URBAN FOREST RESOURCE ANALYSIS

City of Henderson, Nevada

January, 2013
Revised December, 2013

DAVEY RESOURCE GROUP
A Division of The Davey Tree Expert Company

City of Henderson, Nevada

Urban Forest Resource Analysis

January 2013

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Acknowledgements

While the specific reports and recommendations can be attributed to this study, the basis for its structure and written content comes from the entire series of Municipal Forest Resource Analysis reports prepared and published by the USDA Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research, and credit should be given to those authors. The Municipal Forest Resource Analysis Reports are companions to the regional Tree Guides and i-Tree's STRATUM application developed by the USDA Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research.

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Executive Summary

Trees play a vital role in the community of Henderson, Nevada. They provide numerous benefits both tangible and intangible, to residents, visitors, and neighboring communities. Recognized as a Tree City, USA by the National Arbor Day Foundation since 1991, Henderson has demonstrated that public trees are a valued community resource, an important component of the urban infrastructure, and a part of the City's identity.

With a proactive approach to managing the urban forest, the City of Henderson contracted with Davey Resource Group (DRG) in 2012 to collect an inventory of public trees in the City. The inventory included an inspection by a team of Certified Arborists who recorded information including species, size, condition, and current maintenance needs, as well as the geographic location of 25,753 individual tree sites. This inventory represents all city-managed trees. Upon completion of the inventory, DRG developed a detailed and quantified analysis of the current structure, function, and value of this tree resource using the inventory data in conjunction with i-Tree benefit-cost modeling software.

The analysis determined that Henderson's public tree population is a cost-effective resource that **provides annual benefits of $869,789 ($3.24 per capita).** These benefits include energy savings, air quality improvements, stormwater interception, atmospheric CO_2 reduction, and aesthetic contributions to the social and economic health of the community. Considering the annual investment of $304,139 ($1.13 per capita) to provide care for this resource, the community realizes an overall net benefit of $565,598. **The bottom line is that for every $1 spent on public trees, the community of Henderson receives $2.86 in benefits.**

Replacement of Henderson's 25,753 public trees with trees of similar size, species, and condition would cost more than $59 million.

Henderson's public urban forest is reducing annual electric energy consumption by 1,221 megawatt hours (MWh) and annual natural gas consumption by 8,637 therms, for a combined value of $87,518 annually. In addition, these trees are removing 1.45 tons of pollutants from the air, including ozone (O_3), nitrogen dioxide (NO_2), and particulates (PM_{10}) for an overall annual air quality benefit of $38,196. The tree canopy is reducing annual stormwater runoff volume by 7.68 million gallons, protecting local water resources by reducing sediment and pollution loading. **Replacement of Henderson's 25,753 public trees with trees of similar size, species, and condition would cost more than $59 million.**

Trees are one community asset that has the potential to increase in value over time and with proper maintenance. Henderson's public tree resource is a relatively young population in overall good condition. Moreover, although it is critical to maintain an adequate level of resources to protect this investment, with more than 127 different species, Henderson is well positioned to realize a significant increase in environmental services as this vital resource continues to mature. The City's ongoing commitment to maximizing and maintaining the benefits from its urban forest will ensure that the community continues to enjoy the richness of life afforded by Henderson.

Introduction

The City of Henderson, Nevada is located on the southeast fringe of the Las Vegas metro area. Encompassing an area of 105 square miles at an elevation of 1,867 feet above sea level, Henderson has a generally warm climate with an average rainfall of approximately four inches. The population, currently 268,300, has increased over 300% since 1990. Referred to as "the other side of southern Nevada", the City of Henderson is nestled among three of the most renowned man-made attractions – the neon of Vegas, the engineering marvel of Hoover Dam, and the tranquil beauty of Lake Mead.

Individual trees and a healthy urban forest play important roles in the quality of life and the sustainability of Henderson. Research has demonstrated that healthy urban trees can improve the local environment and lessen the impact resulting from urbanization and industry (CUFR). Trees improve air quality by manufacturing oxygen and absorbing carbon dioxide (CO_2), as well as filtering and reducing airborne particulate matter such as smoke and dust. Urban trees reduce energy consumption by shading structures from solar energy and reducing the overall rise in temperature created through urban heat island effects (EPA). Trees slow and reduce stormwater runoff, helping to protect critical waterways from excess pollutants and particulates. In addition, urban trees provide critical habitat for wildlife and promote a connection to the natural world.

The City of Henderson's inventoried public tree resource is a relatively young population in overall good condition.

In addition to these direct improvements, healthy urban trees increase the overall attractiveness of a community and have been proven to increase the value of local real estate by 7% to 10%, as well as promoting shopping, retail sales, and tourism (Wolf, 2007). Trees support a more livable community, fostering psychological health and providing residents with a greater sense of place (Ulrich, 1986; Kaplan, 1989). Community trees, both public and private, soften the urban hardscape by providing a green sanctuary and making Henderson a more enjoyable place to live, work, and play. The City's 25,753 inventoried public trees play a prominent role in the urban forest benefits afforded to the community and the citizens rely on the City of Henderson to protect and maintain this vital resource.

Acknowledged by the Arbor Day Foundation as a Tree City USA since 1991, there is ample evidence that Henderson values its trees. Reflecting appreciation, concern, and a proactive stance on the management of the community's urban forest resource, the City contracted Davey Resource Group (DRG) to conduct an inventory of public tree assets. A team of ISA Certified Arborists mapped the location and collected data on publicly owned trees using global positioning system (GPS) technology. It is recommended that the resulting inventory data be maintained by the City's tree maintenance staff using an existing or dedicated asset management system to provide accurate and dependable inventory data specific to tree characteristics, health, and maintenance performed.

In addition to location, DRG arborists collected information about the species, size, condition, and current maintenance needs of each tree. The collected data was used in conjunction with i-Tree's *Streets*, a STRATUM Analysis Tool (*Streets* v5.0.1; i-Tree v5.0.6), to develop a resource analysis and report of the current condition of the urban forest. This report, unique to Henderson, effectively quantifies the value of the community's inventoried public trees in regards to actual benefits derived from the tree resource. In addition, the report provides baseline values that can be used when developing and updating an urban forest management plan. This helps in determining where to focus available resources and setting benchmarks for measuring progress. The inventory data collected for this report was collected from May, 2012 to October, 2013.

The purpose of the urban forest resource analysis and report is to provide information on the structure, function, and value of a specific tree resource. From this information, managers and citizens alike can make informed decisions about budgetary support and management priorities. This report provides the following information:

- A description of the current structure of Henderson's public tree resource and an established benchmark for future management decisions.
- Current, detailed management expenditures for Henderson's publicly managed trees and critical baseline information for evaluating program efficiency.
- A quantified value of the environmental benefits provided by Henderson's public trees illustrating the relevance and relationship of the resource to local quality of life issues such as air quality, environmental health, economic development, and psychological health.
- Data that may be used by resource managers in the pursuit of alternative funding sources and collaborative relationships with utility purveyors, non-governmental organizations, air quality districts, federal and state agencies, legislative initiatives, or local assessment fees.
- Benchmark data that can be used in the development of a long-term urban forest management plan.

Henderson's urban forest inventory is a complete dataset of publicly managed trees in streets, parks, and City facilities. The inventory currently represents all of the city-managed trees.

Chapter 1: Urban Forest Resource Summary

Summary of Urban Forest Resource Structure

The City of Henderson's urban forest resource currently includes 25,753 publicly managed trees and 157 available planting sites. A structural analysis is the first step towards understanding the benefits provided by these trees as well as their management needs. Upon examination of species composition, diversity, age distribution, condition, canopy coverage, and replacement value, DRG determined that the following information characterizes Henderson's inventoried public tree resource:

- Approximately 127 tree species were identified in the inventory. The predominant tree species is *Pinus eldarica* (Mondale pine, 9.9%), followed by *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 8.7%) and *Chilopsis linearis* (Desert willow, 7.7%).
- The age structure of Henderson's public tree population is very young, with 71.9% of trees measuring less than seven inches DBH (diameter at breast height, measured at 4'6" above the ground) and 26.2% measuring between 7 and 19 inches DBH.
- The majority of Henderson's trees (73.2%) were determined to be in good condition, with an additional 23.0% graded fair. Maintaining the condition of existing trees for as long as possible will increase their useful lifespan and promote a steady flow of benefits to the community.
- Henderson's public tree population has sequestered 3,750 tons of carbon (CO_2), valued at approximately $56,243.
- Replacement of Henderson's 25,753 public trees with trees of similar size, species, and condition would cost more than $59 million.

Replacement of Henderson's 25,753 public trees with trees of similar size, species, and condition would cost more than $59 million.

Summary of Urban Forest Benefits

Annually, Henderson's public trees provide cumulative benefits to the community at an average value of $33.78 per tree, for a total gross value of $869,789 per year. The City's public trees are providing the following substantial annual benefits:

- Public trees reduce electricity and natural gas use in Henderson through shading and climate effects; a benefit totaling $1,221, an average of $3.40 per tree.
- The public trees in Henderson currently sequester 446 tons of atmospheric CO_2 per year. An additional 610 tons is avoided through decreased energy use, resulting in a net value of $15,334 and an average of $0.60 per tree.
- Net air quality improvements provided by the public tree population through the removal and avoidance of air pollutants are valued at $38,196, an average per tree benefit of $1.48.
- Henderson public trees intercept an estimated 7.7 million gallons of stormwater annually for a total value of $36,857 per year, an average of $1.43 per tree.

- The total annual benefits contributed by Henderson's public trees to property value increases, aesthetics, and socioeconomic value are $691,883, an average of $26.87 per tree.
- When the City's annual investment of $304,139 for maintenance of this urban forest resource is considered, the annual net benefit (benefits minus investment) to the City is $565,650. The average net benefit for an individual public tree in Henderson is $21.96 per year. In other words, **Henderson receives $2.86 in benefits for every $1 invested on the public tree population.**

Henderson receives $2.86 in benefits for every $1 invested on the public tree population

Urban Forest Resource Management

Henderson's public tree population is a dynamic resource that is worth continued investment to maintain and extend its full benefit potential. **The community forest is one of the few assets that has the potential to increase in value over time with proper management.** Appropriate and timely tree care can substantially increase lifespan, preserving the higher benefit stream that results from a mature community forest. As individual trees continue to mature, and aging trees are replaced, the overall value of the community forest and the amount of benefits provided can be expected to increase as well. This vital, living resource is, however, vulnerable to a host of stressors and requires ecologically sound and sustainable best management practices to ensure a continued flow of benefits for future generations. With the benefit of a relatively young urban forest in good condition, Henderson can focus resources on maximizing the flow of benefits from the current tree population and maintaining a forward thinking approach. Based on the resource analysis, Davey Resource Group recommends the following:

- Work toward developing an appropriate age distribution. Henderson's tree population is very heavily weighted toward small, young trees. This is likely indicative of the rapid growth Henderson has experienced in terms of human population over the last two decades. Henderson should work to offset this by implementing a nutrition-fertilization program to help maximize healthy tree growth.
- Maximize the benefits of the existing tree resource through comprehensive tree maintenance and a cyclical pruning schedule.
- Implement a structural pruning program for young and establishing trees to promote healthy structure, extend life expectancy, and reduce future costs and liability. This is especially important in the case of Henderson with such a large population of young trees.
- Continue to develop species diversity. While Henderson does not have any species comprising greater than 10% of the overall population, there are under-represented species and genera that Henderson could focus planting to improve overall diversity among its tree population.
- Maintain the inventory in an existing or newly purchased asset management system.
- Inventory the remainder of the urban forest, and update with new trees as they are planted.

The value of Henderson's public tree resource should continue to increase as existing trees mature and new trees are planted. As the resource grows, continued investment in management

is critical to ensuring that residents will continue receiving a high return on investment in the future. It is not as simple as planting more trees to increase canopy cover and benefits. Planning and funding for tree care and tree management must complement planting efforts in order to ensure the long-term success and health of Henderson's urban forest. Existing mature trees should be maintained and protected whenever possible since the greatest benefits accrue from the continued growth and longevity of the existing canopy. Since the City's tree population is so young, the benefits provided by the more mature trees are even more pronounced. Henderson can take pride in knowing that street trees improve the quality of life in the City and that trees are well worth the investment.

This urban forest resource analysis and report, based on the current inventory status, defines the population and structure of Henderson's public urban forest and quantifies the benefits of that resource. The analysis focuses solely on publicly owned, City-managed trees on streets, parks, and City facilities, using i-Tree *Streets* to establish baseline information on the value to the community. This report and the included analysis, which is unique to Henderson, effectively estimates and quantifies the value of these public tree assets in regards to actual benefits derived from this resource. In addition, the report provides a baseline analysis that can be used when creating, implementing, and updating an urban forest management plan, determining where best to focus available resources and setting benchmarks for measuring progress. An urban forest resource analysis provides information on the structure, function, and value of the urban forest and its assets so that forest managers and citizens alike can make informed decisions about budgetary support and management priorities. This report provides the following information:

- A description of the current structure of Henderson's inventoried public urban forest resources, establishing a benchmark for future management decisions.
- Current, detailed management expenditures for Henderson's public trees and critical baseline information for evaluating program efficiency.
- A quantified value of the environmental benefits provided by Henderson's public urban forest, illustrating the relevance and relationship of the resource to local quality of life issues, such as air quality and environmental health, economic development, and psychological health.
- Quantified data that may be used by forest resource managers in the pursuit of alternative funding sources and collaborative relationships with utility managers, non-profit organizations, air quality districts, federal and state agencies, legislative initiatives, and/or in establishing or updating local assessment fees.
- Benchmark data that can be used in the development of a long-term urban and community forest management plan.

Chapter 2: Henderson's Urban Forest Resource

Population Composition

Broadleaf hardwood species dominate Henderson's tree population, comprising 84.3% of the total inventory. Broadleaf trees typically have larger canopies than coniferous trees of the same size. Since many of the measurable benefits derived from trees are directly related to leaf surface area, broadleaf trees generally provide the highest level of benefits to a community. Larger-statured broadleaf tree species provide greater benefits than smaller-statured trees, independent of diameter (DBH). Deciduous broadleaf species make up 65% of Henderson's public tree population, including 3% large-stature, 28% medium-stature, and 35% small-stature trees. Evergreen broadleaf trees comprise 19% of the population, including 1% large-stature, 8% medium-stature and 10% small-stature evergreen broadleaf trees. Large-stature conifers represent 13% of the overall population. Medium-statured palms make up 1% of the population, and small palms total 2%. Additional species total less than 1% of the population (Figure 1).

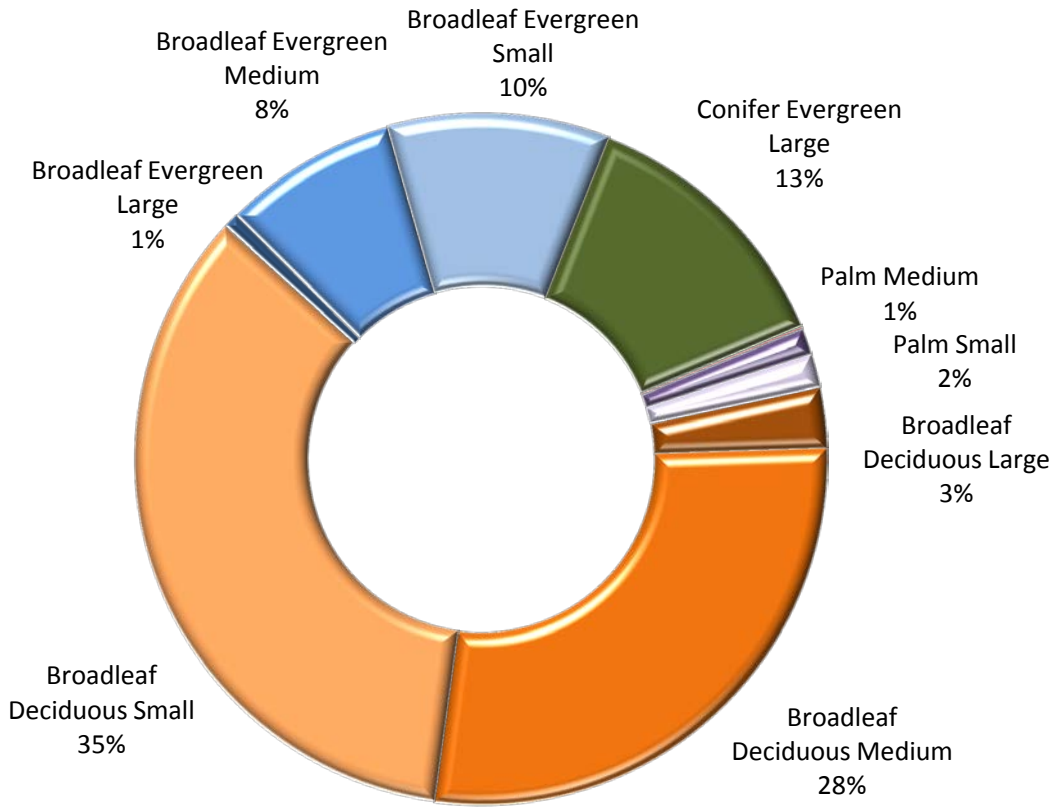


Figure 1.Composition of Henderson's Public Tree Population

Species Richness and Composition

Henderson's inventoried public tree population includes a mix of 127 species, significantly more than that of the mean of 53 species reported by McPherson and Rowntree (1989) in their nationwide survey of street tree populations in 22 U. S. cities.

The top ten species represent 58.3% of the total population (Figure 2 and Table 1). The predominant tree species are *Pinus eldarica* (Mondale pine, 9.9%), *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 8.7%) and *Chilopsis linearis* (Desert willow, 7.7%).

There is a widely accepted rule that no single species should represent greater than 10% of the total population, while no single genus more than 20% (Clark Et al, 1997). In Henderson, no genus represents more than 20% of the population. The most prevalent genus is *Prosopis* (mesquite, 15.1%), followed by *Fraxinus* (ash) representing nearly 14.9% of the population. No species is more than 10% of the population, but *Pinus eldarica* and *Fraxinus velutina* 'Fan-Tex', which together make up almost 20% of the overall public tree population, come very close to exceeding the 10% species rule. A complete population summary can be found in Appendix C.

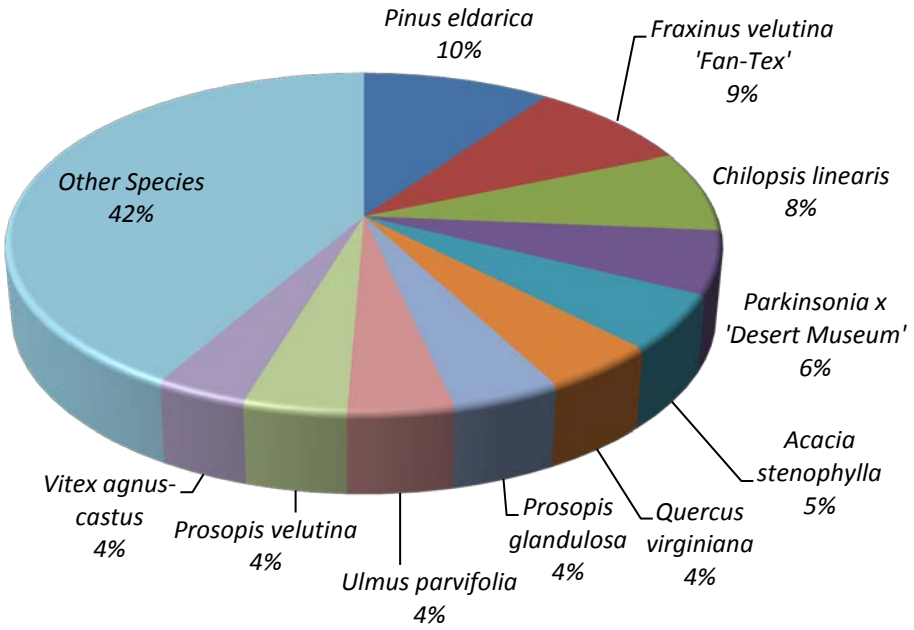


Figure 2.Species Frequency in Henderson's Public Tree Population

Maintaining a diverse population within an urban forest is important. Dominance of any single species or genus can have detrimental consequences in the event of storms, drought, disease, pests, or other stressors that can severely affect an urban forest and the flow of benefits and costs over time. Catastrophic pathogens, such as Dutch Elm Disease (*Ophiostoma ulmi)*, Emerald Ash Borer (*Agrilus planipennis*), Gold Spotted Oak Borer (GSOB) (*Agrilus auroguttatus*) Asian Longhorned Beetle (*Anoplophora glabripennis*), and Sudden Oak Death (SOD) (*Phytophthora ramorum*) are some examples of unexpected, devastating, and costly pests and pathogens that highlight the importance of diversity and the balanced distribution of species and genera.

Table 1. Population Summary of Henderson's Public Tree Inventory

Species	DBH Class (in)										% of Pop.
	0-4	4-7	7-13	13-19	19-25	25-31	31-37	37-42	> 42	Total	
Broadleaf Deciduous Large (BDL)											
Gleditsia triacanthos	68	72	98	0	0	0	0	0	0	238	0.9
Populus fremontii	107	19	19	3	0	0	1	0	0	149	0.6
BDL Other	125	83	90	35	6	1	0	0	0	340	1.3
Total	**300**	**174**	**207**	**38**	**6**	**1**	**1**	**0**	**0**	**727**	**2.8**
Broadleaf Deciduous Medium (BDM)											
Fraxinus velutina 'Fan-Tex'	778	873	517	83	1	0	0	0	0	2,252	8.7
Ulmus parvifolia	578	288	155	46	1	0	0	0	0	1,068	4.1
Fraxinus velutina	369	214	258	68	3	1	0	0	0	913	3.5
Pistacia chinensis	351	221	272	26	0	0	0	0	0	870	3.4
Parkinsonia florida	221	222	149	27	2	0	0	0	0	621	2.4
Fraxinus angustifolia	181	171	159	47	2	0	0	0	0	560	2.2
Prosopis chilensis	116	107	79	16	1	0	0	0	0	319	1.2
Robinia pseudoacacia	44	111	55	5	0	0	0	0	0	215	0.8
BDM Other	121	54	64	34	22	12	7	0	0	315	1.2
Total	**2,759**	**2,261**	**1,708**	**352**	**32**	**13**	**7**	**0**	**0**	**7,133**	**27.7**
Broadleaf Deciduous Small (BDS)											
Chilopsis linearis	1,570	334	75	5	0	0	0	0	0	1,984	7.7
Parkinsonia x 'Desert Museum'	1,243	252	50	1	0	0	0	0	0	1,546	6.0
Prosopis glandulosa	846	156	89	12	0	0	0	0	0	1,103	4.3
Prosopis velutina	642	254	127	18	4	0	0	0	0	1,045	4.1
Vitex agnus-castus	852	75	7	0	0	0	0	0	0	934	3.6
Acacia farnesiana	576	185	78	21	2	0	0	0	0	863	3.4
Chiltalpa tashkentensis	148	289	145	9	0	0	0	0	0	591	2.3
Prosopis torreyana	91	59	33	6	1	0	0	0	0	190	0.7
Prosopis species	49	98	31	7	0	0	0	0	0	185	0.7
Prosopis pubescens	112	52	19	2	0	0	0	0	0	185	0.7
BDS Other	163	88	29	1	0	0	0	0	0	282	1.1
Total	**6,292**	**1,842**	**683**	**82**	**7**	**0**	**0**	**0**	**0**	**8,908**	**34.6**
Broadleaf Evergreen Large (BEL)											
Quercus ilex	66	11	0	0	0	0	0	0	0	77	0.3
Eucalyptus microtheca	69	1	1	3	0	0	0	0	0	74	0.3
Eucalyptus camaldulensis	6	2	5	0	2	0	0	0	0	15	0.1
Eucalyptus papuana	7	1	0	0	0	0	0	0	0	8	0.0
Quercus suber	1	1	1	0	0	0	0	0	0	3	0.0
Eucalyptus microcarpa	0	2	0	0	0	0	0	0	0	2	0.0
Eucalyptus spp.	0	0	1	0	0	0	0	0	0	1	0.0
Total	**149**	**18**	**8**	**3**	**2**	**0**	**0**	**0**	**0**	**180**	**0.7**
Broadleaf Evergreen Medium (BEM)											
Quercus virginiana	261	387	476	54	1	0	0	0	0	1,179	4.6
Prosopis alba	545	122	139	28	2	0	0	0	0	836	3.2
BEM Other	26	41	9	0	0	0	0	0	0	76	0.3
Total	**832**	**550**	**624**	**82**	**3**	**0**	**0**	**0**	**0**	**2,091**	**8.1**

Broadleaf Evergreen Small (BES)											
Acacia stenophylla	721	471	153	19	1	0	0	0	0	1,365	5.3
Sophora secundiflora	182	5	0	0	0	0	0	0	0	187	0.7
Acacia aneura	146	35	2	0	0	0	0	0	0	183	0.7
Olea europaea	38	80	47	2	0	0	0	0	0	167	0.6
Acacia greggii	143	17	2	1	0	0	0	0	0	163	0.6
BES Other	239	230	127	14	0	0	0	0	0	610	2.4
Total	**1,469**	**838**	**331**	**36**	**1**	**0**	**0**	**0**	**0**	**2,675**	**10.4**
Conifer Evergreen Large (CEL)											
Pinus eldarica	364	613	951	498	116	4	0	0	0	2,546	9.9
Pinus halepensis	2	13	158	311	66	10	1	0	0	561	2.2
Pinus roxburghii	2	8	50	71	8	0	0	0	0	139	0.5
Pinus pinea	0	2	10	2	0	0	0	0	0	14	0.1
Cupressus sempervirens	0	6	0	0	0	0	0	0	0	6	0.0
Total	**368**	**642**	**1,169**	**882**	**190**	**14**	**1**	**0**	**0**	**3,266**	**12.7**
Conifer Evergreen Medium (CEM)											
Pinus brutia	0	6	2	3	0	0	0	0	0	11	0.0
Cupressus glabra	3	2	3	1	0	0	0	0	0	9	0.0
Total	**3**	**8**	**5**	**4**	**0**	**0**	**0**	**0**	**0**	**20**	**0.1**
Conifer Evergreen Small (CES)											
Fouquieria splendens	0	0	0	0	0	0	0	1	0	1	0.0
Juniperus spp.	0	0	1	0	0	0	0	0	0	1	0.0
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**0.0**
Palm Evergreen Large (PEL)											
Phoenix canariensis	1	0	0	9	5	2	11	0	0	28	0.1
Trachycarpus fortunei	0	0	2	0	0	0	0	0	0	2	0.0
Total	**1**	**0**	**2**	**9**	**5**	**2**	**11**	**0**	**0**	**30**	**0.1**
Palm Evergreen Medium (PEM)											
Phoenix dactylifera	0	0	2	177	130	3	1	0	0	313	1.2
Total	**0**	**0**	**2**	**177**	**130**	**3**	**1**	**0**	**0**	**313**	**1.2**
Palm Evergreen Small (PES)											
Washingtonia robusta	0	5	46	236	15	0	0	0	0	302	1.2
Washingtonia filifera	0	1	10	28	21	24	2	3	0	89	0.3
Brahea armata	0	2	5	3	0	0	0	0	0	10	0.0
Butia capitata	0	0	0	4	0	0	0	0	0	4	0.0
Arecastrum romanzoffianum	0	0	3	0	0	0	0	0	0	3	0.0
Total	**0**	**8**	**64**	**271**	**36**	**24**	**2**	**3**	**0**	**408**	**1.6**
Grand Total	**12,173**	**6,341**	**4,804**	**1,936**	**412**	**57**	**23**	**4**	**0**	**25,753**	**100%**

Species Importance

To quantify the significance of any one particular species found in Henderson's inventoried public tree population, an *importance value* (IV) is derived for each of the most common species in the inventory. Importance values are particularly meaningful to urban forest managers because they indicate a community's reliance on the functional capacity of particular species. **i-Tree *Streets* calculates importance value based on the mean of three values: percentage of total population, percentage of total leaf area, and percentage of total canopy cover.** Importance value goes beyond tree numbers alone to suggest reliance on specific species based on the benefits they provide. The importance value can range from zero (which implies no reliance) to 100 (suggesting total reliance). No single species should dominate the composition in the City's urban forest population. Because importance value goes beyond population numbers alone, it can help managers to better comprehend the resulting loss of benefits from a catastrophic loss of any one species. When importance values are comparatively equal among the ten to 15 most abundant species, the risk of major reductions to benefits is significantly reduced. Of course, suitability of the dominant species is another important consideration. Planting short-lived or poorly adapted species can result in short rotations and increased long-term management costs.

The 21 most abundant species (>1% of the population) identified in Henderson's public tree inventory represent 84.5% of the total population, 83.5% of the total leaf area, and 85.2% of the total canopy cover for a combined importance value of 84.4 (Table 2). Among these species, Henderson relies most on *Pinus eldarica* (Mondale pine, IV=13.02), followed by *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, IV=10.4).

Table 2. Importance Value (IV) of Henderson's Most Abundant Tree Species

Species	Number of Trees	% of Pop.	Leaf Area (ft2)	% of Total Leaf Area	Canopy Cover (ft^2)	% of Total Canopy Cover	Importance Value
Pinus eldarica	2,546	9.9	2,572,109	16.0	830,017	13.2	**13.0**
Fraxinus velutina 'Fan-Tex'	2,252	8.7	1,668,799	10.4	752,304	12.0	**10.4**
Chilopsis linearis	1,984	7.7	303,830	1.9	150,925	2.4	**4.0**
Parkinsonia x 'Desert Museum'	1,546	6.0	260,783	1.6	160,225	2.5	**3.4**
Acacia stenophylla	1,365	5.3	519,586	3.2	202,633	3.2	**3.9**
Quercus virginiana	1,179	4.6	920,161	5.7	402,300	6.4	**5.6**
Prosopis glandulosa	1,103	4.3	390,280	2.4	169,866	2.7	**3.1**
Ulmus parvifolia	1,068	4.1	1,020,052	6.3	485,561	7.7	**6.1**
Prosopis velutina	1,045	4.1	515,029	3.2	226,425	3.6	**3.6**
Vitex agnus-castus	934	3.6	120,467	0.7	78,848	1.3	**1.9**
Fraxinus velutina	913	3.5	796,559	4.9	254,610	4.0	**4.2**
Pistacia chinensis	870	3.4	590,630	3.7	257,874	4.1	**3.7**
Acacia farnesiana	863	3.4	223,564	1.4	123,518	2.0	**2.2**
Prosopis alba	836	3.2	285,820	1.8	70,343	1.1	**2.0**
Parkinsonia florida	621	2.4	426,041	2.6	253,566	4.0	**3.0**
Chiltalpa tashkentensis	591	2.3	250,603	1.6	132,041	2.1	**2.0**
Pinus halepensis	561	2.2	1,604,692	10.0	371,845	5.9	**6.0**
Fraxinus angustifolia	560	2.2	524,921	3.3	227,330	3.6	**3.0**
Prosopis chilensis	319	1.2	254,291	1.6	112,310	1.8	**1.5**
Phoenix dactylifera	313	1.2	95,524	0.6	68,974	1.1	**1.0**
Other trees	4,284	16.6	2,749,678	17.1	961,280	15.3	**16.3**
Total	**25,753**	**100%**	**16,093,418**	**100%**	**6,292,795**	**100%**	**100%**

Canopy Cover

The amount and distribution of leaf surface area is the driving force behind the urban forest's ability to produce benefits for the community (Clark, 1997). As canopy cover increases, so do the benefits afforded by leaf area. It is important to remember that publicly managed street and park trees throughout the United States, including those in Henderson, likely represent less than 10% of the entire urban forest (Moll and Kollin, 1993). In Henderson, it is estimated that the public tree resource is providing approximately 144.5 acres of tree canopy cover.

Relative Age Distribution

The distribution of individual tree ages within a tree population influences present and future costs as well as the flow of benefits. An unevenly aged population allows managers to allocate annual maintenance costs uniformly over many years and assures continuity in overall tree canopy coverage and associated benefits. A desirable distribution has a high proportion of young trees to offset establishment and age related mortality as the percentage of older trees declines over time (Richards, 1982/83). This ideal, albeit uneven, distribution suggests a large fraction of trees (+/-40% of the total) should be young with diameters at breast height (DBH) less than eight inches, while only 10% should be in the large diameter classes (>24 inches).

An unevenly aged tree population assures continuity in overall tree canopy coverage and associated benefits

Overall, the age distribution of Henderson's inventoried public tree population is heavily weighted in young trees, with 71.9% of the population consisting of trees with a DBH (diameter at breast height) of seven inches or smaller and 27.8% established trees (8-25 inches DBH). Trees greater than 25 inches DBH make less than 1% of the overall population (Figure 3).

With continued, proactive management of this young urban forest, Henderson can expect greater benefits as this vital resource matures. New installations should carefully consider species selection, increasing the use of underutilized and well-performing species. In addition to planting, it is critical that long-term resources be dedicated to ensuring proper maintenance as trees mature. A long-term, sustainable management plan, including regular inspection and reasonable pruning cycles, can ensure Henderson's urban forest remains healthy and well-structured, thereby maximizing environmental services to the community, reducing risk, and promoting a consistent flow of benefits for many generations to come.

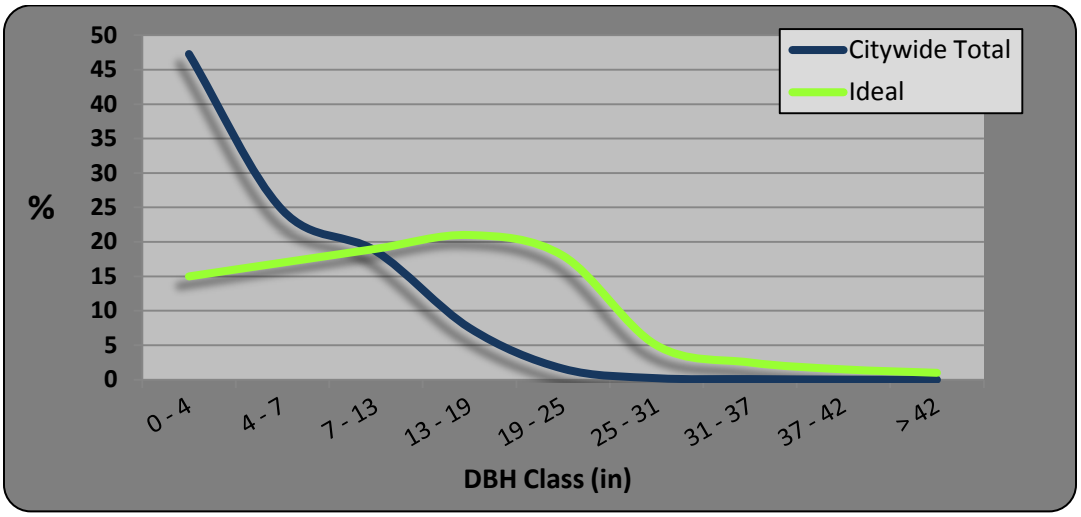


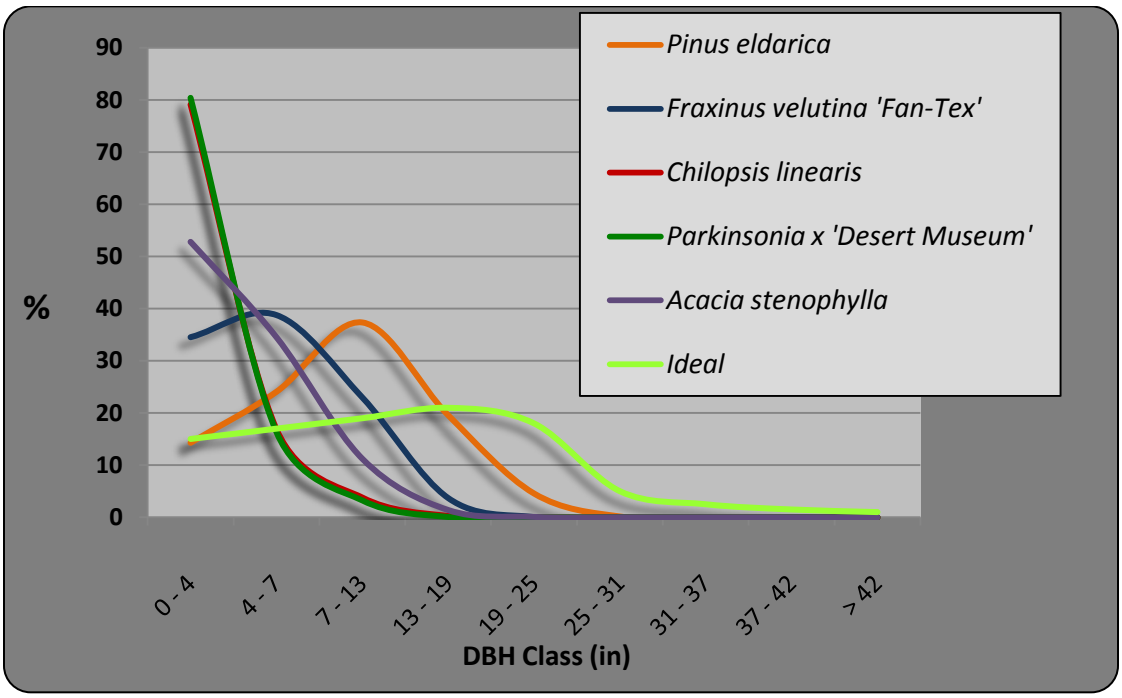
Figure 3. Relative Age Distribution of Henderson's Public Trees

Among Henderson's top ten public tree species (Figure 4), seven have significant representation in the small size class (< 7 inches DBH), indicating that they are either very small stature trees, or recent plantings have focused on these species. *Parkinsonia* x 'Desert Museum' (Desert Museum palo verde, 97%), *Prosopis glandulosa* (Honey mesquite, 91%), *Chilopsis linearis* (desert willow, 97%), *Prosopis velutina* (velvet mesquite, 86%), *Vitex agnus-castus* (chaste tree, 99%), *Acacia stenophylla* (shoestring acacia, 87%), and *Ulmus parvifolia* (Chinese elm, 81%) are all significantly represented in the small size class. The age distributions of these species is partly a reflection of the fact that these are all small stature trees except for *Ulmus parvifolia*, which is medium-stature at maturity.

Considering large and medium-statured trees, only *Pinus eldarica* (Mondale pine, 0.2%) and *Fraxinus velutina* (velvet ash, 0.1%) have any representation (four trees and one tree, respectively) in the large class range (> 25" DBH). Although not among the top ten most numerous species, *Pinus halepensis* (Aleppo pine, 11 trees) and *Morus alba* (white mulberry, 18 trees) also have some large DBH trees.*Pinus eldarica* (Mondale pine, 61%) is a fairly well-established population with the greatest representation between 7 and 25 inches in diameter. *Quercus virginiana* (southern live oak, 40%) are weighted heavily in 7-13 inch size class and will grow to bolster the numbers in the medium size classes with adequate maintenance.

While none of Henderson's top ten species demonstrate an age distribution indicative of a long-standing key species, *Pinus eldarica* comes the closest, with 38% of trees less than seven inches in diameter, 61% between 7 and 25 inches, and 0.2% greater than 24 inches. Considering this age distribution and that 82% of *Pinus eldarica* were rated as good during the inventory, this appears to be a species that is performing well for Henderson. However, as this species is on the threshold of over-representation in the Henderson urban forest (9.9%), future plantings would ideally expand other less-represented species.

It is important to keep in mind that, as these young populations mature and eventually age, their maintenance needs may increase. Future plantings should adequately represent long-standing and high-performing species, making sure to provide sufficient replacements to ensure the functional capacity and benefit streams from these populations, even as individuals begin to decline.



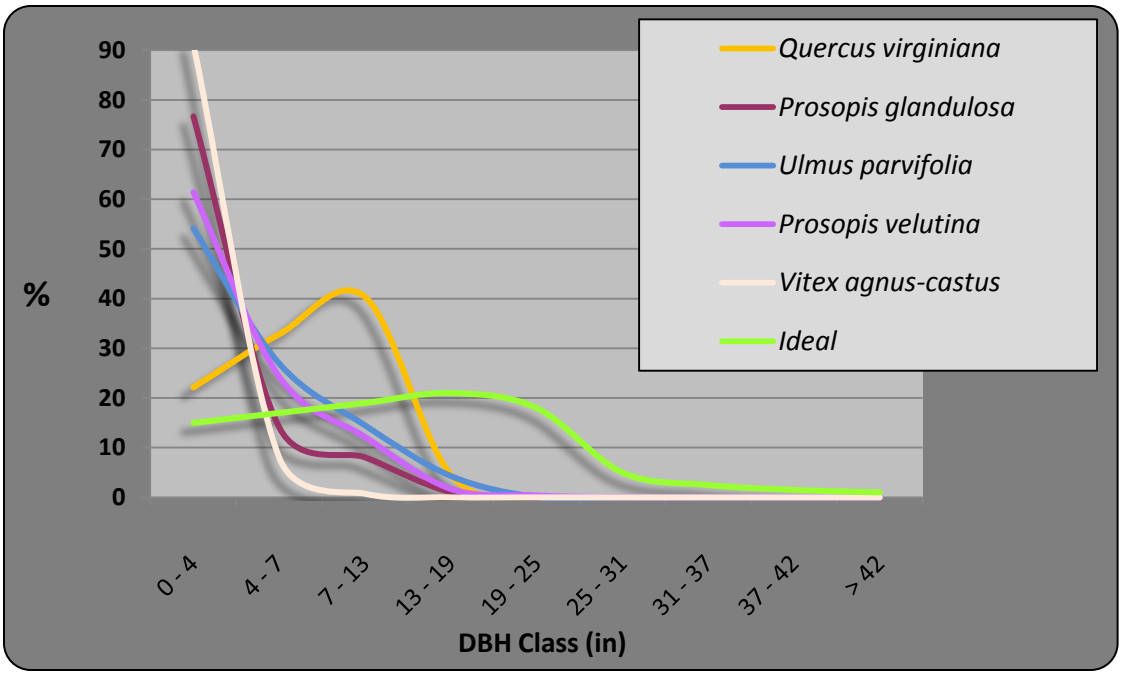


Figure 4. Relative Age Distribution of Henderson's Top Ten Public Tree Species

Urban Forest Condition and Relative Performance

Tree condition is an indication of how well trees are managed and how well they are performing in a given site-specific environment (e.g., street median, parking lot, etc.). Each inventoried tree was rated for overall condition, including consideration for structure, foliage, and the root collar. When trees are performing at their peak, as are 73% of Henderson's inventoried trees classified as good, the benefits they provide are maximized.

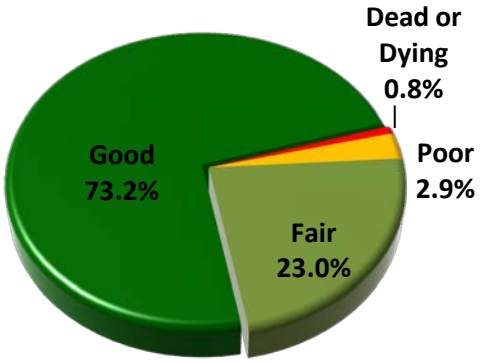


Figure 5. Overall Condition of Henderson's Public Trees

The inventory found 23% of Henderson's trees in fair condition, which may be an indication of age, inadequate resources or maintenance, and/or a poorly sited species, along with many other factors. Only 3.7% of the population was found to be in poor, dying, or dead condition. Removal or mitigation of dead and failing trees is recommended as soon as possible to reduce liability exposure.

The *relative performance index* (RPI) is one way to further analyze the condition and suitability of specific tree species. The RPI provides an urban forest manager with a detailed perspective on how one species' performance compares to that of another. The index compares the condition ratings of each tree species with the condition ratings of every other tree species within a given urban forest population. An RPI value of 1.0 or better indicates that the species is performing as well or better than average when compared to other species. An RPI value below 1.0 indicates that the species is not performing as well in comparison to the rest of the population.

Among the 21 most common species (>1% of the total population) identified in the inventory, 12 have an RPI of 1.0 or greater (Table 3). Of these, *Phoenix dactylifera* (date palm) and *Prosopis glandulosa* (honey mesquite) have the highest RPI of 1.09 and 1.05, respectively. *Chltalpa tashkentensis* (Chitalpa*)* has the lowest rating of 0.89. *Pinus eldarica* (Mondale pine, RPI=1.04) is a population with a close to ideal age distribution, an indicator that the RPI value is a decent measure of performance.

Table 3. Relative Performance Index (RPI) for Henderson's Most Abundant Public Tree Species

Species	Dead or Dying	Poor	Fair	Good	RPI	# of Trees	% of Pop.
Pinus eldarica	0.7	1.2	16.0	82.2	**1.04**	2,546	9.9
Fraxinus velutina 'Fan-Tex'	0.3	2.0	22.6	75.2	**1.01**	2,252	8.7
Chilopsis linearis	0.3	1.8	19.2	78.7	**1.02**	1,984	7.7
Parkinsonia x 'Desert Museum'	0.3	1.9	30.3	67.5	**0.99**	1,546	6.0
Acacia stenophylla	0.1	1.1	14.1	84.7	**1.05**	1,365	5.3
Quercus virginiana	1.1	5.2	25.0	68.7	**0.98**	1,179	4.6
Prosopis glandulosa	0.0	2.1	11.4	86.5	**1.05**	1,103	4.3
Ulmus parvifolia	0.4	4.3	44.1	51.2	**0.93**	1,068	4.1
Prosopis velutina	2.6	5.6	21.9	69.9	**0.97**	1,045	4.1
Vitex agnus-castus	0.5	1.3	16.1	82.1	**1.04**	934	3.6
Fraxinus velutina	2.1	3.7	39.1	55.1	**0.93**	913	3.5
Pistacia chinensis	0.2	0.9	14.3	84.6	**1.05**	870	3.4
Acacia farnesiana	0.3	1.6	28.6	69.4	**0.99**	863	3.4
Prosopis alba	0.8	2.3	30.6	66.3	**0.98**	836	3.2
Parkinsonia florida	3.2	2.7	29.0	65.1	**0.96**	621	2.4
Chiltalpa tashkentensis	0.2	6.4	51.1	42.3	**0.89**	591	2.3
Pinus halepensis	0.0	1.2	17.8	80.9	**1.04**	561	2.2
Fraxinus angustifolia	0.7	4.8	19.3	75.2	**1.00**	560	2.2
Prosopis chilensis	0.0	2.5	22.9	74.6	**1.01**	319	1.2
Phoenix dactylifera	0.0	0.0	2.6	97.4	**1.09**	313	1.2
Washingtonia robusta	0.7	6.0	1.7	91.7	**1.05**	302	1.2
Other trees	0.0	0.1	0.0	2.3	**0.97**	3,982	15.5
Citywide	**0.8**	**2.9**	**23.0**	**73.2**	**1.00**	**25,753**	**100%**

The RPI can be a useful tool for urban forestry managers. For example, if a city has been planting two or more new species in their urban forest, the RPI can be utilized to compare their relative performance. If the RPI indicates that one is performing relatively poorly, a municipality may decide to reduce or even stop planting that species and subsequently save money on both planting stock and replacement costs. The RPI enables managers to look at the performance of long-standing species as well. Species planted for many years that have an RPI of 1.00 or greater have performed well when compared to the population as a whole. These top performers should be retained as a significant portion of the urban forest population. It is important to keep in mind that, because RPI is based on condition, it may not reflect cosmetic or nuisance issues, especially seasonal issues that are not threatening the health or structure of the trees.

An RPI value less than 1.00 may be indicative of a species that is not well adapted to local conditions. Poorly adapted species are more likely to present increased safety and maintenance issues. Species with an RPI less than 1.00 should receive careful consideration before being selected for future planting choices. Prior to selecting or deselecting trees on the basis of RPI alone, managers are encouraged to take into account the age distribution of the species, among other factors. A species that has a RPI of less than 1.00, but has a significant number of trees in larger DBH classes, may just be exhibiting signs of population senescence. The individuals of this species may have produced substantial benefits over the years and should continue to be considered when making species selection determinations for future planting.

The RPI value can also be used to identify underutilized species that are demonstrating good performance. Trees with an RPI value greater than 1.00 and an established age distribution may

be indicating their suitability in the local environment and should receive consideration for additional planting. However, due to the size of the tree population sampled, the age class distribution for Henderson's trees is not varied enough to allow for species performance decisions to be based solely on RPI values. Apart from existing species in Henderson, future tree plantings can enhance species diversity by adding new species with desert proven hardiness, including:

- Australian pine (*Casuarina equisetifolia*)
- Bottlebrush tree (*Callistemon spp.*)
- Kurrajong (*Brachychiton populneus*)
- Thornless cascalote (*Caesalpinia cacalaco*)
- Tipuana (*Tipuana tipu*)

Replacement Value

The current value of Henderson's public tree resource is approximately $59 million. The community forest is a public asset which, when properly cared for, has the potential to appreciate in value as the trees mature over time. Replacement value accounts for the historical investment in trees over their lifetime and is a way of describing the value of a tree population (and/or average value per tree) at a given time. Replacement value is a reflection of current population numbers, stature, placement, and condition. There are several methods available for obtaining a fair and reasonable perception of a tree's value (CTLA, 1992; Watson, 2002). To determine the replacement value, species ratings, replacement costs, and basic prices were obtained for each species and input into the i-Tree software. To replace Henderson's current inventoried public tree population of 25,753 trees with trees of similar size, species, and condition would cost more than $59 million (Table 5 and Appendix C). The average replacement value per tree is $2,303.

Replacement of the Mondale pine population in Henderson's public inventory would cost $11.7 million.

Pinus eldarica (Mondale pine) account for 19.7% ($11.7 million) of the total estimated replacement value, followed by *Pinus halepensis* (Aleppo pine, 12.2%, $7.2 million), and *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 6.9%, $4 million). The high value of each of these species reinforces their importance to the City. Many of the highest valued species are large and medium-stature trees with large canopies and are therefore likely to have high importance values (IV) as well.

Species with lower replacement values are generally smaller-stature trees with a lower IV, as evidenced by *Vitex agnus-castus* (chaste tree) with a replacement value of $452,395 (0.8%), or the easily replaced *Washingtonia robusta* (Mexican fan palm) with a replacement value of $148,134 (0.3%).

Henderson's urban forest is a vital component of the City's infrastructure and a public asset valued at approximately $59 million—an asset that, with proper care and maintenance, will increase in value over time. Distinguishing replacement value from the value of annual benefits produced by Henderson's public trees is very important. Annual benefits are discussed in Chapter 3.

Table 4. Replacement Value of Henderson's Most Common Public Tree Species

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Pinus eldarica	100,287	756,601	3,696,338	4,933,176	2,097,624	117,204	0	0	0	11,701,229	19.7
Pinus halepensis	709	19,839	838,567	4,211,412	1,727,949	385,521	62,523	0	0	7,246,521	12.2
Fraxinus velutina 'Fan-Tex'	213,637	1,070,878	2,006,424	782,280	13,659	0	0	0	0	4,086,877	6.9
Quercus virginiana	77,504	618,521	2,488,597	745,674	27,024	0	0	0	0	3,957,320	6.7
Pistacia chinensis	135,618	486,740	1,869,800	473,274	0	0	0	0	0	2,965,432	5.0
Acacia stenophylla	244,772	810,296	818,490	251,654	27,024	0	0	0	0	2,152,236	3.6
Ulmus parvifolia	167,696	447,545	796,404	592,824	27,024	0	0	0	0	2,031,493	3.4
Prosopis velutina	231,593	515,095	833,159	309,740	128,588	0	0	0	0	2,018,176	3.4
Parkinsonia florida	82,426	447,365	916,091	394,215	59,191	0	0	0	0	1,899,289	3.2
Fraxinus velutina	74,686	202,434	756,164	502,819	36,801	17,389	0	0	0	1,590,292	2.7
Chiltalpa tashkentensis	49,402	533,909	857,098	127,795	0	0	0	0	0	1,568,204	2.6
Chilopsis linearis	526,278	541,300	368,086	54,891	0	0	0	0	0	1,490,554	2.5
Prosopis glandulosa	335,971	319,431	593,343	188,443	0	0	0	0	0	1,437,188	2.4
Acacia farnesiana	222,188	344,696	485,618	327,068	48,986	0	0	0	0	1,428,556	2.4
Fraxinus angustifolia	50,546	203,812	599,098	441,737	38,699	0	0	0	0	1,333,892	2.2
Parkinsonia x 'Desert Museum'	460,568	506,494	297,099	12,996	0	0	0	0	0	1,277,158	2.2
Phoenix dactylifera	0	0	5,940	631,018	468,127	9,744	3,601	0	0	1,118,430	1.9
Prosopis alba	149,947	141,623	475,797	233,896	33,008	0	0	0	0	1,034,271	1.7
Pinus roxburghii	439	7,354	155,219	546,355	117,582	0	0	0	0	826,949	1.4
Morus alba	393	576	2,374	106,788	227,932	190,959	151,253	0	0	680,275	1.1
Prosopis chilensis	32,794	133,322	292,054	131,491	19,350	0	0	0	0	609,011	1.0
Olea europaea	13,510	162,605	313,771	36,822	0	0	0	0	0	526,708	0.9
Prosopis torreyana	35,568	128,740	224,855	88,807	34,698	0	0	0	0	512,668	0.9
Gleditsia triacanthos	14,764	84,430	387,069	0	0	0	0	0	0	486,264	0.8
Vitex agnus-castus	285,116	127,459	39,820	0	0	0	0	0	0	452,395	0.8
Robinia pseudoacacia	12,025	128,058	176,490	36,357	0	0	0	0	0	352,929	0.6

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Prosopis species	11,895	106,654	109,279	59,989	0	0	0	0	0	287,816	0.5
Platanus wrightii	12,239	0	60,171	82,288	82,577	17,389	0	0	0	254,664	0.4
Pyrus kawakamii	0	62,134	122,334	58,777	0	0	0	0	0	243,245	0.4
Chamaerops humilis	709	85,221	56,886	71,781	0	0	0	0	0	214,597	0.4
Prosopis pubescens	31,737	67,016	78,091	20,602	0	0	0	0	0	197,446	0.3
Fouquieria splendens	0	0	0	0	0	0	0	0	196,994	196,994	0.3
Yucca brevifolia	0	27,945	117,788	28,712	0	0	0	0	0	174,445	0.3
Fraxinus uhdei	1,614	19,310	78,889	71,651	0	0	0	0	0	171,465	0.3
Olneya tesota	4,594	14,955	108,609	41,270	0	0	0	0	0	169,427	0.3
Rhus lancea	18,429	47,357	101,726	0	0	0	0	0	0	167,511	0.3
Washingtonia robusta	0	1,389	21,941	118,246	6,557	0	0	0	0	148,134	0.2
Other trees	370,573	570,686	775,112	381,799	62,032	37,135	95,739	3,480	0	2,296,554	3.9
Citywide Total	**$3,970,227**	**$9,741,792**	**$21,924,589**	**$17,096,647**	**$5,284,434**	**$775,341**	**$313,116**	**$3,480**	**$196,994**	**$59,306,619**	**100%**

Chapter 3: Urban Forest Resource Benefits

Trees are important to the City of Henderson. Environmentally, they help conserve and reduce energy use, reduce local and global carbon dioxide (CO_2) levels, improve air quality, and mitigate stormwater runoff. Additionally, trees provide a wealth of well-documented psychological, social, and economic benefits related primarily to their aesthetic effects. Environmentally, trees make good sense, working ceaselessly to provide benefits back to the community. However, the question remains, are the collective benefits worth the costs of management? In other words, are trees a good investment for Henderson? To answer this question, the benefits must be quantified in financial terms. This analysis provides a snapshot of the annual benefits (along with the value of those benefits) produced by Henderson's inventoried public urban forest. While the annual benefits produced by the urban forest can be substantial, it's important to recognize that the greatest benefits from the urban forest are derived from the benefit stream that results over a greater period of time from a mature forest where trees are well managed, healthy, and long-lived.

Trees and other vegetation within an urbanized environment help reduce the urban heat island effect

This analysis-utilized Henderson's current public tree inventory and i-Tree's *Streets* model to assess and quantify the beneficial functions of this public tree resource and to place a dollar value on the annual environmental benefits these trees provide. These estimates provide first-order approximations of tree value. While i-Tree *Streets* only generally accounts for the benefits produced by Henderson's public tree population, it is an accounting based on the best available and current scientific research with an accepted degree of uncertainty. The data returned from i-Tree *Streets* can provide a platform from which management decisions can be made (Maco and McPherson, 2003). A discussion on the methods used to quantify and put a monetary value on these benefits can be found in Appendix A.

Energy Savings

Trees modify climate and conserve energy in three principal ways:

- Shading reduces the amount of radiant energy absorbed and stored by hardscape surfaces, thereby reducing the heat island effect.
- Transpiration converts moisture to water vapor, thereby cooling the air by using solar energy that would otherwise result in heating of the air.
- Reduction of wind speed and the movement of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows) (Simpson, 1998).

Heat island effect describes the increase in urban temperatures in relation to surrounding locations and is associated with an increase in hardscape and impervious surfaces. Trees and

other vegetation within an urbanized environment help reduce the heat island effect by lowering air temperatures 5°F (3°C) compared with outside the green space (Chandler, 1965). On a larger citywide scale, temperature differences of more than 9°F (5°C) have been observed between city centers without adequate canopy coverage and more vegetated suburban areas (Akbari and others, 1992). The relative importance of these effects depends upon the size and configuration of trees and other landscape elements (McPherson, 1993). Tree spacing, crown spread, and vertical distribution of leaf area each influence the transport of warm air and pollutants along streets and out of urban canyons.

By reducing air movement into buildings and against conductive surfaces (e.g., glass, metal siding), trees reduce conductive heat loss from buildings. Trees can reduce wind speed and the resulting air infiltration by up to 50%, translating into potential annual heating savings of 25% (Heisler, 1986).

Electricity and Natural Gas Reduction

Electricity and natural gas saved annually in Henderson from both the shading and climate effects of public trees is equal to 1,221 MWh ($87,518) and 8,637 therms ($5,575), for a total retail savings of approximately $87,518 and an average of $3.40 per tree (Table 6). *Pinus eldarica* (Mondale pine), which represents 9.9% of the population with an importance value of 13.0, accounts for 14% of the total energy savings. *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 11.7%) provides the next greatest contribution towards total energy savings, mostly due in part to canopy size and prevalence within the overall population.

Quercus virginiana (southern live oak), which represents 4.6% of the total population, is contributing 6.4% of the total energy savings because of the relatively young age distribution of this population (55% of trees <7" DBH). As this population of medium-stature trees matures, the energy benefits can be expected to increase substantially.

Examining average energy savings on a per tree basis (Figure 6), *Pinus halepensis* (Aleppo pine, $9.22) is currently the greatest contributor, primarily due to their relatively mature age distribution as compared to the rest of the tree population. Small-stature trees, such as *Prosopis alba* (South American mesquite, $1.27) and *Chilopsis linearis* (desert willow, $1.03), are contributing energy-saving benefits well below the average of $3.40. Although each of these populations has a young age distribution, neither species matures with a substantial canopy, consequently their contribution to energy savings will not increase substantially as they age. While these species are recommended for future plantings, this is based on their relative performance in terms of condition. If Henderson wishes to increase the benefits of energy savings from their urban tree population, consideration should be given to larger stature trees that have an increased performance in terms of shading and wind reduction.

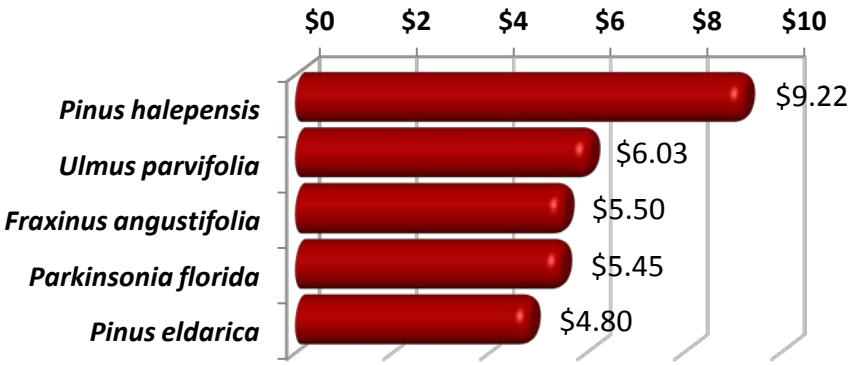


Figure 6. Annual Electricity and Natural Gas Benefits - Top 5 Species

Table 5. Annual Electric and Natural Gas Benefits from Henderson's Tree Resource

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	% of Pop.	% of Total $	Avg. $/tree
Pinus eldarica	171.9	11,535	1,078.8	696.4	12,231	9.9	14.0	4.80
Fraxinus velutina 'Fan-Tex'	142.8	9,580	1,022.0	659.7	10,239	8.7	11.7	4.55
Chilopsis linearis	28.1	1,884	239.6	154.7	2,038	7.7	2.3	1.03
Parkinsonia x 'Desert Museum'	29.6	1,984	252.7	163.1	2,147	6.0	2.5	1.39
Acacia stenophylla	38.2	2,566	297.2	191.8	2,758	5.3	3.2	2.02
Quercus virginiana	78.8	5,288	538.8	347.8	5,636	4.6	6.4	4.78
Prosopis glandulosa	31.7	2,129	242.4	156.5	2,286	4.3	2.6	2.07
Ulmus parvifolia	90.4	6,063	582.3	375.9	6,439	4.2	7.4	6.03
Prosopis velutina	42.4	2,846	314.1	202.8	3,049	4.1	3.5	2.92
Vitex agnus-castus	14.3	960	127.3	82.2	1,042	3.6	1.2	1.12
Fraxinus velutina	50.2	3,366	365.4	235.9	3,602	3.6	4.1	3.94
Pistacia chinensis	49.8	3,345	360.5	232.7	3,577	3.4	4.1	4.11
Acacia farnesiana	23.1	1,553	187.0	120.7	1,674	3.4	1.9	1.94
Prosopis alba	14.8	993	100.7	65.0	1,058	3.3	1.2	1.27
Parkinsonia florida	47.3	3,175	329.1	212.4	3,387	2.4	3.9	5.45
Chiltalpa tashkentensis	25.3	1,701	195.6	126.3	1,827	2.3	2.1	3.09
Pinus halepensis	72.8	4,884	447.8	289.0	5,173	2.2	5.9	9.22
Fraxinus angustifolia	43.0	2,887	298.7	192.8	3,079	2.2	3.5	5.50
Prosopis chilensis	21.3	1,427	150.4	97.1	1,524	1.2	1.7	4.78
Phoenix dactylifera	12.3	826	108.5	70.1	896	1.2	1.0	2.86
Washingtonia robusta	5.3	353	44.5	28.7	382	1.2	0.4	1.26
Other trees	187.8	12,602	1,353.1	873.5	13,475	15.5	15.4	3.38
CITYWIDE TOTAL	**1,221**	**$81,943**	**8,637**	**$5,575**	**$87,518**	**100%**	**100%**	**$3.40**

Atmospheric Carbon Dioxide Reduction

As environmental awareness continues to increase, governments are paying particular attention to global warming and the effects of greenhouse gas emissions. Two national policy options are currently under debate, the establishment of a carbon tax and a greenhouse gas cap-and-trade system, aimed at the reduction of atmospheric carbon dioxide (CO_2) and other greenhouse gases. A carbon tax would place a tax burden on each unit of greenhouse gas emission and would require regulated entities to pay for their level of emissions. Alternatively, in a cap-and-trade system, an upper limit (or cap) is placed on global (federal, regional, or other jurisdiction) levels of greenhouse gas emissions and the regulated entities would be required to either reduce emissions to required limits or purchase emissions allowances in order to meet the cap (Williams and others, 2007). The concept of purchasing emission allowances (offsets) has led to the acceptance of carbon credits as a commodity that can be exchanged for financial gain. The Center for Urban Forest Research (CUFR, Pacific Southwest Research Station, and USDA Forest Service) recently led the development of Urban Forest Project Reporting Protocol. The protocol, which incorporates methods of the Kyoto Protocol and Voluntary Carbon Standard (VCS), establishes methods for calculating reductions, provides guidance for accounting and reporting, and guides urban forest managers in developing tree planting and stewardship projects that could be registered for greenhouse gas (GHG) reduction credits (offsets). The protocol can be applied to urban tree planting projects within municipalities, campuses, and utility service areas anywhere in the United States.

Henderson's public trees provide air quality improvements and a significant reduction in atmospheric carbon dioxide.

While Henderson's urban forest resource may or may not qualify for carbon-offset credits or be traded in the open market, the City's public trees are nonetheless providing a significant reduction in atmospheric carbon dioxide (CO_2) for a positive environmental and financial benefit to the community.

Urban trees reduce atmospheric carbon dioxide (CO_2) in two ways:

- Directly, through growth and the sequestration of CO_2 as wood and foliar biomass
- Indirectly, by lowering the demand for heating and air conditioning, thereby reducing the emissions associated with electric power generation and natural gas consumption.

Conversely, CO_2 is released by vehicles and other combustible engines used to plant and care for trees. Additionally, when a tree dies, most of the CO_2 that accumulated as woody biomass is released back into the atmosphere during decomposition, except in cases where the wood is

recycled. Each of these factors must be considered when calculating the CO_2 reduction benefits of trees.

Sequestered Carbon Dioxide

To date, Henderson's inventoried public urban forest has sequestered a total of 3,750 tons of carbon dioxide (CO_2) valued at $56,243[1]. Annually, this tree resource directly sequesters 448 tons of CO_2, valued at $6,715, into woody and foliar biomass. Accounting for estimated CO_2 emissions from tree decomposition (-30 tons), tree related maintenance activity (-5.7 tons), and avoided CO_2 (610 tons), Henderson's trees provide an annual net reduction in atmospheric CO_2 of 1,022 tons, valued at $15,334 with an average of $0.60 per tree (Table 7).

Pinus halepensis (Aleppo pine, $1.74) and *Quercus virginiana* (southern live oak, $1.33) are currently providing the highest per tree benefit (Figure 7).

Pinus eldarica (Mondale pine) are providing the greatest percentage of overall benefits at 12.2% due to their prevalence in the population and large stature (just $0.74 per tree).

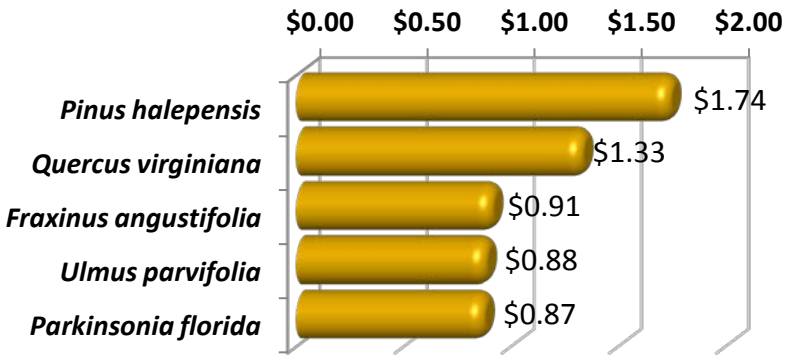


Figure 7. Annual Reduction of CO_2 - Top 5 species

[1] Based on i-Tree Streets default value of $15 per ton. Market value may vary.

Table 6. Annual CO_2 Reduction Benefits Provided by Henderson's Public Tree Resource

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release(lb)	Maintenance Release (lb)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	% of Pop.	% of Total $	Avg. $/tree
Pinus eldarica	91,136	684	-11,075	-1,889	-97.23	171,821	1,288.65	249,993	1,874.94	9.9	12.2	0.74
Fraxinus velutina 'Fan-Tex'	89,970	675	-4,133	-1,010	-38.57	142,692	1,070.19	227,519	1,706.39	8.7	11.1	0.76
Chilopsis linearis	14,074	106	-74	-456	-3.97	28,056	210.42	41,600	312.00	7.7	2.0	0.16
Parkinsonia x 'Desert Museum'	31,642	237	-1,288	-344	-12.24	29,547	221.60	59,558	446.68	6.0	2.9	0.29
Acacia stenophylla	14,236	107	-742	-462	-9.02	38,220	286.65	51,253	384.40	5.3	2.5	0.28
Quercus virginiana	137,092	1,028	-6,745	-650	-55.47	78,767	590.75	208,463	1,563.47	4.6	10.2	1.33
Prosopis glandulosa	22,831	171	-766	-285	-7.88	31,713	237.85	53,494	401.20	4.3	2.6	0.36
Ulmus parvifolia	38,196	286	-2,346	-396	-20.56	90,313	677.35	125,767	943.26	4.2	6.2	0.88
Prosopis velutina	28,639	215	-1,171	-339	-11.32	42,396	317.97	69,525	521.44	4.1	3.4	0.5
Vitex agnus-castus	14,381	108	-431	-171	-4.52	14,296	107.22	28,074	210.56	3.6	1.4	0.23
Fraxinus velutina	41,855	314	-2,532	-445	-22.33	50,133	376.00	89,012	667.59	3.6	4.4	0.73
Pistacia chinensis	21,037	158	-1,546	-396	-14.57	49,820	373.65	68,914	516.86	3.4	3.4	0.59
Acacia farnesiana	26,509	199	-1,659	-258	-14.38	23,132	173.49	47,724	357.93	3.4	2.3	0.42
Prosopis alba	15,402	116	-1,563	-286	-13.86	14,791	110.93	28,344	212.58	3.3	1.4	0.25
Parkinsonia florida	26,189	196	-1,286	-284	-11.78	47,288	354.66	71,907	539.30	2.4	3.5	0.87
Chiltalpa tashkentensis	31,158	234	-2,049	-272	-17.41	25,336	190.02	54,173	406.30	2.3	2.7	0.69
Pinus halepensis	63,700	478	-5,465	-658	-45.92	72,744	545.58	130,321	977.41	2.2	6.4	1.74
Fraxinus angustifolia	26,531	199	-1,456	-289	-13.09	42,999	322.49	67,784	508.38	2.2	3.3	0.91
Prosopis chilensis	13,322	100	-663	-148	-6.08	21,252	159.39	33,763	253.22	1.2	1.7	0.79
Phoenix dactylifera	5,115	38	-1,430	-221	-12.38	12,298	92.24	15,762	118.22	1.2	0.8	0.38
Washingtonia robusta	7,333	55	-1,813	-333	-16.10	5,262	39.47	10,449	78.37	1.2	0.5	0.26
Other trees	135,006	1,013	-9,759	-1,767	-86.45	187,710	1,407.83	311,190	2,333.92	15.5	15.2	0.59
CITYWIDE TOTAL	**895,354**	**$6,715**	**-59,992**	**-11,359**	**-$535.14**	**1,220,586**	**$9,154**	**2,044,589**	**$15,334**	**100%**	**100%**	**$0.60**

Air Quality Improvement

Urban trees improve air quality in five fundamental ways:

- Absorption of gaseous pollutants such as ozone (O_3) and nitrogen dioxide (NO_2) through leaf surfaces,
- Interception of particulate matter (PM_{10}), such as dust, ash, dirt, pollen, and smoke,
- Reduction of emissions from power generation by reducing energy consumption,
- Increase of oxygen levels through photosynthesis, and
- Transpiration of water and shade provision, resulting in lower local air temperatures, thereby reducing ozone (0_3) levels.

According to data reported by the Clark County Department of Air Quality, air quality in Henderson exceeded the state 24-hour standard of 150 µg/m^3 for PM_{10} only 1 day in 2012.

Between 2003 and 2012 there have been 91 exceedances of the Federal 8-hour standard for ground level ozone ((0_3), an average of 9.1 days per year (Table 7).

Year	Ozone > Federal 2012 8-hour Standard
2012	19
2011	9
2010	1
2009	5
2008	10
2007	17
2006	8
2005	8
2004	4
2003	10
Average	**9.1**

Table 7. Number of Exceedances of Federal Ground Level Ozone

In the absence of cooling effects provided by trees, higher temperatures contribute to ozone (O_3) formation. Additionally, short-term increases in ozone concentrations have been statistically associated with increased tree mortality for 95 large US cities (Bell and others, 2004). However, it should be noted that while trees do a great deal to absorb air pollutants (especially ozone and particulate matter), they also negatively contribute to air pollution. Trees emit various biogenic volatile organic compounds (BVOCs), such as isoprenes and monoterpenes, which can also contribute to ozone formation. These BVOC emissions are accounted for by i-Tree *Streets* in the air quality net benefit.

Deposition and Interception

Each year, approximately 1.9 tons of nitrogen dioxide (NO_2), small particulate matter (PM_{10}), and ozone (O_3) are intercepted or absorbed by the public trees in Henderson, for a value of $19.590 (Table 9). As a population, *Pinus eldarica* (Mondale pine, 783 lbs.), *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 371 lbs.), and *Ulmus parvifolia* (Chinese elm, 256 lbs.) are the greatest contributors to air quality improvements, accounting for nearly half (38%) of total deposition benefits.

Avoided Pollutants

By reducing energy needs, the energy savings provided by trees have the additional indirect benefit of reducing air pollutant emissions (NO_2, PM_{10}, SO_2, and VOCs) that result from energy production. Altogether, 2.1 tons of pollutants, valued at $38,728, are avoided annually through the shading effects of Henderson's public trees. The populations of *Pinus eldarica* (Mondale pine, 589 lbs.), *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash, 488 lbs.), *Ulmus parvifolia* (Chinese elm, 308 lbs.) and *Quercus virginiana* (southern live oak, 270 lbs.) provide a combined 40% of the total benefits and have the greatest impact on reducing energy needs and therefore avoiding the additional generation of pollutants.

BVOC Emissions

Biogenic volatile organic compound (BVOC) emissions from trees, which negatively affect air quality, must also be considered. Approximately 2.5 tons of BVOCs are annually emitted from Henderson's public trees, offsetting the total air quality benefit by -$20,120. *Quercus virginiana* (southern live oak*)* are the heaviest per tree emitters of BVOCs (1.62 lbs. per tree), accounting for 38% of the total BVOC emissions, while representing only 4.6% of the total population. Ultimately, *Quercus virginiana* has a negative net impact on air quality of -$3.48 per tree.

Net Air Quality Improvement

Net air pollutants removed, avoided, and released by Henderson's inventoried public tree population are valued at $38,187 annually. The average net benefit per tree is $1.48. Trees vary dramatically in their ability to produce net air quality benefits. Typically, large-canopied trees with large leaf surface areas that are not high emitters of BVOCs produce the greatest benefits. On a per tree basis, *Pinus halepensis* (Aleppo pine*,* $4.14) and *Ulmus parvifolia* (Chinese elm, $3.91) currently produce the greatest per tree net air quality improvements (Figure 8).

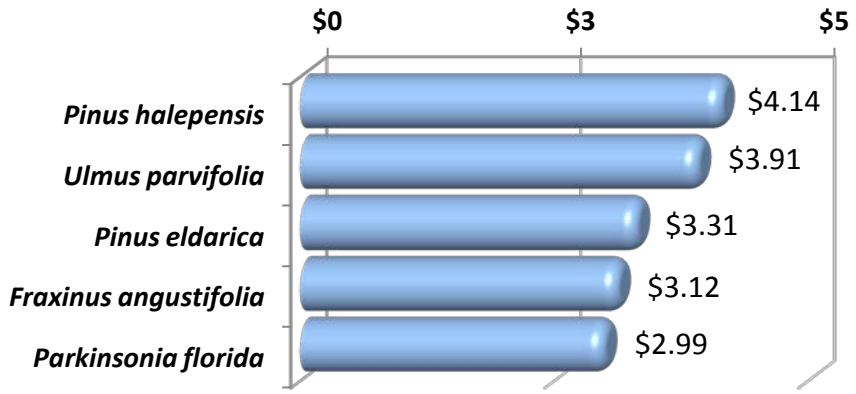


Figure 8. Annual Improvement to Air Quality - Top 5 Species

Table 8. Annual Air Quality Improvements Provided by Henderson's Public Tree Resource

Species	Deposition O3 (lb)	Deposition NO2 (lb)	Deposition PM10 (lb)	Deposition SO2 (lb)	Total Deposition ($)	Avoided NO2 (lb)	Avoided PM10 (lb)	Avoided VOC (lb)	Avoided SO2 (lb)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	% of Pop.	Avg. $/tree
Pinus eldarica	295.3	161.1	294.6	32.48	4,102.99	307.5	15.7	2.7	263.3	5,469.4	-286.03	-1,144.1	1,086.6	8,428.27	9.9	3.31
Fraxinus velutina 'Fan-Tex'	140.3	67.4	149.6	13.96	1,947.49	254.9	13.0	2.3	217.8	4,526.2	-236.73	-946.9	622.6	5,526.84	8.7	2.45
Chilopsis linearis	15.6	4.3	14.5	0.95	181.34	50.3	2.6	0.5	42.8	890.9	-202.56	-810.3	-71.1	261.99	7.7	0.13
Parkinsonia x 'Desert Museum'	29.0	14.0	31.1	2.89	404.04	53.0	2.7	0.5	45.1	938.8	-108.12	-432.5	70.2	910.34	6.0	0.59
Acacia stenophylla	33.2	18.1	39.5	3.65	499.30	68.4	3.5	0.6	58.3	1,213.0	0.00	0.0	225.2	1,712.28	5.3	1.25
Quercus virginiana	69.5	37.9	81.9	7.66	1,041.48	141.2	7.2	1.3	120.7	2,508.4	-1,913.37	-7,653.5	-1,446.0	-4,103.63	4.6	-3.48
Prosopis glandulosa	25.0	12.0	28.5	2.49	357.62	56.7	2.9	0.5	48.4	1,005.9	-55.36	-221.5	121.0	1,142.09	4.3	1.04
Ulmus parvifolia	108.4	41.9	96.9	8.69	1,319.18	160.8	8.2	1.4	137.5	2,857.6	0.00	0.0	563.9	4,176.83	4.1	3.91
Prosopis velutina	39.0	18.7	42.4	3.88	546.62	75.7	3.9	0.7	64.6	1,343.0	-73.06	-292.2	175.8	1,597.36	4.1	1.53
Vitex agnus-castus	10.4	5.0	12.3	1.04	151.80	25.6	1.3	0.2	21.8	453.7	-49.95	-199.8	27.8	405.74	3.6	0.43
Fraxinus velutina	47.1	18.2	44.6	3.78	588.10	90.1	4.6	0.8	76.9	1,599.0	0.00	0.0	286.1	2,187.10	3.5	2.40
Pistacia chinensis	85.5	33.1	70.8	6.86	1,006.58	89.4	4.6	0.8	76.3	1,586.8	-542.64	-2,170.5	-175.3	422.86	3.4	0.49
Acacia farnesiana	34.3	16.5	33.1	3.41	455.47	41.7	2.1	0.4	35.6	740.1	-92.69	-370.8	74.5	824.80	3.3	0.96
Prosopis alba	13.8	7.5	15.6	1.52	202.27	26.7	1.4	0.2	22.9	474.8	-80.25	-321.0	9.3	356.04	3.2	0.43
Parkinsonia florida	63.6	30.6	62.9	6.32	853.11	84.3	4.3	0.8	72.0	1,497.1	-123.93	-495.7	200.8	1,854.49	2.4	2.99
Chiltalpa tashkentensis	42.5	20.4	39.8	4.22	557.18	45.5	2.3	0.4	38.8	807.0	-103.90	-415.6	90.2	948.60	2.3	1.61
Pinus halepensis	55.4	30.2	68.4	6.10	849.03	128.6	6.6	1.1	110.1	2,287.4	-203.03	-812.1	203.6	2,324.27	2.2	4.14
Fraxinus angustifolia	50.3	24.2	51.2	5.00	683.75	76.6	3.9	0.7	65.5	1,361.2	-74.46	-297.8	203.0	1,747.12	2.2	3.12
Prosopis chilensis	22.7	10.9	23.7	2.26	311.64	37.9	1.9	0.3	32.4	673.4	-36.07	-144.3	96.0	840.73	1.2	2.64
Phoenix dactylifera	39.3	21.4	36.8	4.32	531.62	21.5	1.1	0.2	18.3	381.1	-253.34	-1,013.3	-110.3	-100.67	1.2	-0.32
Washingtonia robusta	16.0	8.7	14.9	1.76	215.83	9.4	0.5	0.1	8.0	167.0	-100.82	-403.3	-41.4	-20.46	1.2	-0.07
Other trees	210.0	96.7	207.6	19.79	2,783.08	334.9	17.1	3.0	286.1	5,945.8	-493.80	-1,975.2	681.4	6,753.73	15.5	1.70
CITYWIDE TOTAL	**1,446**	**699**	**1,461**	**143**	**$19,590**	**2,181**	**111**	**20**	**1,864**	**$38,728**	**-5,030**	**-$20,120**	**2,894**	**$38,197**	**100%**	**$1.48**

Stormwater Runoff Reductions

According to Federal Clean Water Act regulations, municipalities must obtain a permit for managing their stormwater discharges into water bodies. Each city's program must identify the *best management practices* (BMPs) it will implement to reduce its pollutant discharge.

Rainfall interception by trees can reduce the amount of stormwater that enters collection and treatment facilities during large storm events. Trees intercept rainfall in their canopy, acting as mini-reservoirs, controlling runoff at the source. This is especially important in an urban setting with a significant quantity of impervious surfaces near a major waterway. Healthy urban trees can reduce the amount of runoff and pollutant loading in receiving waters in three primary ways:

- Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
- Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.
- Tree canopies reduce soil erosion and surface flows by diminishing the impact of raindrops on barren surfaces.

Henderson's inventoried public trees intercept 7.7 million gallons of stormwater annually for an average of 298 gallons per tree (Table 9). The total annual value of this benefit to the City is $36,857, an average of $1.43 per tree. *Pinus halepensis* (Aleppo pine) are currently providing the greatest per tree benefit of $6.24 and the third highest percentage of overall stormwater benefits of 9.5% (Figure 9). Owing to their prevalence in the overall population, *Pinus eldarica* (Mondale pine) have the greatest percentage of overall stormwater benefits (17.2%), though the per tree benefit is $2.49. Many of the species currently demonstrating very low benefits, including *Chilopsis linearis* (desert willow, $0.22/tree) and *Vitex agnus-castus* (chaste tree, $0.38/tree), are immature populations of small-growing trees and will most likely not increase as those species age.

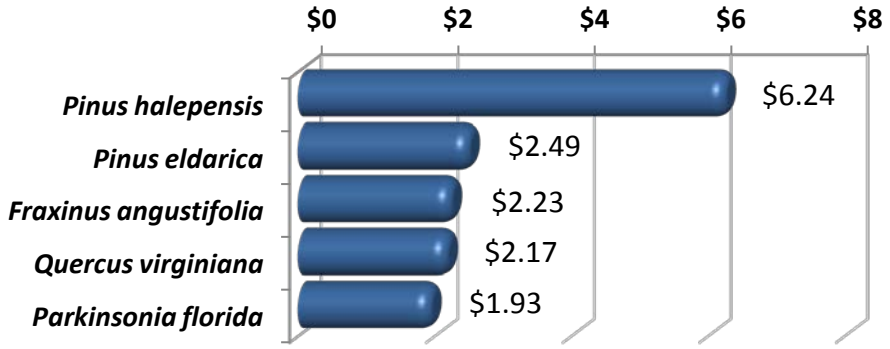


Figure 9. Annual Reduction in Stormwater Runoff - Top 5 Species

Table 9 Annual Stormwater Runoff Reduction Benefits Provided by Henderson's Public Tree Resource

Species	Total Rainfall Interception (Gal)	Total ($)	% of Pop.	% of Total $	Avg. $/tree
Pinus eldarica	1,321,968	6,346	9.9	17.2	2.49
Fraxinus velutina 'Fan-Tex'	842,912	4,046	8.7	11.0	1.80
Chilopsis linearis	89,257	428	7.7	1.2	0.22
Parkinsonia x 'Desert Museum'	155,611	747	6.0	2.0	0.48
Acacia stenophylla	285,399	1,370	5.3	3.7	1.00
Quercus virginiana	532,853	2,558	4.6	6.9	2.17
Prosopis glandulosa	193,178	927	4.3	2.5	0.84
Ulmus parvifolia	402,492	1,932	4.2	5.2	1.81
Prosopis velutina	256,464	1,231	4.1	3.3	1.18
Vitex agnus-castus	74,502	358	3.6	1.0	0.38
Fraxinus velutina	237,875	1,142	3.6	3.1	1.25
Pistacia chinensis	218,428	1,049	3.4	2.8	1.21
Acacia farnesiana	125,730	604	3.4	1.6	0.70
Prosopis alba	130,845	628	3.3	1.7	0.75
Parkinsonia florida	250,055	1,200	2.4	3.3	1.93
Chiltalpa tashkentensis	137,544	660	2.3	1.8	1.12
Pinus halepensis	728,832	3,499	2.2	9.5	6.24
Fraxinus angustifolia	259,701	1,247	2.2	3.4	2.23
Prosopis chilensis	127,069	610	1.2	1.7	1.91
Phoenix dactylifera	69,915	336	1.2	0.9	1.07
Washingtonia robusta	46,307	222	1.2	0.6	0.74
Other trees	1,191,150	5,718	15.5	15.5	1.44
CITYWIDE TOTAL	**7,678,088**	**$36,857**	**100%**	**100%**	**$1.43**

Aesthetic, Property Value & Socioeconomic Benefits

Trees provide beauty in the urban landscape, privacy to homeowners, improved human health, a sense of comfort and place, and habitat for urban wildlife. There is documented evidence that trees promote better business by stimulating more frequent and extended shopping and a willingness to pay more for goods and parking (Wolf, 1999). Some of these benefits may be captured as a percentage of the value of the property on which a tree stands. To determine the value of these less tangible benefits, i-Tree *Streets* uses research that compares differences in sales prices of homes to estimate the contribution associated with trees.

Trees provide beauty in the urban landscape.

Differences in housing prices in relation to the presence (or lack) of a street tree help define the aesthetic value of street trees in the urban environment. Consideration is given to the location of the street tree in relation to the land use. Street trees located in front of multi-family homes will not increase the property value at the same rate as single-family homes.

Furthermore, street trees located adjacent to commercial and nonresidential properties do not have the same resale potential as residential areas. These factors are taken into consideration and the value of those trees is adjusted accordingly. The calculation of annual aesthetic and other benefits corresponds with a tree's annual increase in leaf area. When a tree is actively growing, leaf area may increase dramatically. Once a tree is mature, there may be little or no net increase in leaf area from one year to the next; thus, there is little or no incremental annual aesthetic benefit for that year, although the cumulative benefit over the course of the entire life of the tree may be large. Since this report represents a one-year sample snapshot of the public tree population, aesthetic benefits reflect the increase in leaf area for each species population over the course of a single year. As a result, a very young population of 100 *Fraxinus velutina* 'Fan-Tex' (Fan-Tex ash*)* will have a greater annual aesthetic benefit than an equal number of mature *Quercus virginiana* (southern live oak). However, the cumulative lifetime aesthetic value of *Quercus virginiana* would be greater than that of *Fraxinus velutina* 'Fan-Tex'.

Urban trees promote retail shopping by stimulating more frequent visits and a willingness to pay more for goods and services (Wolf 1999).

The total annual benefit associated with property value increases and other less tangible benefits is $691,883, an average of $27.87 per tree (Table 11). Tree species that produced the highest average per tree aesthetic benefits are *Pinus halepensis* (Aleppo pine, $76.60), followed by *Fraxinus angustifolia* (Raywood ash, $45.99).

As a population, *Fraxinus velutina* 'Fan-Tex' contribute 13.9% of the overall benefits while representing on 8.7% of the population.

Figure 10. Annual Increase in Property and Socioeconomic Values - Top 5 Species

Table 10. Annual Property Value, Aesthetic, and Socioeconomic Benefits of Henderson's Tree Resource

Species	Total ($)	% of Pop.	% of Total $	Avg. $/tree
Pinus eldarica	55,635	9.9	8.0	21.85
Fraxinus velutina 'Fan-Tex'	95,889	8.7	13.9	42.58
Chilopsis linearis	18,211	7.7	2.6	9.17
Parkinsonia x 'Desert Museum'	17,369	6.0	2.5	11.24
Acacia stenophylla	25,932	5.3	3.8	19.00
Quercus virginiana	44,989	4.6	6.5	38.16
Prosopis glandulosa	35,530	4.3	5.1	32.21
Ulmus parvifolia	48,505	4.2	7.0	45.42
Prosopis velutina	37,431	4.1	5.4	35.82
Vitex agnus-castus	9,903	3.6	1.4	10.60
Fraxinus velutina	26,595	3.6	3.8	29.13
Pistacia chinensis	22,444	3.4	3.2	25.80
Acacia farnesiana	10,641	3.4	1.5	12.34
Prosopis alba	10,761	3.3	1.6	12.87
Parkinsonia florida	21,517	2.4	3.1	34.65
Chiltalpa tashkentensis	8,913	2.3	1.3	15.08
Pinus halepensis	42,973	2.2	6.2	76.60
Fraxinus angustifolia	25,752	2.2	3.7	45.99
Prosopis chilensis	13,817	1.2	2.0	43.31
Phoenix dactylifera	1,196	1.2	0.2	3.82
Washingtonia robusta	2,469	1.2	0.4	8.17
Other trees	115,410	15.5	16.7	28.99
CITYWIDE TOTAL	**$691,883**	**100%**	**100%**	**$26.87**

Benefit Summary

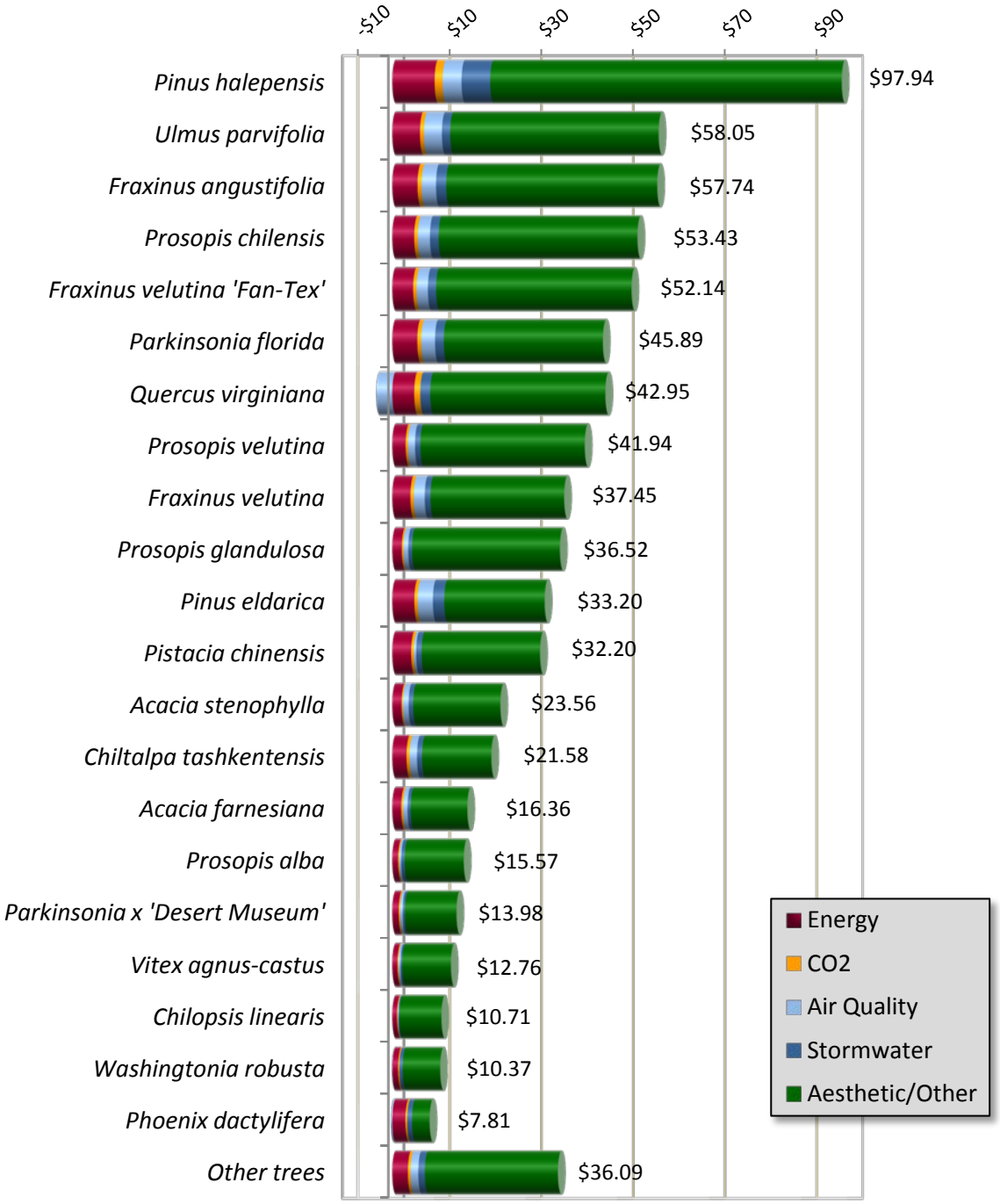
Henderson's public trees have beneficial effects on the community. Annual increases in property value, socioeconomic, and other aesthetic values are substantial, accounting for almost 80% of the total benefits.

Approximately 20% ($177,906) of the total annual benefits quantified in this study are environmental services (Table 13). Energy savings ($87,518) account for nearly 50% of the annual environmental benefits and 10% of all annual benefits. Air quality benefits ($38,197) account for 21% of annual environmental benefits and 4% of all annual benefits. Stormwater benefits ($36,857) account for 21% of the annual environmental benefits and 4% of all benefits. Carbon reduction benefits, valued at $15,334, account for 9% of environmental benefits and 1.7% of all benefits.

Table 11. Summary of Average Current Annual Per Tree Related Benefits from Henderson's Tree Resource

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total
Pinus eldarica	4.80	0.74	3.31	2.49	21.85	33.20
Fraxinus velutina 'Fan-Tex'	4.55	0.76	2.45	1.80	42.58	52.14
Chilopsis linearis	1.03	0.16	0.13	0.22	9.17	10.71
Parkinsonia x 'Desert Museum'	1.39	0.29	0.59	0.48	11.24	13.98
Acacia stenophylla	2.02	0.28	1.25	1.00	19.00	23.56
Quercus virginiana	4.78	1.33	-3.48	2.17	38.16	42.95
Prosopis glandulosa	2.07	0.36	1.04	0.84	32.21	36.52
Ulmus parvifolia	6.03	0.88	3.91	1.81	45.42	58.05
Prosopis velutina	2.92	0.50	1.53	1.18	35.82	41.94
Vitex agnus-castus	1.12	0.23	0.43	0.38	10.60	12.76
Fraxinus velutina	3.94	0.73	2.40	1.25	29.13	37.45
Pistacia chinensis	4.11	0.59	0.49	1.21	25.80	32.20
Acacia farnesiana	1.94	0.42	0.96	0.70	12.34	16.36
Prosopis alba	1.27	0.25	0.43	0.75	12.87	15.57
Parkinsonia florida	5.45	0.87	2.99	1.93	34.65	45.89
Chiltalpa tashkentensis	3.09	0.69	1.61	1.12	15.08	21.58
Pinus halepensis	9.22	1.74	4.14	6.24	76.60	97.94
Fraxinus angustifolia	5.50	0.91	3.12	2.23	45.99	57.74
Prosopis chilensis	4.78	0.79	2.64	1.91	43.31	53.43
Phoenix dactylifera	2.86	0.38	-0.32	1.07	3.82	7.81
Washingtonia robusta	1.26	0.26	-0.07	0.74	8.17	10.37
Other trees	3.38	0.59	1.70	1.44	28.99	36.09
Citywide average	**$3.40**	**$0.60**	**$1.48**	**$1.43**	**$26.87**	**$33.78**

Figure 11. Summary of Annual per Tree Benefits from Henderson's Most Prevalent Tree Species

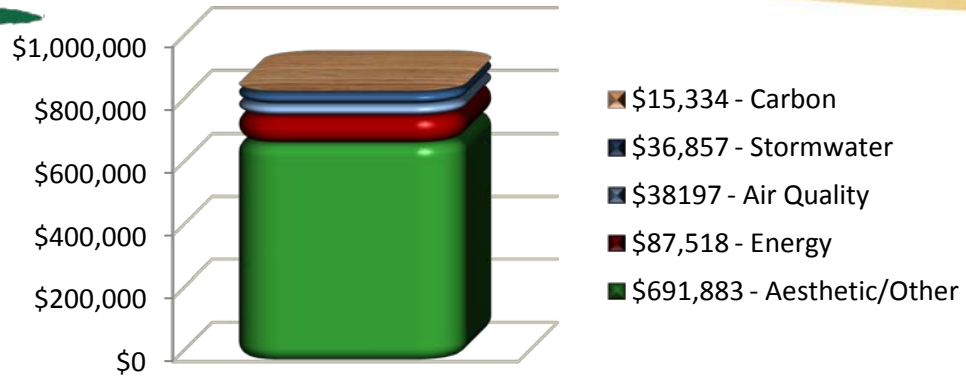


Net Benefits and Benefit-Investment Ratio (BIR)

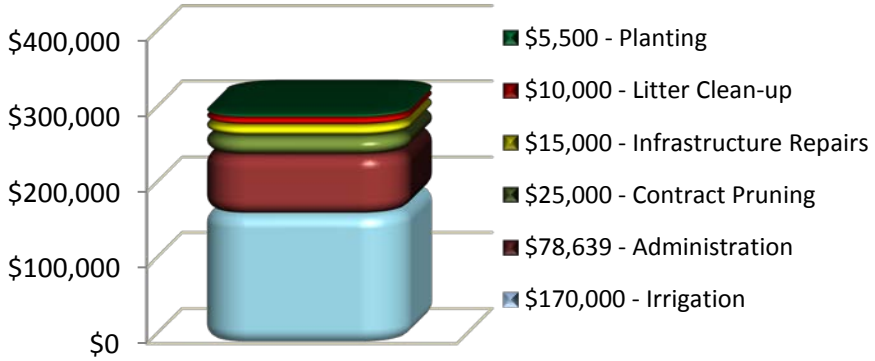
Henderson receives substantial benefits from public trees; however, the City must also consider the costs of maintaining this resource. Applying a *benefit-investment ratio* (BIR) is a useful way to evaluate the public investment in the community tree population. A BIR is an indicator used to summarize the overall value compared to the costs of a given project. Specifically, in this analysis, BIR is the ratio of the total benefits provided by the City's public trees expressed in monetary terms compared to the costs (investment) associated with their management, also expressed in monetary terms.

The estimated sum of benefits provided by Henderson's public tree resource is $869,789, a value of $33.78 per tree and $3.24 per capita. These benefits are realized on an annual basis. It is important to acknowledge that this is not a full accounting of the benefits provided by this public tree resource, as some benefits are intangible and/or difficult to quantify, such as impacts on psychological health, crime, and violence. Empirical evidence of these benefits does exist (Wolf, 2007; Kaplan, 1989; Ulrich, 1986), but there is limited knowledge about the physical processes at work and their interactions make quantification imprecise. Tree growth and mortality rates are highly variable. A true and full accounting of benefits and costs must consider variability among sites (e.g., tree species, growing conditions, maintenance practices) throughout the City, as well as variability in tree growth. In other words, **trees are worth far more than what one can ever quantify!**

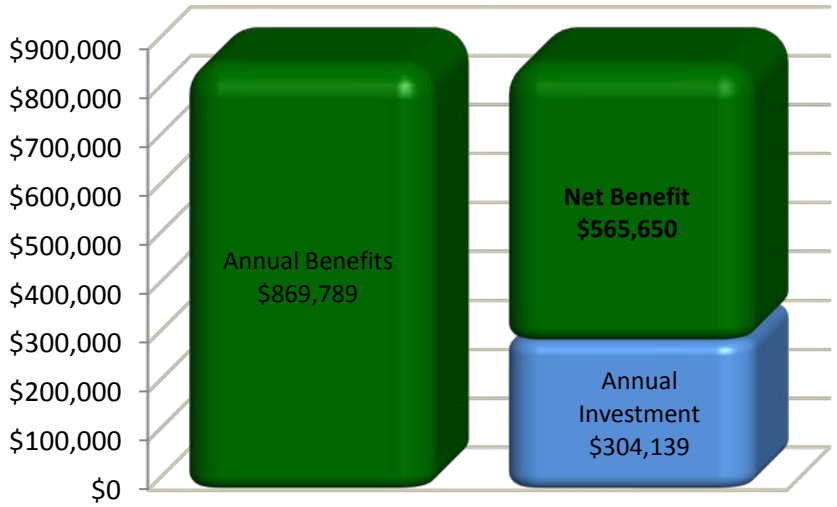
The total annual quantifiable benefit that public trees provide to the City of Henderson is $869,789. When the City's annual tree related expenditures (or investment) of $304,139 are considered, the net annual benefit (benefits minus investment) to the City is $565,650. The average net benefit for an individual public tree in Henderson is $21.97 and the per capita net benefit is $2.11. Based on the inventory of 25,753 public trees, Henderson is receiving $2.86 in benefits for every $1 that is spent on its urban forest resource (Table 13). Considering the relatively young age of this tree population (56% are <7" DBH and 28% are between 7" and 25" DBH), Henderson can expect greater benefits as these tress continue to mature.



Total Annual Benefits from Henderson's Public Tree Resource: $869,789
Average Annual per Tree Benefits: $33.78
Annual Value of Benefits Per Capita: $3.24



Total Annual Investment to Maintain Henderson's Public Tree Resource: $304,139
Average Annual per Tree Investment: $13.82
Annual Investment Per Capita: $1.13



Annual Net Benefits of Henderson's Public Tree Resource: $565,650
For EVERY $1 Invested in public trees, Henderson receives $2.86 in Benefits.

Table 12. Benefit Versus Investment Summary for Henderson's Public Tree Resource

Benefits	Total ($)	$/tree	$/capita
Energy	87,518	3.40	0.33
CO2	15,334	0.60	0.06
Air Quality	38,197	1.48	0.14
Stormwater	36,857	1.43	0.14
Aesthetic/Other	691,883	26.87	2.58
Total Benefits	**$869,789**	**$33.78**	**$3.24**

Investment			
Planting	5,500	0.21	0.02
Contract Pruning	25,000	0.97	0.09
Pest Management	0	0.00	0.00
Irrigation	170,000	6.60	0.63
Removal	0	0.00	0.00
Administration	78,639	3.05	0.29
Inspection/Service	0	0.00	0.00
Infrastructure Repairs	15,000	0.58	0.06
Litter Clean-up	10,000	0.39	0.04
Liability/Claims	0	0.00	0.00
Other Costs	0	0.00	0.00
Total Investment	**$304,139**	**$11.81**	**$1.13**
Net Benefits	**$565,650**	**$21.97**	**$2.11**
Benefit-cost ratio	**2.86**		

Conclusion

This analysis describes the current structural characteristics of Henderson's inventoried municipal forest using established tree sampling, numerical modeling, and statistical methods to provide a general accounting of the benefits produced by this public tree resource. The analysis provides a "snapshot" of this resource at its current population and condition level. Rather than examining each individual tree as an inventory does, the resource analysis examines trends and performance measures over the entire urban forest and each of the major species populations within.

When evaluating the bottom line, Henderson's public trees are worth the investment. This public resource gives back more in quantifiable benefits, including energy savings, stormwater runoff reduction, reduction in atmospheric CO_2, and aesthetic benefits, than the community invests in its care. The City's 25,753 trees are providing $869,789 in annual gross benefits, a value of $33.78 per tree and $3.24 per capita. Taking into consideration the investment necessary to manage this resource, ($304,139), Henderson's public trees provide $565,650 in net benefits. That is an average of $21.97 per tree and $2.11 per capita. **For every $1 invested in Henderson's public trees, the community receives $2.86 in benefits.**

Henderson's inventoried urban forest is quite young and in good condition with 127 different species. Although it is critical to maintain an adequate level of resources to protect and nurture this resource, Henderson's public trees can be expected to provide even greater benefits in the future and for many generations to come. The City can focus resources on maximizing the flow of benefits from the current tree population and maintaining a forward-thinking approach. Based on the resource analysis, Davey Resource Group recommends the following:

- Work toward developing an appropriate age distribution. Henderson's tree population is very heavily weighted toward small, young trees. This is likely indicative of the rapid growth Henderson has experienced in terms of human population over the last two decades. Henderson should work to offset this by implementing a nutrition-fertilization program to help maximize healthy tree growth.
- Maximize the benefits of the existing tree resource through comprehensive tree maintenance and a cyclical pruning schedule.
- Implement a structural pruning program for young and establishing trees to promote healthy structure, extend life expectancy, and reduce future costs and liability. This is especially important in the case of Henderson with such a large population of young trees.
- Continue to develop species diversity. While Henderson does not have any species comprising greater than 10% of the overall population, there are under-represented species and genera that Henderson could focus planting to improve overall diversity among its tree population.
- Maintain the inventory in an existing or newly purchased asset management system.
- Inventory the remainder of the urban forest, and update with new trees as they are planted.

Understanding the current status of the City's tree population allows forest managers to consider what future trends are likely and what management challenges will need to be met to sustain or, more importantly, increase the current level of benefits. Performance data from the analysis can be used to make determinations regarding species selection, distribution, and maintenance policies. Documenting current structure is necessary for establishing goals and performance

objectives and can serve as a benchmark for measuring future success. Information from the urban forest resource analysis can be used to create an urban forest management or master plan. An urban forest master plan is a critical tool for successful urban forest management, inspiring commitment and providing vision for communication with key decision-makers both inside and outside the organization.

As a Tree City, USA with a forward-looking approach to urban forest management, Henderson, Nevada is a community that recognizes the vital importance of trees to the environmental, social, and economic well-being of the City. Henderson has demonstrated that public trees are a valued community resource, a vital component of the urban infrastructure, and an important part of the City's history and identity. The City takes a proactive and forwarding-looking approach to caring for the community's trees, as evidenced by the condition and structure of this public resource. Current and complete inventory data will help staff to more efficiently track maintenance activities and tree health and will provide a strong basis for making informed management decisions. With additional tree planting and continued proactive management, Henderson's urban forest can be expected to produce an even greater flow of benefits as this resource continues to mature. With a demonstrated commitment to maintaining and maximizing the benefits from its public trees, the community will always be able to enjoy the richness of life afforded by the City of Henderson.

Appendix A: Methods and Procedures

Henderson's tree inventory was collected by Certified Arborists, using ArcPad software to assist the inventory arborist in locating the sample plots on the ground and inputting tree attributes (details about each tree's species, size, and condition). The data was formatted for use in i-Tree's public tree population assessment tool, **i-Tree *Streets, a STRATUM Analysis Tool*** (*Streets* v 5.0.1; i-Tree v 5.0.6). i-Tree *Streets* assesses tree population structure and the function of those trees, such as their role in building energy use, air pollution removal, stormwater interception, carbon dioxide removal, and property value increases. In order to analyze the economic benefits of Henderson's trees, i-Tree *Streets* calculates the dollar value of annual resource functionality and compares that to annual program expenditures. This analysis combines the results of the City's tree inventory with benefit-cost modeling data to produce information regarding resource structure, function, and value for use in determining management recommendations. i-Tree *Streets* regionalizes the calculations of its output by incorporating detailed reference City project information for 17 climate zones across the United States (Henderson is located in the Southwest Desert Climate Zone).

For each of the modeled benefits, an annual resource unit was determined on a per tree basis. Resource units are measured as MWh of electricity saved per tree; MBtu of natural gas conserved per tree, pounds of atmospheric CO_2 reduced per tree; pounds of NO_2, PM_{10}, and VOCs reduced per tree; cubic feet of stormwater runoff reduced per tree; and square feet of leaf area added per tree to increase property values.

Prices were assigned to each resource unit using economic indicators of society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations as some benefits are difficult to quantify (e.g., impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations based on current research. It is intended to be a general accounting of the benefits produced by urban trees.

Table 13. Henderson Benefit Prices Used In This Analysis

Benefits	Price	Unit	Source
Electricity	$0.0671	$/Kwh	Submitted by City of Henderson
Natural Gas	$0.6455	$/Therm	Submitted by City of Henderson
CO_2	$0.0075	$/lb	*Streets* default – Southwest Desert
PM_{10}	$6	$/lb	*Streets* default – Southwest Desert
NO_2	$4	$/lb	*Streets* default – Southwest Desert
SO_2	$15.70	$/lb	*Streets* default – Southwest Desert
VOC	$4	$/lb	*Streets* default – Southwest Desert
Stormwater Interception	$0.0048	$/gallon	*Streets* default – Southwest Desert
Median Home Value	$135,000	$	Submitted by City of Henderson

i-Tree *Streets* default values (Table 14) from the Southwest Desert Climate Zone were used for all benefit prices except for median home values and electric and natural gas rates. Electric rates, Natural Gas rates, and Median home value for Henderson was submitted by the City of Henderson. Using these rates, the magnitude of the benefits provided by the public tree resource was calculated using i-Tree *Streets***.** Program budget values used in benefit versus investment ratio calculations were supplied by City of Henderson.

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Appendix C: Reports

Henderson Complete Population of Public Trees

Species	DBH Class (in)										% of Pop.
	0-4	4-7	7-13	13-19	19-25	25-31	31-37	37-42	> 42	Total	
Broadleaf Deciduous Large (BDL)											
Gleditsia triacanthos	68	72	98	0	0	0	0	0	0	238	0.9
Populus fremontii	107	19	19	3	0	0	1	0	0	149	0.6
Platanus wrightii	57	0	22	11	6	1	0	0	0	97	0.4
Fraxinus uhdei	7	26	35	14	0	0	0	0	0	82	0.3
Quercus muehlenbergii	13	16	2	0	0	0	0	0	0	31	0.1
Quecus shumardii	14	6	6	1	0	0	0	0	0	27	0.1
Plantanus occidentalis	10	5	6	6	0	0	0	0	0	27	0.1
Populus spp.	5	21	0	0	0	0	0	0	0	26	0.1
Ulmus pumila	6	3	8	0	0	0	0	0	0	17	0.1
Quercus buckleyi (texana)	8	1	1	0	0	0	0	0	0	10	0.0
Quercus lobata	1	0	5	3	0	0	0	0	0	9	0.0
Sophora japonica	1	2	5	0	0	0	0	0	0	8	0.0
Celtis sinensis	0	2	0	0	0	0	0	0	0	2	0.0
Zelkova serratta	1	1	0	0	0	0	0	0	0	2	0.0
Fraxinus americana junginger	1	0	0	0	0	0	0	0	0	1	0.0
Carya illinoinensis	1	0	0	0	0	0	0	0	0	1	0.0
Total	**300**	**174**	**207**	**38**	**6**	**1**	**1**	**0**	**0**	**727**	**2.8**
Broadleaf Deciduous Medium (BDM)											
Fraxinus velutina 'Fan-Tex'	778	873	517	83	1	0	0	0	0	2,252	8.7
Ulmus parvifolia	578	288	155	46	1	0	0	0	0	1,068	4.1
Fraxinus velutina	369	214	258	68	3	1	0	0	0	913	3.5
Pistacia chinensis	351	221	272	26	0	0	0	0	0	870	3.4
Parkinsonia florida	221	222	149	27	2	0	0	0	0	621	2.4
Fraxinus angustifolia	181	171	159	47	2	0	0	0	0	560	2.2
Prosopis chilensis	116	107	79	16	1	0	0	0	0	319	1.2
Robinia pseudoacacia	44	111	55	5	0	0	0	0	0	215	0.8
Parkinsonia aculeata	27	34	35	8	0	0	0	0	0	105	0.4
Morus alba	2	1	1	20	22	12	6	0	0	64	0.2
Koelreuteria paniculata	21	7	10	0	0	0	0	0	0	38	0.1
Celtis reticulata	21	0	0	0	0	0	0	0	0	21	0.1
Robinia ambigua 'Purple Rose'	19	2	0	0	0	0	0	0	0	21	0.1
Fraxinus velutina 'Glabra'	4	3	7	4	0	0	0	0	0	18	0.1
Melia azedarach	6	5	3	0	0	0	0	0	0	14	0.1
Celtis occidentalis	7	2	1	0	0	0	0	0	0	10	0.0
Salix gooddingii	7	0	1	1	0	0	0	0	0	9	0.0
Albizia julibrissin	5	0	3	0	0	0	0	0	0	8	0.0
Pistacia vera	2	0	3	0	0	0	0	0	0	5	0.0

Machaerium tipu	0	0	0	1	0	0	1	0	0	2	0.0
Total	**2,759**	**2,261**	**1,708**	**352**	**32**	**13**	**7**	**0**	**0**	**7,133**	**27.7**
Broadleaf Deciduous Small (BDS)											
Chilopsis linearis	1,570	334	75	5	0	0	0	0	0	1,984	7.7
Parkinsonia x 'Desert Museum'	1,243	252	50	1	0	0	0	0	0	1,546	6.0
Prosopis glandulosa	846	156	89	12	0	0	0	0	0	1,103	4.3
Prosopis velutina	642	254	127	18	4	0	0	0	0	1,045	4.1
Vitex agnus-castus	852	75	7	0	0	0	0	0	0	934	3.6
Acacia farnesiana	576	185	78	21	2	0	0	0	0	863	3.4
Chiltalpa tashkentensis	148	289	145	9	0	0	0	0	0	591	2.3
Prosopis torreyana	91	59	33	6	1	0	0	0	0	190	0.7
Prosopis species	49	98	31	7	0	0	0	0	0	185	0.7
Prosopis pubescens	112	52	19	2	0	0	0	0	0	185	0.7
Cercis canadensis	59	6	4	0	0	0	0	0	0	69	0.3
Parkinsonia microphylla	43	13	1	0	0	0	0	0	0	57	0.2
Prunus cerasifera	17	17	3	0	0	0	0	0	0	37	0.1
Cercidium praecox	5	20	7	0	0	0	0	0	0	32	0.1
Parkinsonia x 'Sonoran Emerald'	13	8	1	0	0	0	0	0	0	22	0.1
Pyrus calleryana	2	10	8	0	0	0	0	0	0	20	0.1
Prosopis juliflora	7	5	3	0	0	0	0	0	0	16	0.1
Lagerstroemia indica	6	8	0	0	0	0	0	0	0	14	0.1
Quercus gambelli	0	0	2	1	0	0	0	0	0	3	0.0
Tamarix chinensis	2	0	0	0	0	0	0	0	0	2	0.0
Cercis canadensis texensis	2	0	0	0	0	0	0	0	0	2	0.0
Ficus carica	2	0	0	0	0	0	0	0	0	2	0.0
Prunus armeniaca	1	0	0	0	0	0	0	0	0	1	0.0
Cercis reniformis	1	0	0	0	0	0	0	0	0	1	0.0
Malus spp.	1	0	0	0	0	0	0	0	0	1	0.0
Cercis orbiculata	1	0	0	0	0	0	0	0	0	1	0.0
Punica granatum	1	0	0	0	0	0	0	0	0	1	0.0
Prunus spp.	0	1	0	0	0	0	0	0	0	1	0.0
Total	**6,292**	**1,842**	**683**	**82**	**7**	**0**	**0**	**0**	**0**	**8,908**	**34.6**
Broadleaf Evergreen Large (BEL)											
Quercus ilex	66	11	0	0	0	0	0	0	0	77	0.3
Eucalyptus microtheca	69	1	1	3	0	0	0	0	0	74	0.3
Eucalyptus camaldulensis	6	2	5	0	2	0	0	0	0	15	0.1
Eucalyptus papuana	7	1	0	0	0	0	0	0	0	8	0.0
Quercus suber	1	1	1	0	0	0	0	0	0	3	0.0
Eucalyptus microcarpa	0	2	0	0	0	0	0	0	0	2	0.0
Eucalyptus spp.	0	0	1	0	0	0	0	0	0	1	0.0
Total	**149**	**18**	**8**	**3**	**2**	**0**	**0**	**0**	**0**	**180**	**0.7**
Broadleaf Evergreen Medium (BEM)											
Quercus virginiana	261	387	476	54	1	0	0	0	0	1,179	4.6

Prosopis alba	545	122	139	28	2	0	0	0	0	836	3.2
Brachychiton populneum	12	22	6	0	0	0	0	0	0	40	0.2
Acacia salicina	0	17	1	0	0	0	0	0	0	18	0.1
Quercus fusiformis	12	2	0	0	0	0	0	0	0	14	0.1
Schinus molle	1	0	2	0	0	0	0	0	0	3	0.0
Laurus nobillis	1	0	0	0	0	0	0	0	0	1	0.0
Total	**832**	**550**	**624**	**82**	**3**	**0**	**0**	**0**	**0**	**2,091**	**8.1**

Broadleaf Evergreen Small (BES)											
Acacia stenophylla	721	471	153	19	1	0	0	0	0	1,365	5.3
Sophora secundiflora	182	5	0	0	0	0	0	0	0	187	0.7
Acacia aneura	146	35	2	0	0	0	0	0	0	183	0.7
Olea europaea	38	80	47	2	0	0	0	0	0	167	0.6
Acacia greggii	143	17	2	1	0	0	0	0	0	163	0.6
Rhus lancea	56	32	27	0	0	0	0	0	0	115	0.4
Olea europaea 'Swan Hill'	86	9	10	0	0	0	0	0	0	105	0.4
Pyrus kawakamii	0	56	33	6	0	0	0	0	0	95	0.4
Chamaerops humilis	2	47	10	5	0	0	0	0	0	64	0.2
Yucca brevifolia	0	16	21	2	0	0	0	0	0	39	0.2
Acacia constricta	16	20	3	0	0	0	0	0	0	39	0.2
Ligustrum lucidum	7	16	10	0	0	0	0	0	0	33	0.1
Acacia schaffneri	19	2	2	0	0	0	0	0	0	23	0.1
Ebenopsis ebano	9	8	1	0	0	0	0	0	0	18	0.1
Olneya tesota	6	3	7	1	0	0	0	0	0	17	0.1
Arbutus unedo	1	10	0	0	0	0	0	0	0	11	0.0
Prunus caroliniana	3	7	0	0	0	0	0	0	0	10	0.0
Salix exigua	8	0	0	0	0	0	0	0	0	8	0.0
Vauquelinia californica	4	0	1	0	0	0	0	0	0	5	0.0
Callistemon viminalis	4	0	0	0	0	0	0	0	0	4	0.0
Eucalyptus woodwardii	4	0	0	0	0	0	0	0	0	4	0.0
Leucaena retusa	3	0	1	0	0	0	0	0	0	4	0.0
Eucalyptus sargentii	3	0	0	0	0	0	0	0	0	3	0.0
Eucalyptus gillii	2	0	0	0	0	0	0	0	0	2	0.0
Acacia pendula	0	1	1	0	0	0	0	0	0	2	0.0
Fraxinus greggii	2	0	0	0	0	0	0	0	0	2	0.0
Nicotiana glauca	0	1	0	0	0	0	0	0	0	1	0.0
Celtis pallida	1	0	0	0	0	0	0	0	0	1	0.0
Caesalpinia cascalaco	1	0	0	0	0	0	0	0	0	1	0.0
Xylosma congestum	1	0	0	0	0	0	0	0	0	1	0.0
Unknown spp.	0	1	0	0	0	0	0	0	0	1	0.0
Simmondsia chinensis	1	0	0	0	0	0	0	0	0	1	0.0
Rhus ovata	0	1	0	0	0	0	0	0	0	1	0.0
Total	**1,469**	**838**	**331**	**36**	**1**	**0**	**0**	**0**	**0**	**2,675**	**10.4**

Conifer Evergreen Large (CEL)											
Pinus eldarica	364	613	951	498	116	4	0	0	0	2,546	9.9
Pinus halepensis	2	13	158	311	66	10	1	0	0	561	2.2
Pinus roxburghii	2	8	50	71	8	0	0	0	0	139	0.5

Pinus pinea	0	2	10	2	0	0	0	0	0	14	0.1
Cupressus sempervirens	0	6	0	0	0	0	0	0	0	6	0.0
Total	**368**	**642**	**1,169**	**882**	**190**	**14**	**1**	**0**	**0**	**3,266**	**12.7**
Conifer Evergreen Medium (CEM)											
Pinus brutia	0	6	2	3	0	0	0	0	0	11	0.0
Cupressus glabra	3	2	3	1	0	0	0	0	0	9	0.0
Total	**3**	**8**	**5**	**4**	**0**	**0**	**0**	**0**	**0**	**20**	**0.1**
Conifer Evergreen Small (CES)											
Fouquieria splendens	0	0	0	0	0	0	0	1	0	1	0.0
Juniperus spp.	0	0	1	0	0	0	0	0	0	1	0.0
Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**0.0**
Palm Evergreen Large (PEL)											
Phoenix canariensis	1	0	0	9	5	2	11	0	0	28	0.1
Trachycarpus fortunei	0	0	2	0	0	0	0	0	0	2	0.0
Total	**1**	**0**	**2**	**9**	**5**	**2**	**11**	**0**	**0**	**30**	**0.1**
Palm Evergreen Medium (PEM)											
Phoenix dactylifera	0	0	2	177	130	3	1	0	0	313	1.2
Total	**0**	**0**	**2**	**177**	**130**	**3**	**1**	**0**	**0**	**313**	**1.2**
Palm Evergreen Small (PES)											
Washingtonia robusta	0	5	46	236	15	0	0	0	0	302	1.2
Washingtonia filifera	0	1	10	28	21	24	2	3	0	89	0.3
Brahea armata	0	2	5	3	0	0	0	0	0	10	0.0
Butia capitata	0	0	0	4	0	0	0	0	0	4	0.0
Arecastrum romanzoffianum	0	0	3	0	0	0	0	0	0	3	0.0
Total	**0**	**8**	**64**	**271**	**36**	**24**	**2**	**3**	**0**	**408**	**1.6**
Grand Total	**12,173**	**6,341**	**4,804**	**1,936**	**412**	**57**	**23**	**4**	**0**	**25,753**	**100%**

Relative Performance Index (RPI) for Henderson's Public Tree Species

Species	Dead or Dying	Poor	Fair	Good	RPI	# of Trees	% of Pop.
Pinus eldarica	0.7	1.2	16.0	82.2	1.04	2,546	9.9
Fraxinus velutina 'Fan-Tex'	0.3	2.0	22.6	75.2	1.01	2,252	8.7
Chilopsis linearis	0.3	1.8	19.2	78.7	1.03	1,985	7.7
Parkinsonia x 'Desert Museum'	0.3	1.9	30.3	67.5	0.99	1,546	6.0
Acacia stenophylla	0.1	1.1	14.1	84.7	1.05	1,365	5.3
Quercus virginiana	1.1	5.2	25.0	68.7	0.98	1,179	4.6
Prosopis glandulosa	0.0	2.1	11.4	86.5	1.05	1,103	4.3
Ulmus parvifolia	0.4	4.3	44.1	51.2	0.93	1,068	4.1
Prosopis velutina	2.6	5.6	21.9	69.9	0.97	1,045	4.1
Vitex agnus-castus	0.5	1.3	16.1	82.1	1.04	934	3.6
Fraxinus velutina	2.1	3.7	39.1	55.1	0.93	913	3.5
Pistacia chinensis	0.2	0.9	14.3	84.6	1.05	870	3.4
Acacia farnesiana	0.3	1.6	28.6	69.4	0.99	863	3.4
Prosopis alba	0.8	2.3	30.6	66.3	0.98	836	3.2
Parkinsonia florida	3.2	2.7	29.0	65.1	0.96	621	2.4
Chiltalpa tashkentensis	0.2	6.4	51.1	42.3	0.89	591	2.3
Pinus halepensis	0.0	1.2	17.8	80.9	1.04	561	2.2
Fraxinus angustifolia	0.7	4.8	19.3	75.2	1.00	560	2.2
Prosopis chilensis	0.0	2.5	22.9	74.6	1.01	319	1.2
Phoenix dactylifera	0.0	0.0	2.6	97.4	1.09	313	1.2
Washingtonia robusta	0.7	6.0	1.7	91.7	1.05	302	1.2
Gleditsia triacanthos	4.6	7.6	24.4	63.4	0.93	238	0.9
Robinia pseudoacacia	2.8	6.5	33.0	57.7	0.93	215	0.8
Prosopis torreyana	0.0	2.1	13.7	84.2	1.04	190	0.7
Sophora secundiflora	0.0	2.7	7.5	89.8	1.06	187	0.7
Prosopis pubescens	1.1	4.9	5.9	88.1	1.04	185	0.7
Prosopis species	2.7	7.6	41.6	48.1	0.89	185	0.7
Acacia aneura	1.1	1.6	12.6	84.7	1.04	183	0.7
Olea europaea	0.0	2.4	31.1	66.5	0.99	167	0.6
Acacia greggii	0.6	3.7	36.2	59.5	0.95	163	0.6
Populus fremontii	4.0	10.1	11.4	74.5	0.96	149	0.6
Pinus roxburghii	0.0	0.7	18.0	81.3	1.04	139	0.5
Rhus lancea	0.9	7.0	40.0	52.2	0.92	115	0.4
Parkinsonia aculeata	4.8	18.1	39.0	38.1	0.81	105	0.4
Olea europaea 'Swan Hill'	0.0	0.0	6.7	93.3	1.08	105	0.4
Platanus wrightii	1.0	3.1	43.3	52.6	0.93	97	0.4
Pyrus kawakamii	1.1	9.5	25.3	64.2	0.95	95	0.4
Washingtonia filifera	0.0	0.0	4.5	95.5	1.09	89	0.3
Fraxinus uhdei	1.2	2.4	15.9	80.5	1.02	82	0.3
Quercus ilex	1.3	2.6	80.5	15.6	0.81	77	0.3
Eucalyptus microtheca	0.0	0.0	1.4	98.6	1.10	74	0.3
Cercis canadensis	7.2	13.0	69.6	10.1	0.72	69	0.3

Species	Dead or Dying	Poor	Fair	Good	RPI	# of Trees	% of Pop.
Morus alba	0.0	1.6	21.9	76.6	1.02	64	0.2
Chamaerops humilis	0.0	0.0	0.0	100.0	1.10	64	0.2
Parkinsonia microphylla	3.5	7.0	63.2	26.3	0.82	57	0.2
Brachychiton populneum	0.0	2.5	7.5	90.0	1.06	40	0.2
Yucca brevifolia	0.0	0.0	7.7	92.3	1.08	39	0.2
Acacia constricta	0.0	0.0	12.8	87.2	1.06	39	0.2
Koelreuteria paniculata	2.6	5.3	7.9	84.2	1.02	38	0.1
Prunus cerasifera	2.7	10.8	35.1	51.4	0.89	37	0.1
Ligustrum lucidum	0.0	30.3	30.3	39.4	0.81	33	0.1
Cercidium praecox	0.0	3.1	6.3	90.6	1.06	32	0.1
Quercus muehlenbergii	3.2	0.0	9.7	87.1	1.04	31	0.1
Phoenix canariensis	0.0	0.0	3.6	96.4	1.09	28	0.1
Plantanus occidentalis	3.7	11.1	25.9	59.3	0.91	27	0.1
Quecus shumardii	3.7	3.7	25.9	66.7	0.96	27	0.1
Populus spp.	0.0	7.7	26.9	65.4	0.96	26	0.1
Acacia schaffneri	30.4	4.3	4.3	60.9	0.76	23	0.1
Parkinsonia x 'Sonoran Emerald'	0.0	0.0	4.5	95.5	1.09	22	0.1
Celtis reticulata	19.0	0.0	57.1	23.8	0.73	21	0.1
Robinia ambigua 'Purple Rose'	0.0	4.8	19.0	76.2	1.01	21	0.1
Pyrus calleryana	0.0	25.0	30.0	45.0	0.84	20	0.1
Ebenopsis ebano	0.0	0.0	33.3	66.7	0.99	18	0.1
Fraxinus velutina 'Glabra'	16.7	0.0	50.0	33.3	0.78	18	0.1
Acacia salicina	0.0	0.0	16.7	83.3	1.05	18	0.1
Ulmus pumila	0.0	0.0	23.5	76.5	1.03	17	0.1
Olneya tesota	0.0	0.0	5.9	94.1	1.08	17	0.1
Prosopis juliflora	0.0	0.0	12.5	87.5	1.06	16	0.1
Eucalyptus camaldulensis	0.0	0.0	33.3	66.7	0.99	15	0.1
Pinus pinea	0.0	0.0	14.3	85.7	1.06	14	0.1
Lagerstroemia indica	0.0	0.0	14.3	85.7	1.06	14	0.1
Quercus fusiformis	0.0	0.0	7.1	92.9	1.08	14	0.1
Melia azedarach	0.0	7.1	35.7	57.1	0.94	14	0.1
Arbutus unedo	0.0	9.1	9.1	81.8	1.01	11	0.0
Pinus brutia	0.0	9.1	36.4	54.5	0.92	11	0.0
Brahea armata	0.0	0.0	0.0	100.0	1.10	10	0.0
Prunus caroliniana	0.0	20.0	30.0	50.0	0.87	10	0.0
Celtis occidentalis	0.0	60.0	20.0	20.0	0.65	10	0.0
Quercus buckleyi (texana)	0.0	0.0	20.0	80.0	1.04	10	0.0
Cupressus glabra	0.0	11.1	22.2	66.7	0.96	9	0.0
Quercus lobata	0.0	0.0	55.6	44.4	0.92	9	0.0
Salix gooddingii	0.0	11.1	11.1	77.8	0.99	9	0.0
Albizia julibrissin	0.0	0.0	37.5	62.5	0.98	8	0.0
Sophora japonica	12.5	12.5	25.0	50.0	0.82	8	0.0
Eucalyptus papuana	25.0	0.0	25.0	50.0	0.78	8	0.0
Salix exigua	0.0	0.0	0.0	100.0	1.10	8	0.0

Species	Dead or Dying	Poor	Fair	Good	RPI	# of Trees	% of Pop.
Cupressus sempervirens	16.7	0.0	0.0	83.3	0.94	6	0.0
Vauquelinia californica	0.0	0.0	20.0	80.0	1.04	5	0.0
Pistacia vera	0.0	0.0	40.0	60.0	0.97	5	0.0
Leucaena retusa	0.0	0.0	50.0	50.0	0.94	4	0.0
Callistemon viminalis	0.0	0.0	0.0	100.0	1.10	4	0.0
Eucalyptus woodwardii	0.0	25.0	25.0	50.0	0.86	4	0.0
Butia capitata	0.0	0.0	0.0	100.0	1.10	4	0.0
Quercus suber	0.0	0.0	33.3	66.7	0.99	3	0.0
Quercus gambelli	0.0	0.0	66.7	33.3	0.89	3	0.0
Schinus molle	0.0	0.0	0.0	100.0	1.10	3	0.0
Eucalyptus sargentii	0.0	0.0	33.3	66.7	0.99	3	0.0
Arecastrum romanzoffianum	0.0	100.0	0.0	0.0	0.45	3	0.0
Eucalyptus microcarpa	0.0	0.0	0.0	100.0	1.10	2	0.0
Machaerium tipu	0.0	0.0	50.0	50.0	0.94	2	0.0
Zelkova serratta	0.0	0.0	100.0	0.0	0.78	2	0.0
Tamarix chinensis	0.0	0.0	0.0	100.0	1.10	2	0.0
Cercis canadensis texensis	0.0	0.0	0.0	100.0	1.10	2	0.0
Celtis sinensis	50.0	50.0	0.0	0.0	0.29	2	0.0
Fraxinus greggii	0.0	0.0	0.0	100.0	1.10	2	0.0
Ficus carica	0.0	0.0	0.0	100.0	1.10	2	0.0
Acacia pendula	0.0	0.0	0.0	100.0	1.10	2	0.0
Eucalyptus gillii	50.0	0.0	0.0	50.0	0.62	2	0.0
Trachycarpus fortunei	0.0	0.0	50.0	50.0	0.94	2	0.0
Fraxinus americana junginger	0.0	0.0	0.0	100.0	1.10	1	0.0
Juniperus spp.	0.0	0.0	0.0	100.0	1.10	1	0.0
Prunus spp.	0.0	0.0	100.0	0.0	0.78	1	0.0
Fouquieria splendens	0.0	0.0	0.0	100.0	1.10	1	0.0
Caesalpinia cascalaco	0.0	0.0	100.0	0.0	0.78	1	0.0
Celtis pallida	0.0	0.0	0.0	100.0	1.10	1	0.0
Carya illinoinensis	0.0	0.0	0.0	100.0	1.10	1	0.0
Cercis reniformis	0.0	0.0	0.0	100.0	1.10	1	0.0
Laurus nobillis	0.0	0.0	0.0	100.0	1.10	1	0.0
Malus spp.	0.0	0.0	0.0	100.0	1.10	1	0.0
Eucalyptus spp.	0.0	0.0	0.0	100.0	1.10	1	0.0
Cercis orbiculata	0.0	100.0	0.0	0.0	0.45	1	0.0
Punica granatum	0.0	0.0	0.0	100.0	1.10	1	0.0
Nicotiana glauca	0.0	0.0	0.0	100.0	1.10	1	0.0
Xylosma congestum	0.0	0.0	100.0	0.0	0.78	1	0.0
Rhus ovata	0.0	0.0	0.0	100.0	1.10	1	0.0
Simmondsia chinensis	0.0	0.0	100.0	0.0	0.78	1	0.0
Prunus armeniaca	0.0	0.0	0.0	100.0	1.10	1	0.0
Citywide	**0.8**	**2.9**	**23.0**	**73.2**	**1.00**	**25,753**	**100%**

Replacement Value of Henderson's Public Tree Species

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Pinus eldarica	100,287	756,601	3,696,338	4,933,176	2,097,624	117,204	0	0	0	11,701,229	19.7
Pinus halepensis	709	19,839	838,567	4,211,412	1,727,949	385,521	62,523	0	0	7,246,521	12.2
Fraxinus velutina 'Fan-Tex'	213,637	1,070,878	2,006,424	782,280	13,659	0	0	0	0	4,086,877	6.9
Quercus virginiana	77,504	618,521	2,488,597	745,674	27,024	0	0	0	0	3,957,320	6.7
Pistacia chinensis	135,618	486,740	1,869,800	473,274	0	0	0	0	0	2,965,432	5.0
Acacia stenophylla	244,772	810,296	818,490	251,654	27,024	0	0	0	0	2,152,236	3.6
Ulmus parvifolia	167,696	447,545	796,404	592,824	27,024	0	0	0	0	2,031,493	3.4
Prosopis velutina	231,593	515,095	833,159	309,740	128,588	0	0	0	0	2,018,176	3.4
Parkinsonia florida	82,426	447,365	916,091	394,215	59,191	0	0	0	0	1,899,289	3.2
Fraxinus velutina	74,686	202,434	756,164	502,819	36,801	17,389	0	0	0	1,590,292	2.7
Chiltalpa tashkentensis	49,402	533,909	857,098	127,795	0	0	0	0	0	1,568,204	2.6
Chilopsis linearis	526,278	541,300	368,086	54,891	0	0	0	0	0	1,490,554	2.5
Prosopis glandulosa	335,971	319,431	593,343	188,443	0	0	0	0	0	1,437,188	2.4
Acacia farnesiana	222,188	344,696	485,618	327,068	48,986	0	0	0	0	1,428,556	2.4
Fraxinus angustifolia	50,546	203,812	599,098	441,737	38,699	0	0	0	0	1,333,892	2.2
Parkinsonia x 'Desert Museum'	460,568	506,494	297,099	12,996	0	0	0	0	0	1,277,158	2.2
Phoenix dactylifera	0	0	5,940	631,018	468,127	9,744	3,601	0	0	1,118,430	1.9
Prosopis alba	149,947	141,623	475,797	233,896	33,008	0	0	0	0	1,034,271	1.7
Pinus roxburghii	439	7,354	155,219	546,355	117,582	0	0	0	0	826,949	1.4
Morus alba	393	576	2,374	106,788	227,932	190,959	151,253	0	0	680,275	1.1

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Prosopis chilensis	32,794	133,322	292,054	131,491	19,350	0	0	0	0	609,011	1.0
Olea europaea	13,510	162,605	313,771	36,822	0	0	0	0	0	526,708	0.9
Prosopis torreyana	35,568	128,740	224,855	88,807	34,698	0	0	0	0	512,668	0.9
Gleditsia triacanthos	14,764	84,430	387,069	0	0	0	0	0	0	486,264	0.8
Vitex agnus-castus	285,116	127,459	39,820	0	0	0	0	0	0	452,395	0.8
Robinia pseudoacacia	12,025	128,058	176,490	36,357	0	0	0	0	0	352,929	0.6
Prosopis species	11,895	106,654	109,279	59,989	0	0	0	0	0	287,816	0.5
Platanus wrightii	12,239	0	60,171	82,288	82,577	17,389	0	0	0	254,664	0.4
Pyrus kawakamii	0	62,134	122,334	58,777	0	0	0	0	0	243,245	0.4
Chamaerops humilis	709	85,221	56,886	71,781	0	0	0	0	0	214,597	0.4
Prosopis pubescens	31,737	67,016	78,091	20,602	0	0	0	0	0	197,446	0.3
Fouquieria splendens	0	0	0	0	0	0	0	0	196,994	196,994	0.3
Yucca brevifolia	0	27,945	117,788	28,712	0	0	0	0	0	174,445	0.3
Fraxinus uhdei	1,614	19,310	78,889	71,651	0	0	0	0	0	171,465	0.3
Olneya tesota	4,594	14,955	108,609	41,270	0	0	0	0	0	169,427	0.3
Rhus lancea	18,429	47,357	101,726	0	0	0	0	0	0	167,511	0.3
Washingtonia robusta	0	1,389	21,941	118,246	6,557	0	0	0	0	148,134	0.2
Other trees	370,573	570,686	775,112	381,799	62,032	37,135	95,739	3,480	0	2,296,554	3.9
Parkinsonia aculeata	4,265	21,135	66,323	36,515	0	0	0	0	0	128,238	0.2
Phoenix canariensis	961	0	0	41,841	23,245	9,298	51,139	0	0	126,483	0.2
Acacia aneura	48,886	61,863	9,704	0	0	0	0	0	0	120,452	0.2
Washingtonia filifera	0	636	11,376	32,136	23,334	27,837	2,320	3,480	0	101,118	0.2

	DBH Class (in)										
Species	0-4	4-7	7-13	13-19	19-25	25-31	31-37	37-42	> 42	Total	% of Total $
Acacia greggii	44,065	26,558	11,377	14,356	0	0	0	0	0	96,357	0.2
Olea europaea 'Swan Hill'	30,299	15,786	50,194	0	0	0	0	0	0	96,278	0.2
Pinus pinea	0	3,626	55,213	24,490	0	0	0	0	0	83,329	0.1
Cercidium praecox	1,589	35,198	39,820	0	0	0	0	0	0	76,607	0.1
Brachychiton populneum	4,072	38,824	32,459	0	0	0	0	0	0	75,355	0.1
Eucalyptus microtheca	24,373	1,813	5,689	43,068	0	0	0	0	0	74,943	0.1
Pyrus calleryana	340	16,126	53,863	0	0	0	0	0	0	70,328	0.1
Populus fremontii	20,654	8,459	16,036	9,685	0	0	10,723	0	0	65,556	0.1
Sophora secundiflora	52,738	6,710	0	0	0	0	0	0	0	59,447	0.1
Fraxinus velutina 'Glabra'	810	3,631	22,726	32,115	0	0	0	0	0	59,282	0.1
Acacia constricta	5,259	35,731	17,066	0	0	0	0	0	0	58,055	0.1
Ligustrum lucidum	2,090	23,679	30,116	0	0	0	0	0	0	55,884	0.1
Koelreuteria paniculata	5,824	8,604	41,100	0	0	0	0	0	0	55,528	0.1
Plantanus occidentalis	1,832	3,603	11,449	29,970	0	0	0	0	0	46,854	0.1
Cercis canadensis	16,223	9,676	20,519	0	0	0	0	0	0	46,418	0.1
Brahea armata	0	4,744	25,776	15,848	0	0	0	0	0	46,368	0.1
Pinus brutia	0	6,459	5,847	31,230	0	0	0	0	0	43,536	0.1
Parkinsonia microphylla	12,672	25,667	5,130	0	0	0	0	0	0	43,469	0.1
Machaerium tipu	0	0	0	10,301	0	0	31,557	0	0	41,858	0.1
Prosopis juliflora	2,865	10,751	26,931	0	0	0	0	0	0	40,547	0.1
Quercus ilex	16,992	16,746	0	0	0	0	0	0	0	33,737	0.1
Prunus	4,442	16,904	11,121	0	0	0	0	0	0	32,468	0.1

	DBH Class (in)										
Species	0-4	4-7	7-13	13-19	19-25	25-31	31-37	37-42	> 42	Total	% of Total $
cerasifera											
Parkinsonia x 'Sonoran Emerald'	5,322	17,604	7,267	0	0	0	0	0	0	30,193	0.1
Eucalyptus camaldulensis	1,384	1,393	10,472	0	15,453	0	0	0	0	28,702	0.0
Quercus gambelli	0	0	10,260	18,411	0	0	0	0	0	28,671	0.0
Quecus shumardii	2,619	4,659	13,544	5,856	0	0	0	0	0	26,679	0.0
Quercus lobata	163	0	10,472	14,124	0	0	0	0	0	24,758	0.0
Cupressus glabra	853	1,497	12,425	7,348	0	0	0	0	0	22,122	0.0
Ulmus pumila	1,384	1,969	17,593	0	0	0	0	0	0	20,946	0.0
Lagerstroemia indica	2,215	18,276	0	0	0	0	0	0	0	20,492	0.0
Quercus muehlenbergii	2,930	11,865	4,747	0	0	0	0	0	0	19,542	0.0
Ebenopsis ebano	3,088	12,373	4,015	0	0	0	0	0	0	19,476	0.0
Melia azedarach	1,494	5,526	12,330	0	0	0	0	0	0	19,350	0.0
Acacia schaffneri	5,342	2,560	11,377	0	0	0	0	0	0	19,279	0.0
Arbutus unedo	170	17,599	0	0	0	0	0	0	0	17,769	0.0
Acacia salicina	0	14,032	2,531	0	0	0	0	0	0	16,563	0.0
Populus spp.	950	15,227	0	0	0	0	0	0	0	16,177	0.0
Salix gooddingii	2,013	0	1,692	10,301	0	0	0	0	0	14,006	0.0
Albizia julibrissin	1,324	0	11,121	0	0	0	0	0	0	12,445	0.0
Schinus molle	355	0	11,377	0	0	0	0	0	0	11,732	0.0
Pistacia vera	600	0	9,912	0	0	0	0	0	0	10,513	0.0
Prunus caroliniana	960	9,493	0	0	0	0	0	0	0	10,453	0.0
Sophora japonica	96	1,633	8,378	0	0	0	0	0	0	10,106	0.0
Cupressus sempervirens	0	9,279	0	0	0	0	0	0	0	9,279	0.0

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Quercus fusiformis	4,153	3,626	0	0	0	0	0	0	0	7,779	0.0
Acacia pendula	0	1,813	5,689	0	0	0	0	0	0	7,502	0.0
Trachycarpus fortunei	0	0	7,457	0	0	0	0	0	0	7,457	0.0
Quercus suber	355	1,280	5,689	0	0	0	0	0	0	7,323	0.0
Vauquelinia californica	1,315	0	5,689	0	0	0	0	0	0	7,003	0.0
Robinia ambigua 'Purple Rose'	5,438	1,500	0	0	0	0	0	0	0	6,938	0.0
Celtis occidentalis	1,319	2,289	2,901	0	0	0	0	0	0	6,510	0.0
Eucalyptus spp.	0	0	5,689	0	0	0	0	0	0	5,689	0.0
Juniperus spp.	0	0	5,689	0	0	0	0	0	0	5,689	0.0
Leucaena retusa	960	0	4,015	0	0	0	0	0	0	4,975	0.0
Celtis reticulata	4,722	0	0	0	0	0	0	0	0	4,722	0.0
Butia capitata	0	0	0	4,203	0	0	0	0	0	4,203	0.0
Quercus buckleyi (texana)	1,845	576	1,676	0	0	0	0	0	0	4,097	0.0
Eucalyptus papuana	1,905	1,813	0	0	0	0	0	0	0	3,718	0.0
Eucalyptus microcarpa	0	3,626	0	0	0	0	0	0	0	3,626	0.0
Salix exigua	3,275	0	0	0	0	0	0	0	0	3,275	0.0
Nicotiana glauca	0	1,813	0	0	0	0	0	0	0	1,813	0.0
Rhus ovata	0	1,813	0	0	0	0	0	0	0	1,813	0.0
Prunus spp.	0	1,613	0	0	0	0	0	0	0	1,613	0.0
Arecastrum romanzoffianum	0	0	1,270	0	0	0	0	0	0	1,270	0.0
Eucalyptus woodwardii	1,130	0	0	0	0	0	0	0	0	1,130	0.0
Callistemon viminalis	982	0	0	0	0	0	0	0	0	982	0.0

	DBH Class (in)										
Species	**0-4**	**4-7**	**7-13**	**13-19**	**19-25**	**25-31**	**31-37**	**37-42**	**> 42**	**Total**	**% of Total $**
Eucalyptus sargentii	960	0	0	0	0	0	0	0	0	960	0.0
Tamarix chinensis	819	0	0	0	0	0	0	0	0	819	0.0
Cercis canadensis texensis	819	0	0	0	0	0	0	0	0	819	0.0
Ficus carica	819	0	0	0	0	0	0	0	0	819	0.0
Zelkova serratta	163	576	0	0	0	0	0	0	0	739	0.0
Fraxinus greggii	709	0	0	0	0	0	0	0	0	709	0.0
Eucalyptus gillii	525	0	0	0	0	0	0	0	0	525	0.0
Celtis sinensis	0	432	0	0	0	0	0	0	0	432	0.0
Cercis reniformis	409	0	0	0	0	0	0	0	0	409	0.0
Punica granatum	409	0	0	0	0	0	0	0	0	409	0.0
Malus spp.	409	0	0	0	0	0	0	0	0	409	0.0
Prunus armeniaca	409	0	0	0	0	0	0	0	0	409	0.0
Carya illinoinensis	355	0	0	0	0	0	0	0	0	355	0.0
Laurus nobillis	355	0	0	0	0	0	0	0	0	355	0.0
Celtis pallida	355	0	0	0	0	0	0	0	0	355	0.0
Caesalpinia cascalaco	250	0	0	0	0	0	0	0	0	250	0.0
Simmondsia chinensis	250	0	0	0	0	0	0	0	0	250	0.0
Xylosma congestum	250	0	0	0	0	0	0	0	0	250	0.0
Fraxinus americana junginger	231	0	0	0	0	0	0	0	0	231	0.0
Cercis orbiculata	170	0	0	0	0	0	0	0	0	170	0.0
Citywide Total	**$3,970,227**	**$9,741,792**	**$21,924,589**	**$17,096,647**	**$5,284,434**	**$775,341**	**$313,116**	**$3,480**	**$196,994**	**$59,306,619**	**100%**