifically identified otherwise.

The sampled trees provide the basis for statistical estimates for the entire street tree population. In general, sample sizes that produce a Standard Error (SE) value of 20% or less of the total tree estimate are considered sufficient for making basic judgments about the state of the street tree resource. Streets with center medians are included in the survey with the length of these street segments increased as if the median were divided between the two sides of the street. Table 1 details the sampling results for this survey.

Table 1: Street Tree Sampling Results

Total Miles (# blocksides):	573.21 (1194)
Miles Sampled (# blocksides):	83.54 (198)
Sample Size:	14.6% (16.6%)
Estimated Total Public Trees:	11,919
Standard Error (SE):	+/- 1,514
Standard Error Percent:	12.7%

The report findings are divided into three sections: Street Tree Structure, Street Tree Care and Street Tree Values. TFS foresters have provided professional insight into the data results, followed by a set of recommendations based on an understanding of the city's current program and the state of the street tree resource.

Street Tree Structure

The pattern of trees found in a community can be referred to as its structure. This includes the different tree species and their sizes, as well as the overall number of trees and how they fill the available space along city streets, which is what urban foresters call stocking. These key measures will guide the recommendations at the end of the report.

Stocking

Every city has a designated amount of street miles to maintain. A model residential street has trees planted along both sides of the ROW, often between the curb and sidewalk. Larger collector streets and boulevards also may have medians that are wide enough to support street trees. If all planting spaces are filled with the largest trees possible for the available growing space (termed "full stocking"), a typical U.S. city will have about 105 ROW trees per mile. This benchmark is equivalent to one tree every 50 feet, but takes into account visibility triangles at corners and lost planting spaces due to intersections, driveways and other public infrastructure. Median spaces provide additional planting opportunities, as do spaces on adjacent private property that can shade public sidewalks and ROWs. The estimates here did not take into account underground utility conflicts that would lower the potential number of planting sites.

Table 2 shows the current estimate of street trees in the community, as well as planting site criteria and opportunities as found in the sample inventory.

Table 2: Street Tree Stocking

Estimated No. ROW Trees:	11,120
Estimated No. Median Trees:	+ 799
Estimated Total No. Street Trees:	11,919
Total Street Miles:	573.21
Estimated Stocking (trees/mile):	20.79
% Stocking:	20%
Median/ROW Planting Spaces:	36,964
Private Yard Planting Spaces:	+ 28,215
Total Planting Opportunities:	65,179

Planting Site Criteria

Tree Size: Medium or large tree to be planted, if room; only small trees planted under powerlines.

Location: Within public ROW and/or within 30' of ROW edge in private front yard. Tree lawn minimum 4' width.

Distances: Overhead - 15'
Hydrant, utility pole, street light - 10'
Street intersection - 25'
Driveway - 5'
Other trees - 20-50'

Key findings:

Midland has an estimated street tree stocking level of just 20%, which leaves ample opportunities for increasing street tree cover. To reach full stocking, the city would need to plant new trees in all of the estimated 36,000 planting spaces available along medians and ROWs. To reach just 50% of full stocking within the next ten years, the city would need to plant 1,200 trees annually and replace all trees removed during that period.

Beyond the city-owned ROW space, private homeowners could plant another 28,000 trees in their front yards within 30 feet of the curb. Since these owners provide tree maintenance, either individually or through their homeowner associations, Midland can realize the added benefits of trees over streets and sidewalks without the associated increase in management costs.

However, filling many of the planting sites on ROWs and medians will be challenging. Planting spaces less than four feet wide between the curb and sidewalk can prevent the planting of shade trees along new streets. Utility easements also may occupy the spaces normally reserved for street trees.

Species

As a rule, urban foresters recommend having no more than 10% of the street tree population made up of any one species, and no more than 20% made up of any one tree genus (i.e. the oaks or elms). This can prevent the catastrophic loss of trees during an outbreak of insects or disease – like Dutch Elm disease in the Eastern U.S. or Emerald Ash Borer in the Upper Midwest. Species diversity is one sign of a healthy tree resource.

Figures 2 and 3 show the most common species and genera, respectively, found in the sample inventory. The top ten species or genera are shown (could be more if categories tie for tenth place), plus a category combining the remaining species or genera. A complete list of species encountered during the inventory is listed in Appendix B.

Figure 2: "Top Ten" Species

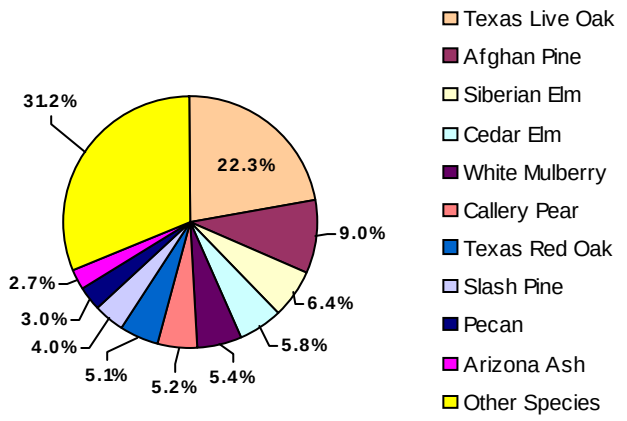
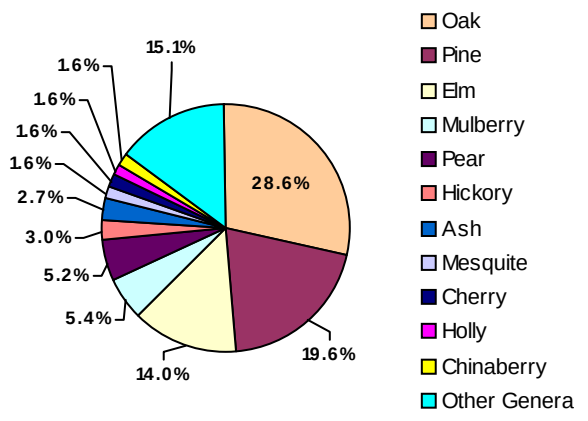


Figure 3: "Top Ten" Genera



Key findings:

The population of street trees in Midland is surprisingly diverse, with more than 50 species tallied during our survey. That said, the five most common species make up almost one-half of all street trees: Texas live oak (22%), Afghan pine (9%), Siberian elm (6%), cedar elm (6%), and white mulberry (5%). Only Texas live oak exceeds the recommended 10% species limit for street trees.

However, it may not be wise to completely avoid planting more live oak trees. It is a drought hardy, long-lived species that can provide tremendous shade along streets and in yards. Its one weakness is a susceptibility to oak wilt disease – already a problem in some Midland neighborhoods – so an effort should be made to break up row plantings of live oaks with other species. Bur oak, Mexican white oak, and chinkapin oak all provide high shade value but are less susceptible to oak wilt. Other shade species to consider include Italian stone pine, Montezuma baldcypress, Mexican sycamore, lacebark elm and cedar elm.

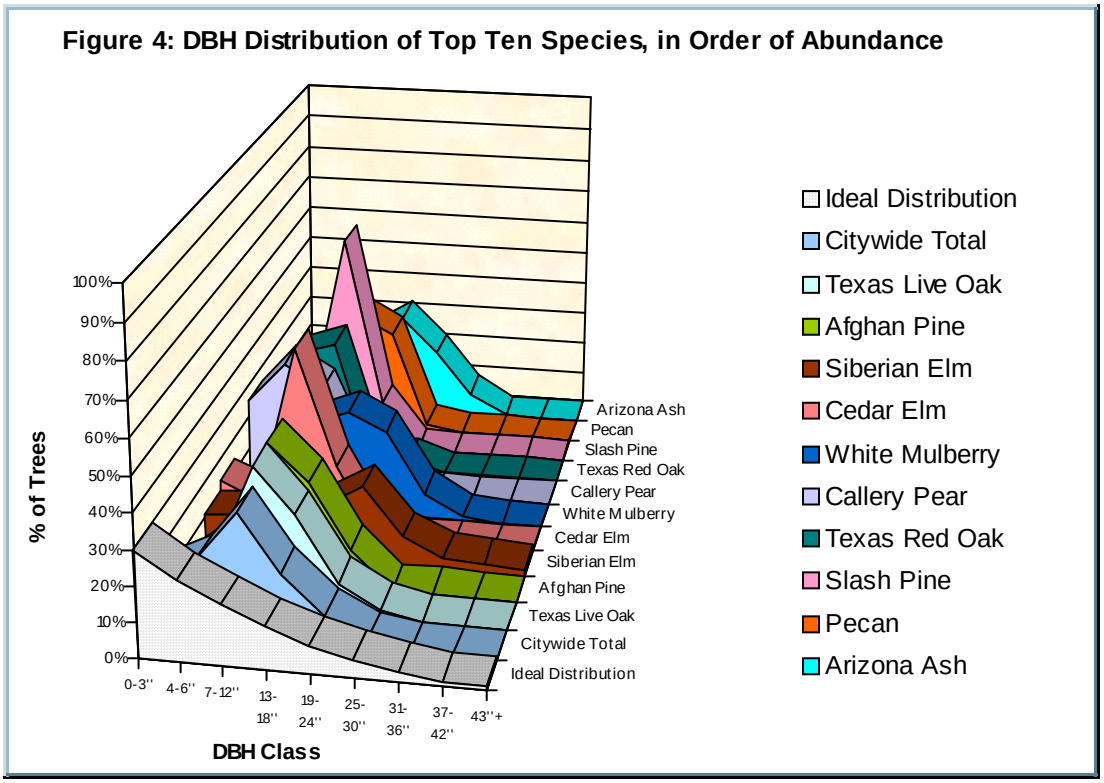
Another way to increase diversity in Midland would be to add species in the 'small tree' category. Adding accent trees such as desert-willow, Mexican redbud, Eve's-necklace, prairie sumac, Texas mountain-laurel and Texas pistache can provide seasonal interest and color beyond crapemyrtles and flowering pears.

Size

Tree diameter – also called diameter at breast height (DBH) – is measured on the trunk, 4.5 feet off the ground. This sample inventory assigned each tree to one of nine size classes as detailed in Appendix B (palms and yuccas are assigned to a class by feet of clear trunk height). The ten most prevalent species are displayed as a graph in Figure 4 (below).

Tree size is generally a good indicator of age, since large trees are usually older than small trees. But species composition also can influence the size class distribution because small-statured species will never grow into the larger classes. Taking into account mortality rates, which are higher for trees when they are young, a balanced size distribution for a species will have more trees in the smaller size classes and fewer in the larger size classes. This report compares the top ten species to an ideal distribution of 30% young trees (0-3" DBH), 40% maturing trees (4-12" DBH), 20% mature trees (13-24" DBH), and 10% old trees (>24" DBH).

Figure 4: DBH Distribution of Top Ten Species, in Order of Abundance



Key findings:

The size distribution of street trees reflects Midland's boom-and-bust pattern of growth, which generated distinct waves of tree planting over the past 30 years. With few trees in the native landscape, almost all street trees are planted specimens and several of the most common trees are non-native species (Figure 4).

For instance, three species – Siberian elm, white mulberry, and Arizona ash – have current distributions that reflect plantings that occurred as many as 30 years ago, making these some of the largest trees in the community. All three are fast-growing species, planted to generate shade quickly. These trees now may be approaching the end of their natural life span, making them more susceptible to damage from storm events during the coming years.

The distributions for individual species offer additional insight (see Appendix B for detail). The curve for callery pear (often referred to as 'Bradford' pear) shows that fewer numbers of this species have been planted recently, even though it is still the most common 'small' tree planted.

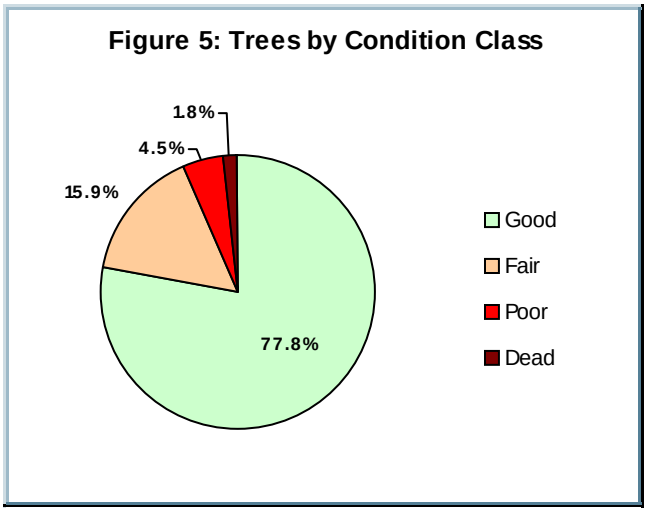
Street Tree Care

The care and maintenance practices for street trees – or lack thereof – will determine the condition of the resource as well as its future needs. This sample inventory evaluated trees for their overall condition, maintenance needs and safety clearance.

Condition

Sampled trees were briefly observed and assigned to one of four condition classes: good, fair, poor or dead (see Appendix A for condition class descriptions). This evaluation was designed to capture an overall assessment of the tree including its health and structural soundness. It did not rate each individual part of the tree such as leaves, twigs, branches, trunk and roots.

Figure 5 shows the distribution of street trees by condition class, as found in the sample survey.



Key findings:

The majority of street trees in Midland are well-cared-for, with more than three-quarters (78%) in good condition. If proper maintenance continues, these trees can remain in good health and produce increasing economic and environmental benefits for years to come.

But 16% of street trees are only in fair condition. These are trees that usually can be restored to full health with appropriate treatment, but much depends on the reason for the classification. Trees in this category may be large Siberian elms and white mulberries that have damage from previous ice storms or internal decay due to advanced age. Or, these trees could be new plantings that have not received proper care or sufficient water.

A small number of trees were rated poor (4%) in the survey. One key reason for rating a tree poor during our survey would be evidence of past topping, a common but misguided practice of cutting off main limbs. Some of these trees will never recover from such treatment, developing decay that forces their removal at some point. Removal cost is almost always higher than the cost of proper maintenance.

Very few dead trees (2%) were discovered, which is a sign of an effective monitoring and removal program. All dead trees should be located and removed each year.

Maintenance

Tree maintenance is the primary responsibility of the street tree manager. A prudent manager will schedule the removal or repair of trees that pose a risk to the public, as well as improve tree health and reduce future maintenance costs. This sample inventory evaluated ROW and median trees and assigned each to a maintenance category as shown in Table 3 (below).

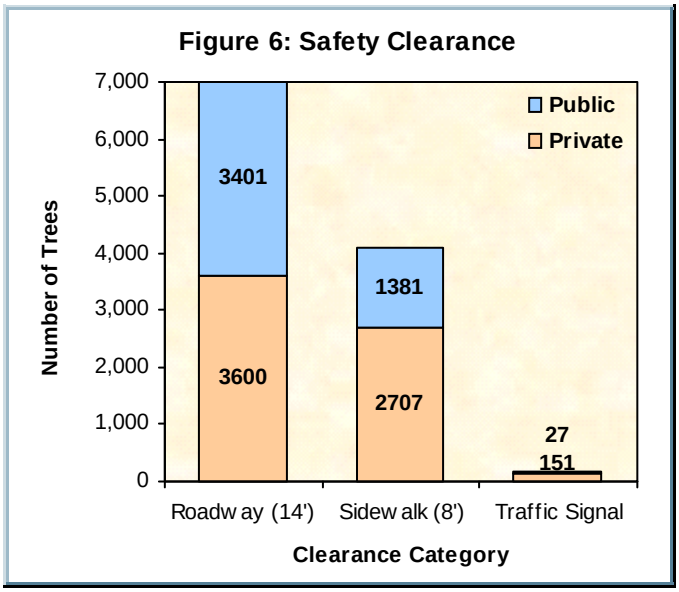
Table 3: Maintenance Needs

Treatment	Description	Estimate	Percent
Prune-Immediate	Dangerous broken branches and/or large deadwood. Presents safety risk to persons or property. Pruning should be accomplished as soon as resources are available.	48	0.4%
Prune-High Priority	Broken branches or deadwood, but no apparent immediate safety risk to persons or property. Prune as soon as resources are available.	96	0.8%
Prune-Routine	Routine, ongoing pruning should be scheduled on a cycle of five to seven years to remove dead, dying or diseased branches.	8,851	74.3%
Prune-Training	Recent plantings require pruning that develops a strong central leader and scaffold limbs, while eliminating trunk sprouts and dead, crossing, diseased or weak branches.	2,539	21.3%
Remove-Immediate	Trees should be removed ASAP because their condition and proximity to active-use areas pose an apparent risk to persons or property.	55	0.5%
Remove	Low priority removals should be scheduled when resources are available and after high-priority removals. Trees are generally located away from facilities and areas of use.	329	2.8%

Clearance

One important aspect of a tree maintenance program is to create safe clear zones over streets and sidewalks and to ensure the visibility of traffic signs and signals for emergency vehicles and the public. Even though a tree may be located on adjacent private property, it is the city's responsibility to ensure that necessary pruning is performed – either by the owner or the city. Figure 6 shows the estimated number of trees that require pruning to meet the appropriate distance standard.

Figure 6: Safety Clearance



Key findings:

Because Midland has many small trees along its streets, training pruning is required for more than 2,500 trees (21%). This type of pruning shapes and directs the growth of young trees, helps reduce future maintenance costs and allows each tree to reach its potential. Training pruning is the single best maintenance investment a city can make.

Our survey estimates a total of 55 street trees that need to be removed immediately and another 48 trees that require immediate pruning. Trees that generated these sample results were reported to city officials after they were discovered and should have been already treated.

Safety clearance over sidewalks (8') and streets (14') is one significant area of concern. While our survey reveals as many as 178 trees that obstruct street signs or signals, this situation appears to be routinely handled by city crews or homeowners. However, an estimated 4,700 public trees and 6,300 private trees have limbs that encroach into the safety zones above streets and sidewalks. Safety clearance work provides an excellent reason to develop a routine maintenance schedule for all street trees.

Street Tree Values

Developing a management program for street trees undoubtedly carries the burden of cost. But these trees also deliver valuable returns to a community, and in recent years many of these values have been quantified. Street trees stabilize neighborhoods and add value to adjacent real estate, thus improving the property tax base. They reduce air and water pollution, increase the energy efficiency of nearby buildings, sequester carbon and can even lower medical costs. The aesthetic benefits of street trees are harder to quantify, but they are just as important, if you ask most citizens. New research aims to quantify the health benefits for pedestrians from direct solar shading, the economic benefits from increased shopping activity in business districts and reduced street repair costs. In fact, public trees are the only portion of a city's infrastructure that can increase in value over time because healthy trees grow each year and increase the benefits they provide. Investing in a tree maintenance program can actually deliver a positive return to a city when the full benefits of trees are considered.

Tree Replacement Value

One accepted method for quantifying the value of trees was developed by the Council of Tree and Landscape Appraisers, published as the *Guide for Plant Appraisal–9th Edition (2000)* This method combines tree ratings in four categories (species, condition, size and location) to calculate the cost of replacing a given tree in the event it is damaged or destroyed. The location rating is an average of three factors: site, contribution and placement. This sample inventory used a conservative location rating of 70% and recorded DBH class values and condition ratings, as well as published species ratings and regional replacement costs (Texas Supplement, Third Approximation, 2011) to arrive at the estimated street tree value shown in Table 4. A complete list of replacement values by species is shown in Appendix C.

Table 4: Tree Replacement Values

Estimated No. Trees:	11,919
Estimated Total Value:	$32,282,875
Average Tree Value:	$2,709 ea.

Key findings:

Street trees in Midland have a replacement value totalling more than $32 million, an average of $2,709 per tree. Considering the number of healthy trees that will continue to grow over time, city leaders can expect increasing value from street trees for many years to come.

Appendix C illustrates the value of large trees. Even a tree with a low species rating such as Siberian elm has a high average value ($4,021/tree) because the average DBH is more than 18". Conversely, common crapemyrtles represent 1.2% of the total street tree population, but because their average size is so small (<3" DBH) they represent just 0.1% of total value ($214/tree). Unfortunately, this species simply won't grow much beyond this average DBH, meaning its value contribution won't increase much either.

And it's no surprise that Texas live oak is the most valuable species in Midland, since it is also the most common. With trunk diameters averaging a modest 12.8" DBH, the value of these trees will continue to increase for many years as they grow to maturity. One surprise is the per-tree value of Italian stone pine ($7,621/tree), a well-adapted but uncommon species for Midland.

Environmental Values

Trees are more than just landscape specimens; they are living organisms that grow new tissue each year. In a healthy tree, this organic process produces an increasing number of leaves. More leaves means more photosynthesis, more leaf area to intercept rainfall, more oxygen production and carbon uptake, cleaner air and a larger tree to shade nearby buildings.

Recently, new methods for calculating these benefits have become available. *i-Tree* is a software suite offered by the USDA Forest Service that can calculate several key benefits of trees. In particular, the *i-Tree Streets* tool is designed to quantify the value of environmental services that street trees provide. It uses tree growth curves and computer models that consider regional climate, building characteristics, air pollutant concentrations, and median housing prices to produce a general accounting of street tree benefits. Table 5 summarizes the monetary value of five key environmental and social benefits.

As described in the *i-Tree Streets* manual, energy benefits are derived from the reduced cost for natural gas and electricity used for home heating and air conditioning. Stormwater is the value of runoff intercepted by trees as rainfall. Air quality benefits include pollutant uptake by leaves and lower emissions from power plants from reduced energy use. Carbon dioxide (CO2) values reflect the reduction in atmospheric carbon due to the woody growth of trees, plus reduced carbon emissions from power plants from reduced energy use. Aesthetic and other benefits reflect the increase in property value from the tangible and intangible benefits of trees.

Table 5: Annual Environmental Benefits

Energy:	$136,314	
Stormwater:	$38,192	
Air Quality:	$35,376	
CO2:	$16,199	
Aesthetics/Other:	$651,890	
Estimated Total Benefits:	$877,971	
Average Tree Benefits:	$73.66	per year

Key findings:

In addition to the $32 million replacement value for street trees, these public assets provide more than $875,000 in environmental and social benefits annually to the residents of Midland. That's an average of $73.66 per tree. When you consider the low city maintenance budget for street trees, you can see that this portion of the public infrastructure is likely providing the highest benefit-to-cost ratio in the city.

The largest single value ($651,890) is generated by the increase in property values, followed by the benefit of reduced energy consumption ($136,314). These energy savings will depend on setback distances to homes and businesses as well as the overall amount of tree cover in the area. The neighborhood cooling effect of tree cover depends on a critical mass of trees, both along the ROW and on adjacent private property.

Midland’s street trees also generate more than $35,000 worth of both air pollution abatement and avoided stormwater costs each year. The annual growth of street trees accounts for the removal of 949 tons of CO2 from the air, valued at $16,199.

Recommendations

The purpose of this report is to provide city leaders with a snapshot of the current structure, maintenance needs and replacement value of the street tree population. Below are the short- and long-term recommendations from Texas Forest Service that the city can use to craft a plan for managing street trees into the future.

Short-Term (1-3 years)

Planting: develop a strategy to plant new trees annually

Midland has a low stocking rate of just 20%. With as many as 37,000 public tree planting sites available, some sort of formal streetscape program should be implemented and budgeted to plant trees in appropriate locations along streets and medians. Even a small program will ensure that some new trees are added each year to replace those that die and must be removed. One successful model is "NeighborWoods." Through this program, the city forester, civic groups, homeowners associations and businesses join forces to select planting sites and then purchase and distribute trees that citizens or volunteers can plant in the ROW. Establishment care then becomes the responsibility of the adjacent homeowner. Another option would be to focus on the 28,000 planting sites on private property, within 30 feet of the curb.

Species to consider planting along streets include live oak, bur oak, chinkapin oak, Mexican white oak, Montezuma baldcypress, cedar elm, lacebark elm, Italian stone pine, desert-willow, prairie sumac, Mexican redbud, Texas mountain-laurel and Texas pistache.

Maintenance: lower the risk to the public from trees

To manage the risk from street trees, the first priority should be to locate and remove trees that pose immediate risk to persons or property. The most effective strategy may be to educate other city workers (public works, fire, police) on how to identify and report a risky tree.

From our survey, more than one-third of all public street trees require pruning for safety clearance over roads and sidewalks. Therefore, the second priority should be to develop a systematic plan to address clearance pruning within neighborhoods. Due to the high value residents place on the shade offered by street trees, the city should consider lowering the standard for limb clearance over parking lanes (from 14' to 10') and sidewalks (from 8' to 7') in order to maximize the shading potential of street trees.

Consider using a contract workforce for this routine maintenance program. Tree crews would need to visit approximately 1,000 trees per year to conduct routine safety pruning on existing trees larger than 6" DBH. This systematic approach will keep these trees healthy and allow city staff to notify the owners of the estimated 6,300 trees on private property that also have clearance problems.

The resources of city staff can best be used by concentrating on training pruning for the 4,200 young trees (less than 6" DBH) along streets. This investment will prevent poor branching and greatly reduce future maintenance costs. Training pruning requires few specialized tools and can be easily taught to staff members or volunteers.

All tree work should conform to the latest ANSI A-300 (Tree, Shrub and Woody Plant Maintenance) and ANSI Z-133 (Safety) standards, as well as the latest Tree Pruning Guidelines from the International Society of Arboriculture (ISA) or the Tree Care Industry Association (TCIA). All work should be directed by ISA Certified Arborists.

Short-Term Recommendations, cont'd

Policy: review ordinances, standards and training

Review local tree ordinances to clarify the role of city departments in caring for street trees. A public tree care ordinance is one of the four required standards for achieving Tree City USA status. The ordinance also can set standards for locating new plantings and define the role individuals, groups and businesses will play when planting trees in the public ROW.

Develop a system for tree maintenance and planting and keep track of your progress. Such annual accomplishment reports can be used to support your Tree City USA recertification application each year. A complete management plan covering the next three to five years would help guide work into the future and help set budget levels to accomplish your goals.

Conduct a basic tree care workshop to train city personnel from all applicable departments on proper tree maintenance practices. The Texas Forest Service urban forester assigned to your region can help schedule training classes, workshops and other educational opportunities.

Community Support: get the public involved

Use the Tree City USA framework to build support for your tree management program. Continue to work with Keep Midland Beautiful to sponsor a community Arbor Day celebration and involve citizens in planning the event. Arbor Day also can provide opportunities to involve other community organizations, such as Rotary Clubs or Lions Clubs. These groups can be great partners that support and advocate for tree issues in the community. Your TFS regional urban forester can support a recognition ceremony at city council meetings or on Arbor Day.

Look to the private sector for additional support. Through your non-profit partners, many local businesses often are willing to donate towards activities with a strong public benefit such as planting and caring for trees. In this era of increasing awareness on environmental issues, many companies are looking for opportunities to invest in local communities.

Long-Term Recommendations

Develop a Street Tree Master Plan to guide annual work plans and provide long-range budget forecasting. This can be an important tool in communicating to city leaders the need for an ongoing maintenance budget. This plan will identify street tree priorities, goals and objectives, and it can help integrate street trees into city infrastructure. As part of the plan, consider a "green infrastructure" fund (1-2%) to pay for new trees on all city capital improvement projects. Other possibilities for diversifying program funding include stormwater or transportation fees, utility bill "check off" programs, or even energy efficiency grants provided by your local electric utility.

Conduct a complete inventory of street trees, which will allow for more efficient management and maintenance of this important part of the community's urban forest. Advances in commercially available software now allow tree inventory data to feed directly into a municipal work order system, vastly improving efficiency and customer service while allowing quick updates to the tree data once work is performed. A complete inventory then can be used to conduct a more thorough cost-benefit analysis of the city's trees using the the i-Tree Streets tool.

Appendix A–Part 1: Sample Blockside Data Sheet

Blockside #:_____ **ROW Width (ft.):** _____ **Date:** _____ **Crew:** _____

Street: _____ **From:** _____ **To:** _____

Tree #	Median/ Private Tree?	Species/ Code	DBH Class									Condition Class/Rating				Maintenance						Clearance Issues			
																Prune				Remove					
			0-3	4-6	7-12	13-18	19-24	25-30	31-36	37-42	43+	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
1	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
2	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
3	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
4	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
5	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
6	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
7	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
8	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
9	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
10	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
11	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
12	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
13	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
14	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
15	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
16	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
17	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
18	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
19	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
20	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
21	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
22	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
23	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
24	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA
25	M PVT		1	2	3	4	5	6	7	8	9	G	F	P	D	PI*	PH	PR	PT	RI*	R	TS*	R	S	NA

Special Notes

Address/Intersection

Number of Planting Sites per Block:

In Public Median or ROW: _____

Private Yards (<30' from ROW): _____

Blockside Sheet **1** of _____

Appendix A–Part 2: Data Sheet Definitions

Tree Inventory Information: TXSCTI

Blockside Number: Blockside = street name from street name to street name. 5% random sample has been mapped with ROW width and Blockside numbers assigned before the survey begins.

Tree #: Tree number is just to help you keep track of where you are since this is a sample inventory. Start at a block end. The survey is taken by walking or driving up one side of the block and down the other. All trees are counted in ROW and medians (if applicable) for residences, businesses, parks and other maintained areas. Only survey trees over 6 inches in fencerows or wild areas. If you have more than 25 trees, use a sheet with blank tree number column and fill in 26, 27, 28… and fill in "Blockside Sheet ____ of ___" at bottom of survey sheet.

Median Tree: Circle 'M' if tree is in a center median strip. Mark map to indicate the total length of the median on the blockside.
Private Tree: Circle 'PVT' if tree is on private property **and** has 'Clearance Issues' - don't record Species, DBH Class, Condition Rating or Maintenance for this tree.

Species Code: From list. Write name in if not on list.

DBH Class: Measure or estimate DBH and assign to one of the following classes: 1 (0-3), 2 (4-6), 3 (7-12), 4 (13-18), 5 (19-24), 6 (25-30), 7 (31-36), 8 (37-42), 9 (43+). If forked, take diameter at narrowest point below fork. If multi-stemmed (i.e. crape myrtles), average the diameters of stems over 1" at DBH. For palm species, assign to class based on feet of clear trunk height (from ground to base of live crown).

Condition Class: Condition addresses the current state of the tree's health, structural soundness, shape, and growth rate. Rate the overall health and condition of a tree by analyzing root characteristics, trunk and branch structure, canopy, twigs, buds, foliage, and any presence of disease and pest pathogens. Classify and record the condition of each tree in one of the following categories adapted from the rating system established by the International Society of Arboriculture:
Good: Trees in this class are judged to be desirable and with regular maintenance can retain this classification. They have few signs of physical damage, decay, disease or insect damage, or deadwood in the crown, limbs or trunk, although they may be interfering with utility lines or are planted in an overcrowded location.
Fair: Trees in this category have visible signs of stress, including one or more of the following: thinning canopy or small leaves; premature fall coloration; limited insect or disease infestation; structural faults or poor form; mechanical stem damage, including evidence of past 'topping'; deadwood >2" in the crown, limbs or trunk.
Poor: Trees in this group are in a general state of decline, exhibiting major disease or insect damage, physical defects, over 50% of the crown has deadwood or other serious defects, or bark may be beginning to peel. Priority pruning is likely required (i.e., large dead wood is present that could cause significant harm or damage).
Dead: Trees in this category are either already dead or in such very poor condition that removal is warranted. These trees have over 90% dead branches and have completely succumbed to insects, pathogens, or nutritional deficiencies. Little or no live foliage is visible during the growing season.

Maintenance:
PI*: Prune Immediate Priority. Requires immediate pruning – record under special notes at bottom of page. Trees in the immediate pruning category present possible safety risks to persons or property. Trees in this category are characterized by broken branches and large deadwood. Pruning should be accomplished as soon as resources are available.
PH: Prune High Priority. Trees requiring high priority pruning should be attended to as quickly as scheduling will allow. These trees, like the immediate priority pruning category, have broken branches and areas of deadwood. The dead areas, however, do not present an apparent immediate safety risk to persons or property.
PR: Prune Routine Priority. All other trees except young and recent plantings fall into the routine pruning category. They require removal of dead, dying, diseased, or obviously weak and heavy branches and deadwood. Routine, ongoing pruning should be scheduled and programmed to ensure all tree pruning is accomplished on a minimum cycle of five to seven years. It is important to remember that low priority problems can become high priority if they are not maintained for an extended period of time.
PT: Prune Train. The final maintenance category is training pruning. Trees in this category are generally young, recent plantings. Minimum maintenance includes trimming root and trunk suckers, deadwood, crossing, diseased, or weak branches, and staking improvement or removal. Trees in this category need to be scheduled for maintenance and not neglected. Generally, young trees should be pruned to reflect their species' natural growth pattern or to a single leader or a strong central leader to promote the development of strong scaffold limbs.
RI*: Removal Immediate Priority. Record under special notes at bottom of page. Trees categorized as high priority removals should be removed as soon as possible based on their lower condition class and proximity to active use areas or structures.
R: Removal-low priority. Low priority removals should be scheduled and accomplished when resources are available after high priority removals have been accomplished. These trees are generally located away from population areas and facilities.

Clearance Issues: Note if it is a private tree by circling PVT.
***TS: Traffic Signal.** Record under special notes at bottom of page. Circle if tree is blocking traffic control device such as a sign or light.
R: Road Clearance. Limb(s) is less than 14' over the curb or roadway.
S: Sidewalk Clearance. Limb(s) is less than 8' over a sidewalk (or other hardscapes for parks and public facilities besides streets).
N/A: No Clearance Issues.

Planting Sites: Medium or large trees to be planted if room. Under power lines, only small trees to be planted. Minimum 4-foot tree lawn needed to plant a tree. Record the number of planting spaces in Public ROW or Median. Also record number of planting spaces in Private Front Yards within 30' of ROW edge.
Distances From:
Utilities – overhead (15'); Hydrants, utility poles, and light posts (10'); Intersections (measured from corner) (25'); Driveways (5'); Other trees: 20-50'

TFS January 2007 PDS

Appendix B: List of Species Sampled and the Distribution of Each by DBH Class

Common Name (Scientific Name)	Distribution by DBH Class									Tree Count	% of Total	Running %
	0-3	4-6	7-12	13-18	19-24	25-30	31-36	37-42	43+			
Texas Live Oak (Quercus fusiformis)	6%	13%	41%	28%	9%	3%	0%			387	22.3%	22.3%
Afghan Pine (Pinus eldarica)	4%	13%	41%	30%	11%	1%	1%			157	9.0%	31.3%
Siberian Elm (Ulmus pumila)	11%	12%	22%	16%	23%	9%	4%	3%	2%	111	6.4%	37.7%
Cedar Elm (Ulmus crassifolia)	14%	9%	55%	21%	1%					100	5.8%	43.5%
White Mulberry (Morus alba)		9%	27%	31%	26%	7%	1%			94	5.4%	48.9%
Callery Pear (Pyrus calleryana)	25%	37%	31%	7%						91	5.2%	54.1%
Texas Red Oak (Quercus buckleyi)	19%	35%	39%	3%	3%					88	5.1%	59.2%
Slash Pine (Pinus elliottii)	7%	13%	65%	14%						69	4.0%	63.2%
Pecan (Carya illinoinensis)	13%	17%	37%	31%	2%					52	3.0%	66.1%
Arizona Ash (Fraxinus velutina)	11%	9%	24%	30%	20%	7%				46	2.6%	68.8%
Chinese Elm (Ulmus parvifolia)	42%	15%	18%	12%	9%	3%				33	1.9%	70.7%
Honey Mesquite (Prosopis glandulosa)	54%	32%	4%	7%		4%				28	1.6%	72.3%
Purpleleaf Plum (Prunus cerasifera)	43%	32%	18%	4%	4%					28	1.6%	73.9%
Yaupon Holly (Ilex vomitoria)	41%	41%	15%	4%						27	1.6%	75.5%
Chinaberry (Melia azedarach)	26%	48%	22%	4%						27	1.6%	77.0%
Aleppo Pine (Pinus halepensis)		23%	19%	38%	12%	8%				26	1.5%	78.5%
Italian Cypress (Cupressus sempervirens)	8%	40%	48%	4%						25	1.4%	80.0%
Japanese Black Pine (Pinus thunbergii)		46%	46%	8%						24	1.4%	81.3%
Pinyon Pine (Pinus edulis)	17%	48%	30%	4%						23	1.3%	82.7%
Willow (Salix species)	22%	26%	48%				4%			23	1.3%	84.0%
Tree-of-heaven (Ailanthus altissima)	19%	33%	29%	19%						21	1.2%	85.2%
Common Crapemyrtle (Lagerstroemia indica)	86%	10%	5%							21	1.2%	86.4%
Palm (Palm species)	57%	24%	19%							21	1.2%	87.6%
Loblolly Pine (Pinus taeda)	22%	11%	56%	11%						18	1.0%	88.7%
Chinese Pistache (Pistacia chinensis)	11%	50%	28%	6%	6%					18	1.0%	89.7%
Desert-Willow (Chilopsis linearis)	35%	29%	18%	6%	12%					17	1.0%	90.7%
Shumard Oak (Quercus shumardii)	24%	35%	35%	6%						17	1.0%	91.7%
Yucca (Yucca species)	33%	33%	13%	7%	13%					15	0.9%	92.5%
Ponderosa Pine (Pinus ponderosa)		8%	46%	38%	8%					13	0.7%	93.3%
Honeylocust (Gleditsia triacanthos)	45%	18%	27%	9%						11	0.6%	93.9%
Italian Stone Pine (Pinus pinea)	9%	9%	36%	9%	18%	18%				11	0.6%	94.5%
Black Locust (Robinia pseudoacacia)		44%	33%	22%						9	0.5%	95.0%
Texas Redbud (Cercis canadensis var. texens	25%	50%	13%		13%					8	0.5%	95.5%
Common Jujube (Ziziphus zizyphus)	13%		75%	13%						8	0.5%	96.0%
Leyland Cypress (Cupressocyparis x leylandii)	14%	43%	43%							7	0.4%	96.4%
Eastern Cottonwood (Populus deltoides)		29%		43%	14%		14%			7	0.4%	96.8%
Oriental Arborvitae (Thuja orientalis)		57%	43%							7	0.4%	97.2%
Chaste Tree (Vitex agnus-castus)	43%	57%								7	0.4%	97.6%
Sugarberry (Celtis laevigata)	50%	17%	17%		17%					6	0.3%	97.9%
Bur Oak (Quercus macrocarpa)	20%	60%		20%						5	0.3%	98.2%
Goldenrain-Tree (Koelreuteria paniculata)	25%	50%		25%						4	0.2%	98.4%
Southern Magnolia (Magnolia grandiflora)	50%	25%	25%							4	0.2%	98.7%
Crabapple (Malus species)	25%	25%	50%							4	0.2%	98.9%
Western Soapberry (Sapindus saponaria var.			50%	50%						4	0.2%	99.1%
Texas Mountain-Laurel (Sophora secundiflora)	75%	25%								4	0.2%	99.4%
American Sycamore (Platanus occidentalis)			33%	33%	33%					3	0.2%	99.5%
Mimosa (Albizia julibrissin)		50%		50%						2	0.1%	99.7%
Sweetgum (Liquidambar styraciflua)			50%	50%						2	0.1%	99.8%
Jerusalem-Thorn (Parkinsonia aculeata)	100%									2	0.1%	99.9%
Japanese Pagodatree (Sophora japonica)				100%						2	0.1%	100.0%

Total Number of Public Trees Sampled: 1737

Total Number of Species Sampled: 50

Appendix C: Tree Replacement Values, by Species

*Values are calculated for each tree in the sample using its recorded condition class rating, an average DBH for its assigned class, an average location rating of 70%, and the State Average 'Basic Price' ($76 per square-inch) for a 3-inch caliper specimen, installed and guaranteed for one year. Values for palm species are calculated using an average height in 'brown trunk feet' (BTF) and a Basic Price for that species. Species ratings for species marked with # were determined by the regional forester.

Tree Species	Species Rating #	Average DBH/BTF	Estimated No. Trees	Average Tree Value*	Total Value	Percent
Texas Live Oak	85%	12.8"	2,655	$4,562.20	$12,114,662	37.5%
Siberian Elm	51%	18.2"	762	$4,021.15	$3,062,670	9.5%
Afghan Pine	45%	12.9"	1,077	$2,487.55	$2,679,775	8.3%
White Mulberry	45%	16.5"	645	$3,155.08	$2,035,001	6.3%
Cedar Elm	78%	9.9"	686	$2,553.32	$1,751,988	5.4%
Arizona Ash	71%	15"	316	$4,901.87	$1,547,197	4.8%
Slash Pine	70%	9.4"	473	$1,985.43	$940,003	2.9%
Pecan	68%	10.6"	357	$2,418.95	$863,089	2.7%
Texas Red Oak	65%	8"	604	$1,326.23	$800,805	2.5%
Aleppo Pine	50%	14.7"	178	$3,590.78	$640,603	2.0%
Italian Stone Pine	86%	16.3"	75	$7,621.18	$575,229	1.8%
Callery Pear	60%	7"	624	$831.45	$519,166	1.6%
Chinese Elm	73%	10.4"	226	$1,982.79	$448,971	1.4%
Honey Mesquite	100%	7.4"	192	$1,745.27	$335,310	1.0%
# Yucca	80%	9.7"	103	$2,505.21	$257,847	0.8%
Chinese Pistache	86%	8.5"	124	$2,076.96	$256,523	0.8%
Tree-of-heaven	80%	8.6"	144	$1,716.13	$247,285	0.8%
# Italian Cypress	80%	7.6"	172	$1,432.26	$245,691	0.8%
Eastern Cottonwood	67%	17.8"	48	$5,071.47	$243,589	0.8%
Desert-Willow	86%	9.4"	117	$2,069.35	$241,384	0.7%
Ponderosa Pine	50%	12.6"	89	$2,566.13	$228,902	0.7%
Loblolly Pine	80%	8.6"	124	$1,776.53	$219,417	0.7%
Japanese Black Pine	60%	8.2"	165	$1,316.59	$216,814	0.7%
Willow	53%	9.6"	158	$1,156.75	$182,555	0.6%
Pinyon Pine	80%	6.8"	158	$1,133.45	$178,878	0.6%
# Purpleleaf Plum	60%	6.9"	192	$806.85	$155,016	0.5%
Shumard Oak	80%	7.2"	117	$1,326.84	$154,772	0.5%
# Yaupon Holly	70%	5.6"	185	$719.83	$133,359	0.4%
Chinaberry	53%	6.2"	185	$602.06	$111,540	0.3%
Black Locust	73%	9.4"	62	$1,735.21	$107,157	0.3%
Western Soapberry	65%	12.4"	27	$3,324.27	$91,239	0.3%
American Sycamore	60%	15.8"	21	$3,880.82	$79,886	0.2%
Sugarberry	65%	9.6"	41	$1,927.84	$79,369	0.2%
Common Jujube	40%	9.4"	55	$1,192.07	$65,436	0.2%
Texas Redbud	45%	8.8"	55	$1,130.97	$62,082	0.2%
Bur Oak	86%	7.8"	34	$1,737.75	$59,619	0.2%
# Japanese Pagodatree	75%	15"	14	$3,525.46	$48,381	0.1%
# Oriental Arborvitae	60%	7"	48	$982.74	$47,202	0.1%
Sweetgum	67%	12.4"	14	$2,796.68	$38,379	0.1%
Goldenrain-Tree	60%	8.3"	27	$1,390.13	$38,154	0.1%
Common Crapemyrtle	80%	2.9"	144	$214.09	$30,849	0.1%
Honeylocust	55%	6.9"	75	$369.36	$27,879	0.1%
Leyland Cypress	43%	6.8"	48	$523.09	$25,125	0.1%
Mimosa	38%	11.2"	14	$1,508.38	$20,700	0.1%
Crabapple	53%	6.9"	27	$748.50	$20,544	0.1%
# Chaste Tree	80%	3.9"	48	$407.80	$19,587	0.1%
# Palm	80%	4.8'	144	$102.17	$14,722	0.0%
Southern Magnolia	53%	5.3"	27	$456.74	$12,536	0.0%
Texas Mountain-Laurel	73%	2.8"	27	$193.68	$5,316	0.0%
Jerusalem-Thorn	65%	1.5"	14	$48.89	$671	0.0%
		Estimated Totals:	**11,917**	**Avg: $2,709 ea**	**$32,282,875**	