2013

Jefferson Westside Street Tree Inventory

Urban Forestry

City of Eugene
Parks and Open Space

September 25, 2013

Jefferson Westside Neighborhood Street Tree Inventory Report 2013

Compiled by:
John Krausser and Joel Grogan, Technician Aides, Urban Forestry, Eugene Parks and Open Space

Planning and event organization by Jefferson Westside Neighborhood Tree Program **Volunteers:**

Stephen Heider	Jefferson Westside Neighbors Tree Program Co-chair
John Kline	Jefferson Westside Neighbors Tree Program Co-chair
Tricia Kandik	Jefferson Westside Neighbors Tree Program Member-at-Large
Erik Burke	Eugene Director, Friends of Trees

Matching Grant funding through the Eugene Neighborhood Services Program:
Michael Kinnison, Neighborhood Program Manager
Cindy Clarke, Neighborhood Program Coordinator
Rene Kane, Neighborhood Planner
Lorna Flormoe, Neighborhood Planner

More than 300 hours of volunteer time were contributed by the following people:
Amy Beller, Ana Orozco, Annah James, Bonnie Grant, Brenda Cervantes, Cal Taylor, Carolyn Partridge, David Lang, Edgar Peara, Emily Gattis, Eric Parsons, Fred Crispell, Gretchen Miller, Gwen Bailey, Hal Dillon, Isaac Self, Janice Gotchall, Jo von Hippel, Joni Dawning, Josh Grenzsund, Joshua Phillips, Jozef Siekel-Zdzienicki, Karla Berg, Kate McQueen, Lindsey Belleau, Madeline Smith, Marilyn Fox, Mary Allison, Nancy Buchanan, Nicole Peterson, Nikki Reser, Paul Conte, Sarah Hendrickson, and Sarah Parsons. Thank you!

Friends of Trees was instrumental in organizing the volunteer effort and also provided equipment necessary to conduct the inventory on each of the volunteer days.

City staff provided training, technical assistance, logistical support, and data entry:

Scott Altenhoff	Lead Arborist, Urban Forestry, Eugene Parks and Open Space
Eric Cariaga	Planning Technician, Eugene Parks and Open Space
Eric DeBord	Certified Arborist, Urban Forestry, Eugene Parks and Open Space

Special thanks to:

City of Portland Parks & Recreation for providing training and materials, sharing their inventory report template, and inspiring the concept of a volunteer-driven, neighborhood-based tree inventory; and,

Stephen Heider, JWN Executive Board Chair and Tree Program Co-chair, for his numerous efforts to engage residents to learn about urban forestry issues and to help care for the JWN street tree resource and especially for his work to secure the Neighborhood Matching Grant funding for this project.

Erik Burke and Tricia Kandik of JWN Tree Program recording the diameter of a Zelkova tree during the Jefferson Westside Neighborhood street tree inventory.

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Overview

Tree inventories are an essential component of proper urban forestry management. They provide information critical for prioritizing maintenance, allocating resources, facilitating decision-making, and educating citizens. This document summarizes the results of a volunteer-driven update to an existing street tree inventory in the Jefferson Westside Neighborhood. It serves as a pilot study for a collaborative, community-based approach to maintaining the accuracy of the City of Eugene's ongoing tree inventory and a method that we hope will be replicated throughout our City's neighborhoods.

> *"You must know what you have in your urban forest, where it is, and what condition it is in before you can truly manage your trees."*
> -North Carolina Forest Service

In recognition of the importance of tree inventories, the Jefferson Westside Neighborhood (JWN) group initiated a survey of the existing state of its street trees (trees rooted in the public rights-of-way). During summer and fall of 2012, teams of volunteers canvased the neighborhood block by block, recording several critical variables that were used to assess the condition of the neighborhood's urban forest. Attributes of both the sites and the trees themselves were considered. The site considerations included planting strip width, sidewalk and curb conflicts, presence of high-voltage overhead power lines or other utilities, and location by address. The tree data that were recorded included botanical name, trunk diameter (DBH), overall condition, and defects.

Volunteers experienced in tree identification acted as team leaders, and certified arborists provided further help as needed. Data were primarily recorded on paper forms, with limited use of mobile electronic devices. Data were then compiled and entered into the City's ArcGIS database. City of Eugene Urban Forestry staff used the data to conduct comparative evaluations of several attributes to determine current conditions, species distribution, stocking levels, maintenance priorities and other issues. For a description of methods utilized in generating this report see Appendix G.

Friends of Trees staff were instrumental in organizing and motivating volunteer teams. Friends of Trees is also actively involved in planting new trees in appropriate planting sites and works in conjunction with volunteers and the Parks and Open Space Division.

Funding for the project was provided in part through a Neighborhood Matching Grant provided by the City of Eugene's Neighborhood Services Program.

*This report is available on the City of Eugene's website (*http://www.eugene-or.gov/index.aspx?NID=325*)*

Executive Summary

During summer and fall of 2012, Jefferson Westside Neighborhood volunteers conducted an inventory of their public street trees in collaboration with City Urban Forestry staff. Dozens of volunteers spent more than 300 hours identifying, mapping, measuring, and assessing the condition of every street tree in the neighborhood.

URBAN FOREST COMPOSITION

At the end of 2012, the Jefferson Westside Neighborhood street tree population contained 3,403 trees of 171 different species or cultivars in the public rights-of-way. Fifteen different plant families compose 95% of the population. Maples (Aceraceae) are more abundant than any other family at 31%. The next most abundant families are Rose family (Roseaceae) - 15%, Olive family (Oleaceae) – 10%, and Beech family (Fagaceae) – 10%, with all other families each representing less than 10% of the total street tree population. Broadleaf deciduous trees make up 95.9% of the population, while coniferous evergreen trees account for 3.7%. Over half (61%) of the population consists of trees less than 12-inch diameter at breast height (DBH). For a more specific breakdown of the species that are currently growing in this neighborhood, see Tables 2 and 4, and Chart 1 .

The overall condition of the neighborhood trees is encouraging. On a four-point rating system (Good, Fair, Poor, Dead) trained volunteers and City staff rated 43.6% of the trees as “Good” and 50.5% as “Fair”. Only 5.5% rated “Poor”. At the time of compilation, there were 11 dead trees in the neighborhood, which represented 0.4% of the population.

STOCKING LEVELS

The Jefferson Westside Neighborhood is well-stocked with 84.7% of street tree planting sites occupied by trees. Nearly 500 vacant planting sites have been identified, including 368 sites that might accommodate large canopy trees because they do not have overhead primary power lines.

FUTURE PRIORITIES

The following recommendations are based on best management practices for urban forestry as well as results from the JWN street tree inventory. The City plans to convene a meeting with JWN Tree Program members to discuss preferences and priorities for management of the neighborhood’s street trees.

- New plantings should focus on increasing species diversity, selecting appropriately-sized tree species, and improving the health and resilience of the urban forest
    - Increase the diversity of tree species planted, especially conifers, and decrease plantings of species that are currently abundant (e.g., maples)
    - Prioritize large canopy trees for open areas with overhead clearance and smaller understory trees beneath primary (high-voltage) power lines and in smaller planting spaces
- Continue education and outreach to encourage planting of approved and appropriate species
- Monitor and maintain newly planted and existing trees to enhance the survival and long-term health of the urban forest
    - Engage volunteers and contractors to build upon the City’s efforts in monitoring tree health
    - Advocate for modification of sidewalks and other infrastructure to accommodate larger trees
- Remove and replace dead trees and those in very poor condition
- Continue and increase timely pruning and maintenance of street trees
- Use inventories to monitor change and guide management decisions

Jefferson Westside Street Trees by the Numbers

Number	%	Metric	Notes	Page #
3,403		*Total trees in JWN rights-of-way*		
$16.6 million		*Total replacement value*	*Calculated using iTree Streets*	*10*
$285,232		*Total annual environmental benefits*	*Calculated using iTree Streets*	*10*
32		*Plant families represented*		*7, Appendix B &F*
171		*Plant species and cultivars represented*		
10"		*Average diameter at breast height (DBH)*		*8*
366	*11%*	*Trees greater than 24" DBH*		*8*
3233	*95%*	*Broadleaf deciduous trees*		*9*
123	*4%*	*Tree/sidewalk conflicts*	*Tree causing damage to sidewalk infrastructure*	*14*
3200	*94%*	*Trees rated "fair" or "good" condition*	*Rated by volunteers on 4 point scale "Good, Fair, Poor, Dead"*	*12*
3405 of 4012	*85%*	*Stocking level*	*% of suitable planting sites that currently have trees*	*13*
729	*21%*	*Oversized trees*	*Trees likely to outgrow their planter width*	*13*
637	*19%*	*Undersized trees*	*Trees smaller than planter width could have supported*	*13*

Table 1: Key metrics of JWN Street Tree Inventory

Top 10 Most Abundant Trees

Rank	Common Name	Botanical Name	Number of Trees	% of Total
1	Norway Maple	*Acer platanoides*	355	10.4%
2	Big-leaf Maple	*Acer macrophyllum*	273	8.0%
3	Red Maple	*Acer rubrum*	201	5.9%
4	American Sweet Gum	*Liquidambar styraciflua*	158	4.6%
5	Hawthorn	*Crataegus* spp.	137	4.0%
6	Cherry	*Prunus* spp.	128	3.8%
7	Red Oak	*Quercus rubra*	104	3.1%
8	Raywood Ash	*Fraxinus oxycarpa* 'Raywood'	89	2.6%
9	Thundercloud Plum	*Prunus cerasifera* 'Thundercloud'	77	2.3%
10	Green Ash	*Fraxinus pennsylvanica*	75	2.2%
	Totals		1,597	50%

Table 2: Most abundant tree types in JWN

Neighborhood Characteristics

The Jefferson Westside Neighborhood (JWN) is located roughly a mile south of the geographic center of Eugene. It is bordered by West 18th Avenue to the south, Chambers Street to the west, West 7th Avenue to the north and Lawrence Street to the east, with an additional eastern portion surrounded by West 13th Avenue, Willamette Street and West 18th Avenue. The neighborhood contains four parks, and a section of the Amazon Creek bicycle path, and is home to both the Lane County Fairgrounds and Lane County Historical Museum. Surrounding neighborhoods include Whiteaker (north), Downtown and West University (east), Friendly (south), and the Far West Neighborhood (west).

JWN character is partly defined by a closed canopy of street trees

Jefferson Westside is one of the oldest neighborhoods in the city. According to the 2010 census, nearly a third of its homes were built prior to 1940. Many of the neighborhood's trees were planted at that time as well. Since planting and growth occurred prior to full infrastructure development, large deciduous street trees such as big-leaf maple and horse chestnut were able to grow to maturity in large planting sites. Much of the current aesthetic and experiential character of the neighborhood is framed by their mature canopy. An interactive map of JWN's inventory and Google satellite imagery can be viewed online, or see Appendix A.

The population of the neighborhood is roughly twice as dense as the city average, due in part to lot size and the number of multi-family residences. It has a lower percentage of college graduates and median household income is about 30% less than the city average. (Table 3)

Demographics	Jefferson Westside	Eugene
Area	569.8 acres	27,993.6 acres
Population	6,746	156,185
Density	11.8 people / acre	5.6 people / acre
Median Household Income	$28,263	$41,326
College Degree	59%	78%

Table 3: Demographics - Source: 2010 Census

For a more detailed review, see Eugene's 2011 Neighborhood Analysis demographics report for the Jefferson Westside Neighborhood.

TREE DISTRIBUTION

A general guideline for urban forest diversity is the 10-20-30 rule, suggesting an ideal distribution of trees is no more than 10% of a given species, 20% of a given genus, and 30% of a given family. This model was designed to encourage diversity in order to protect against widespread diseases and promote resilience within the urban forest. In the Jefferson Westside Neighborhood, the maple family is above the 30% threshold, though other family-level diversity is within recommended levels (Chart 1 & Table 4). This means that if pathogens such as Dutch Elm Disease, Emerald Ash Borer, or Sudden Oak Death occur ever appear in the neighborhood, each of these could affect only up to 8% of the trees; conversely, a pest or disease affecting maples could place over 30% of JWN street trees at risk. It is worth noting that global climate change will likely expand the range of predators and diseases and affect the perfomance of certain tree species in our region – making diversity of the urban forest increasingly important.

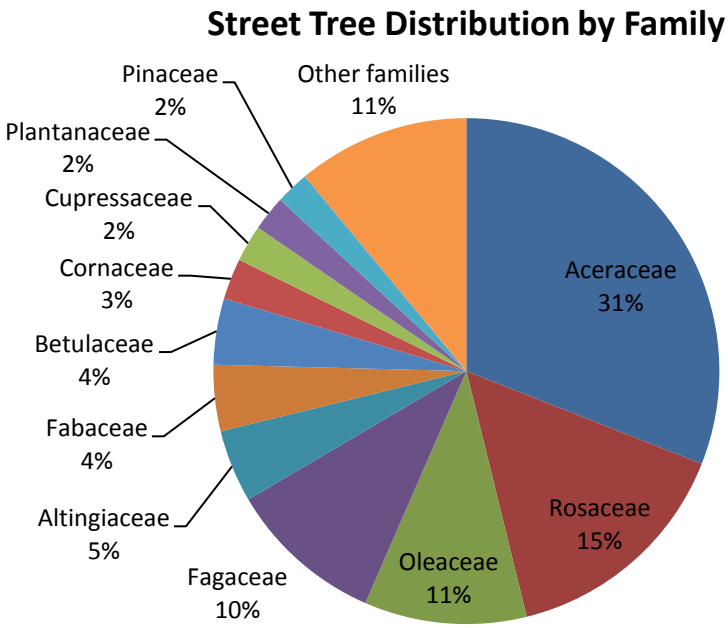


Chart 1: Family-level Diversity

Family	Common Name	Tree Types in this family	Tree Count	Percent of Total Population
Aceraceae	Maple	maple	1054	31.0%
Rosaceae	Rose	almond, apple, cherry, choke cherry, hawthorn, mountain ash, peach, pear, plum	517	15.2%
Oleaceae	Olive	ash, lilac, willow	353	10.4%
Fagaceae	Beech	beech, chestnut, horse chestnut, oak	340	10.0%
Altingiaceae	n/a	sweet gum	158	4.6%
Fabaceae	Pea	goldenchain tree, honey locust, black locust, redbud, silk tree, yellowwood	144	4.2%
Betulaceae	Birch	alder, birch, hazelnut, hornbeam	144	4.2%
Cornaceae	Dogwood	dogwood, tupelo	89	2.6%
Cupressaceae	Cypress	arborvitae, thuja cedar, bald cypress, juniper, redwood, sequoia	80	2.4%
Plantanaceae	Sycamore	plane tree, sycamore	76	2.2%
Pinaceae	Pine	true cedar, fir, larch, pine, spruce	73	2.1%
Other families (see Appendix B)		magnolia, walnut, elm, ginkgo, mulberry, snowbell and others	375	11.0%
Total			**3,403**	**100%**

Table 4: Family-Level Diversity

Size and Age Distribution

The JWN contains nearly 200 trees that are 30 inches DBH or larger, although the majority of trees are 18 inches DBH or smaller. Chart 2 (below) illustrates the relative size, age, and structure of JWN's street trees. The relative age of trees can be inferred from the chart, reflecting the greater population of young (smaller) and middle-aged (middle-size) trees. However, the age association is not entirely accurate since some smaller trees such as dogwood have smaller trunks even when mature. Trees smaller than 3"in diameter reflect the number of small-statured or newly planted trees, while trees in the 6-12" and 12-18" categories reflect a history of persistent tree-planting and effective maintenance. Though very large trees currently make up a small portion of right-of-way trees, these large specimens make a disproportionately large contribution to overall environmental benefits (see the Economic Valuation section p.10). Continued dedication toward tree planting and establishment, along with careful maintenance, aim to increase the JWN's abundance of large, healthy, mature trees.

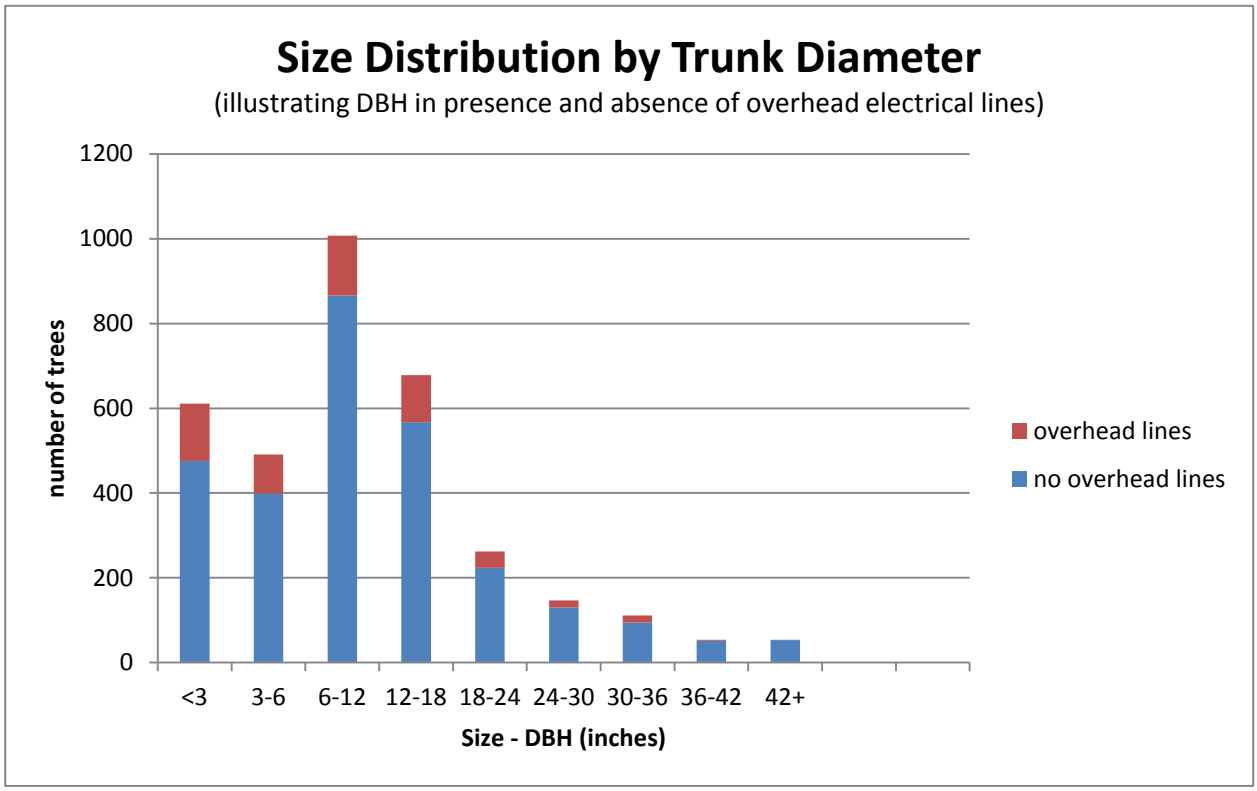


Chart 2: Size distribution by DBH classes. Bars show quantity of trees per DBH class, separated by presence of primary overhead electrical lines

The presence of overhead primary power lines often conflicts with the maturation of large-growing tree species, which must be pruned or 'topped' to protect the electrical transmission system. This pruning artificially prevents these trees from attaining their natural size and form, which can make them unsightly and more susceptible to disease and structural imbalance. When these trees become diseased or hazardous, they must eventually be removed (see page 12). It is important to note that the diameter of the trees (measured in diameter at breast height – DBH) may not be affected by topping – or even inversely affected as the tree widens in response to repeated pruning – so the presence of overhead power lines does not clearly affect size distribution in terms of DBH.

Distribution by Functional Type

Traditional preference for deciduous street trees in addition to current City specifications that prohibit planting of large coniferous evergreens on sites less than 20 feet wide have severely limited the distribution of coniferous trees in rights-of-way. Considering the positive effect of large evergreens on overall urban forest diversity and reductions in storm water runoff (discussed below), the City should revisit street tree specifications to allow appropriate planting of select coniferous and broadleaf evergreen tree species such as Live Oak (*Quercus chrysolepis*), Oregon Myrtle (*Umbellularia californica*), Valley Pine (*Pinus ponderosa* – Willamette Valley selections), Incense Cedar (*Calocedrus decurrens*), and Atlas and Deodar Cedar (*Cedrus* spp.). Several of the above species should be acceptable in planting sites as narrow as 10 feet. Though deciduous conifers are already a rare functional type limited primarily to Dawn Redwood (*Metasequoia glyptostroboides*) and Bald Cypress (*Taxodium distichum*), increasing these trees would provide aesthetic and functional diversity. Future priority should be given to planting coniferous species to increase diversity. Table 5 illustrates the dramatic contrast in abundance of deciduous and evergreen trees.

Functional Type	Number of Trees	Percentage
Broadleaf Deciduous	3,252	95.9%
Coniferous Evergreen	129	3.7%
Broadleaf Evergreen	9	0.2%
Deciduous Conifer	7	0.2%

Table 5: Distribution by Functional Type in JWN

ECONOMIC VALUATION

Quantifying urban forest benefits and their dollar value strengthens the case for increasing resources dedicated to street tree management. iTree Streets, a tool developed by the USDA Forest Service and industry partners, uses a scientifically peer-reviewed method of calculating the economic contribution of urban street trees and their replacement value based on tree data and regional factors such as weather and cost of utilities. A large part of urban trees' economic contribution lies in their ability to clean air, slow storm water, enhance property and aesthetic values, and provide cooling during the summer – all things which would otherwise require costly mitigation. In general, larger trees have greater benefits and replacement values than smaller trees. Jefferson Westside Neighborhood's closed-canopy streets therefore represent large contributions in both benefits and replacement value. The actual dollar values attributed to JWN's street trees can be seen in Tables 6 and 7 and Chart 3.

Environmental and Social Benefits

Urban trees such as those along rights-of-way in the JWN provide numerous environmental benefits. These benefits, which are often referred to as ecosystem services, include carbon sequestration, reduction in peak storm water flows, filtering of stormwater runoff, improved air quality, and reduction of summertime temperatures. These services are the result of functioning ecosystems that benefit all the inhabitants of those ecosystems, not just humans. Urban forests can

Annual Benefits of JWN Trees	Value	
Energy Savings	$	11,485
CO_2 Sequestration	$	1,983
Air Quality	$	5,828
Storm water	$	81,133
Aesthetic/Other	$	184,803
Total Annual Benefits	**$**	**285,232**

Table 6: Annual Environmental Benefits

serve as a primary source of useable habitat for numerous animal species. Other benefits such as aesthetics, energy conservation, stress reduction, human health and wellbeing, and increased property values are also an important and sizable economic contribution of the urban forest. Though presented here as neighborhood-wide figures, different tree species often make substantially different contributions within and across categories. For example, evergreen trees score far better than deciduous trees in storm water interception in our climate, since they have needles or leaves all winter while the deciduous tree species are bare.

Replacement Value

Replacement value reflects the approximate cost of replacement for each tree, should it be removed for some reason. Tree replacement value for each tree was calculated using iTree Streets software based on species rating, size, location, and condition. As shown in Table 7, the total replacement value of the Jefferson Westside Neighborhood's right-of-way trees is estimated at $16,678,879.

DBH Class	# of Trees	Avg. replacement value per tree	Total Replacement Value
0-3"	611	$ 156	$ 95,505
3-6"	491	$ 543	$ 266,388
6-12"	1007	$ 1,892	$ 1,904,813
12-18"	678	$ 4,968	$ 3,368,145
18-24"	262	$ 9,669	$ 2,533,408
24-30"	147	$ 16,273	$ 2,392,132
30-36"	111	$ 24,680	$ 2,739,524
36-42"	54	$ 31,796	$ 1,716,966
>42"	54	$ 30,778	$ 1,661,999
Total			**$ 16,678,879**

Table 7: Replacement Value of JWN Street Trees

The greatest replacement value is represented by size classes of trees between about 12" and 36" in diameter (DBH), which reflects a combination of the total number of trees in each DBH class as well as the value per individual tree (Chart 3). In general, larger DBH classes are much more valuable than smaller classes. The JWN inventory demonstrates this concept: though only 11% of total trees fall into size classes above 24" in diameter, that same 11% of trees represents over 50% of the total replacement value.

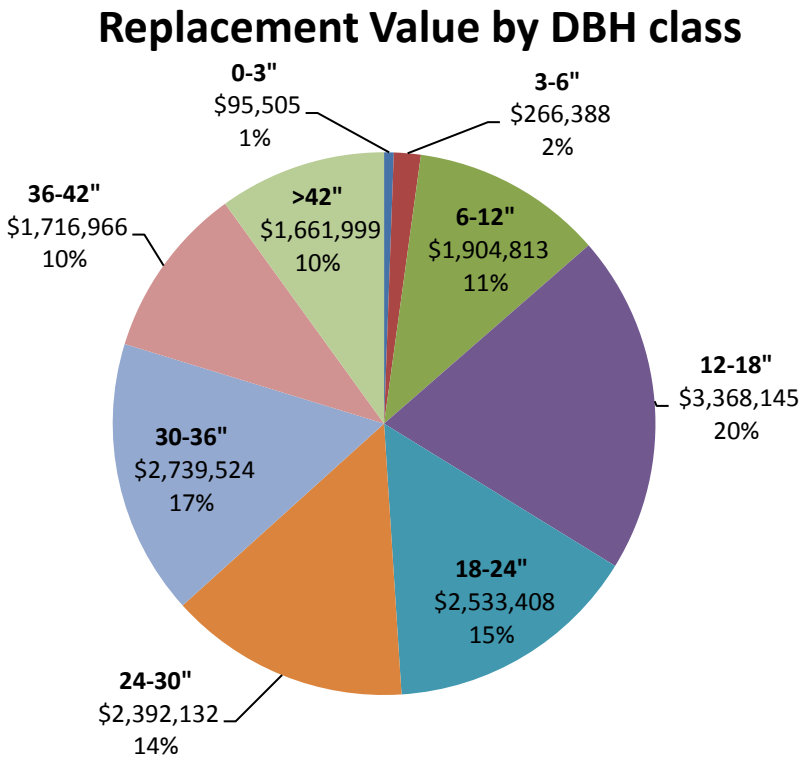


Chart 3: Replacement Value and Percent of total replacement value by DBH class

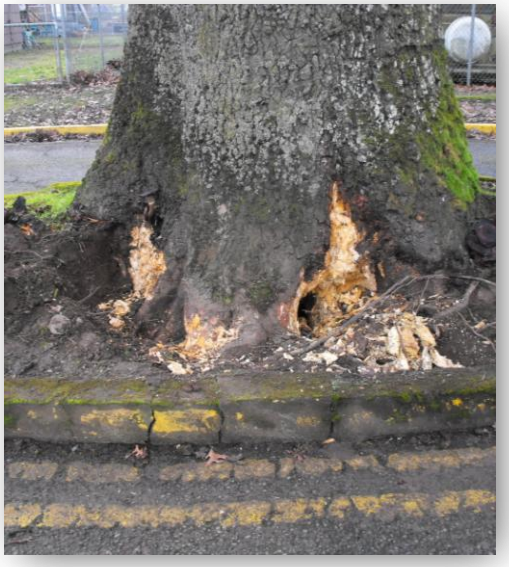
CURRENT ISSUES:

Tree and Planting Site Size

Currently, there are several types of planting sites with inherent characteristics that restrict the selection of appropriate trees for those sites. Small growing spaces or overhead conflicts such as power lines, structures, or competing trees dictate that smaller understory species be selected for these sites. Unfortunately, many of these sites are planted with large tree species that will eventually outgrow their spaces, causing damage to sidewalks and curbs and/or needing continuous pruning. Crowding from other trees can lead to abnormal growth, disease, and decreased ability to withstand high winds or snow loads. These trees will eventually need to be replaced, and the City is working to carry this out with full consideration for existing trees and the neighborhood residents.

Potential Removals

The maintenance of Eugene's trees is a complex and evolving process. The City regularly inspects, prunes, removes, and plants trees as needed to maintain the health and longevity of our urban forest and the safety of those living within it. Enhancing the size, diversity, and overall well-being of this valuable resource is a major goal of the City's urban forestry staff. Sometimes trees must be removed due to disease, hazardous conditions, or conflicts with other elements of their surroundings. These removals may seem drastic at times, but the City's long-term objective of maximizing a healthy population of trees remains a high priority. The City actively seeks alternatives to removal, when appropriate, by identifying possible modifications of infrastructure projects such as re-routing sidewalks or reducing pavement depth in an effort to preserve large, healthy legacy trees.



Severe decay in a mature black oak (*Quercus kelloggii*)

Problematic Trees and Unapproved Species

One purpose of this inventory report is to identify any trees that are potential hazards, are diseased or dying, or are in conflict with their surroundings in some way. By identifying these hazards and removing defective and struggling trees, they can be replaced with trees that are best suited to a particular site and have the best chance of long-term success. Trees are replaced when there are conflicts with overhead power lines, when their health is compromised by disease, or when there is a potential hazard to human safety or property. Though considered undesirable, existing unapproved tree species will not be removed unless they create a hazard or maintenance issue. Removal and replacement of problem trees allow us to avoid future problems, reduce maintenance costs, and maximize the vitality and longevity of a mature urban forest. The trees listed in Table 8 (next page) are no longer approved for use as street trees in Eugene.

Unapproved Species	Botanical Name	Reason for Exclusion
Tree of Heaven	*Ailanthus altissima*	Highly invasive, aggressive rooting that damages infrastructure
English Hawthorn	*Crataegus laevigata*	Disease-prone, unsightly, thorn-covered limbs
Thundercloud Plum	*Prunus cerasifera* 'Thundercloud'	High-maintenance, short-lived, prone to failure
Norway Maple	*Acer platanoides*	Invasive, tends to displace big-leaf maples
Sweet Gum	*Liquidambar styraciflua*	Aggressive rooting that damages infrastructure, prone to sudden limb drop

Table 8: Unapproved Species

DISTRIBUTION BY CONDITION

Volunteers were asked to rate the condition of each tree into one of four categories (Good, Fair, Poor, and Dead) based on the presence of structural defects and the overall appearance of health and vitality. **Good trees** are expected to provide more than 10 years of future benefits to the urban community, while **Fair trees** are expected to provide at least five to ten years of benefits. **Poor trees** are expected to provide no more than five years of benefits, and **Dead trees** are those that cannot provide benefits (beyond serving as habitat). Table 9 indicates the percentage of trees in each condition.

Codominant stems, bark inclusions, and mechanical damage.

Condition	Number of Trees	Percent of Total	Predominant Trees
Good	1,482	43.6%	maple, ash, oak, sweet gum
Fair	1,718	50.6%	maple, ash, prunus, oak, hawthorn
Poor	192	5.5%	prunus, maple, hawthorn
Dead	11	0.4%	maple, hawthorn

Table 9: Tree quantity by condition class

The relatively good condition of trees in this neighborhood is encouraging. This condition can be seen graphically in the condition map (Appendix C).

Stocking Level

The stocking level of the City's trees is the percentage of potential planting sites in rights-of-way that are currently occupied by trees. The Jefferson Westside Neighborhood's rights-of-way are well-populated, with an overall stocking level of about 85%. It is not surprising that the stocking level is lower under primary electrical power lines since these locations require more care in tree selection and in continued maintenance. As seen in Table 10 , stocking rates are similar in planting strips less than and greater than 8 feet wide. An eightfoot width is a reasonable dividing line between sites that can support large-growing tree species from those that should be limited to smaller-stature tree species. Since sites with existing stumps can often be converted to planting sites after grinding, these locations are included along with planting sites in the charts below. The potential planting sites map (Appendix D) illustrates current stumps and unplanted sites without overhead high-voltage lines. This map serves as a graphic aid in prioritization of future planting. A detailed breakdown of stocking sites is attached in Appendix E.

Planting Strip Width	Existing Trees	Stumps and Vacant Sites	Total Spaces	Stocking Level
Less than 8 feet	1,516	266	1,782	85.1%
Greater than 8 feet	1,881	349	2,230	84.3%
Totals	3,397	615	4,012	84.7%

Table 10: Stocking Levels by planting site width

Right Tree, Right Place

Appropriate tree selection, placement, and planting are vital to ensure longevity, safety, and functionality while minimizing maintenance costs. Well-sited trees are more likely to thrive and remain healthy into maturity and beyond. Large trees in small spaces are under greater stress as they mature and come into conflict with their immediate surroundings, potentially causing infrastructure damage, thus requiring intensive maintenance that can make them more susceptible to disease. When small trees are planted in areas that could have supported much larger trees, they constrain the potential benefits of the urban forest. It is important to note that planter width does not tell the whole story; soil type, volume and condition can vary widely in an urban environment regardless of the planter size. Still, planter width is a reasonable predictor of root and trunk space in Eugene. Sites with overhead primary electric lines should generally not be planted with large-growing tree species. City urban forestry staff estimated ideal planting strip widths for tree species in the JWN neighborhood (Appendix F) based on species, neighborhood soils, and years of experience working in Eugene's urban forest. Tree wells and planter widths less than 4 feet are probably too small for any species to thrive due to insufficient soil volume and inadequate water infiltration. See Tables 11 and 12 for a summation of planter width and tree size.

Planter Width	Oversized Trees
<4'	112
4-6'	123
6-8'	350
8-10'	149
Overhead primary electric lines	410
total	**1,144 (33%)**

Planter Width	Undersized Trees
10-19'	47
>=20'	8
total	**55**

Tables 11 & 12: Mature tree sizes relative to planter width size

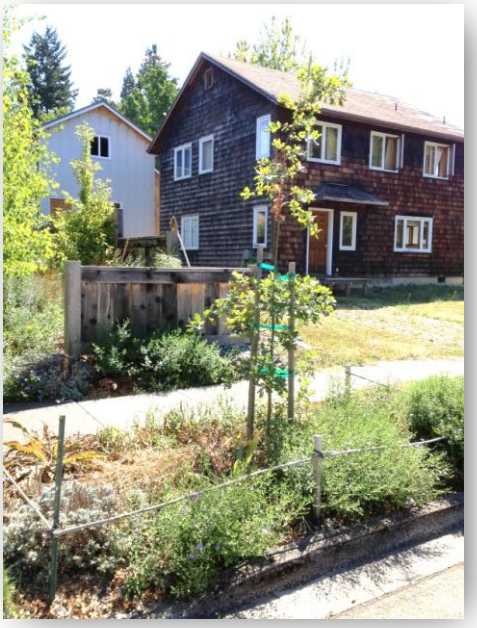
Sidewalk Conflicts

A growing oak tree in a narrow planting strip causing sidewalk damage

As trees grow, their size may begin to create problems with City infrastructure. Sidewalks and curbs may be cracked, broken, lifted, moved or otherwise damaged for a variety of reasons, including tree species with aggressive surface roots (such as sweet gum), trees planted in strips too narrow to accommodate normal plant growth, and trees planted in heavy clay/compacted soils. One potential remedy involves pruning the roots of a tree by cutting them along the edge of the pavement. This may prevent further sidewalk damage, but it can also undermine the health and stability of the tree and hasten its demise. Root pruning is most effective when performed on smaller roots at frequent intervals. Currently, there are 123 recorded tree-sidewalk conflicts in the JWN, which represent less than 4% of total trees. The City is actively exploring various technologies for reducing sidewalk conflicts including alternative sidewalk joint systems, rubberized sidewalks, suspended pavement systems, and root barriers. As repairs are made throughout the city, this new technology will be promoted and alternative sidewalk designs will be explored to create more planting sites appropriate for larger trees.

Future Priorities and Recommendations

This inventory update establishes a baseline to monitor change and manage tree populations more effectively.
It has highlighted several priorities for future work:



A young oak planted in the right-of-way

PLANTING

- Large planting sites without overhead electrical lines should be considered for large trees and tall conifers to maximize environmental benefits.
- New plantings should continue to increase species diversity. Consideration of suitable conifers such as pines, firs, cedars, and spruces will contribute to overall diversity while addressing the current lack of coniferous evergreens.
- Since maples account for the largest percentage of the JWN street tree population, planting of additional non-native maples should be curtailed. Instead, other hardwoods with similar traits, such as oak, birch, catalpa, elm, and walnut should be considered.
- Select appropriate trees for the unique situation of each planting site, prioritizing large-canopy trees for more open spaces and sufficient planter widths, and smaller trees beneath overhead power lines and in smaller planting spaces. Restrict sites with overhead power lines to small trees or to slow-growing larger trees that will tolerate directional pruning well (i.e., species with wood that is decay-resistant and strong enough to support large, horizontal scaffold branches).

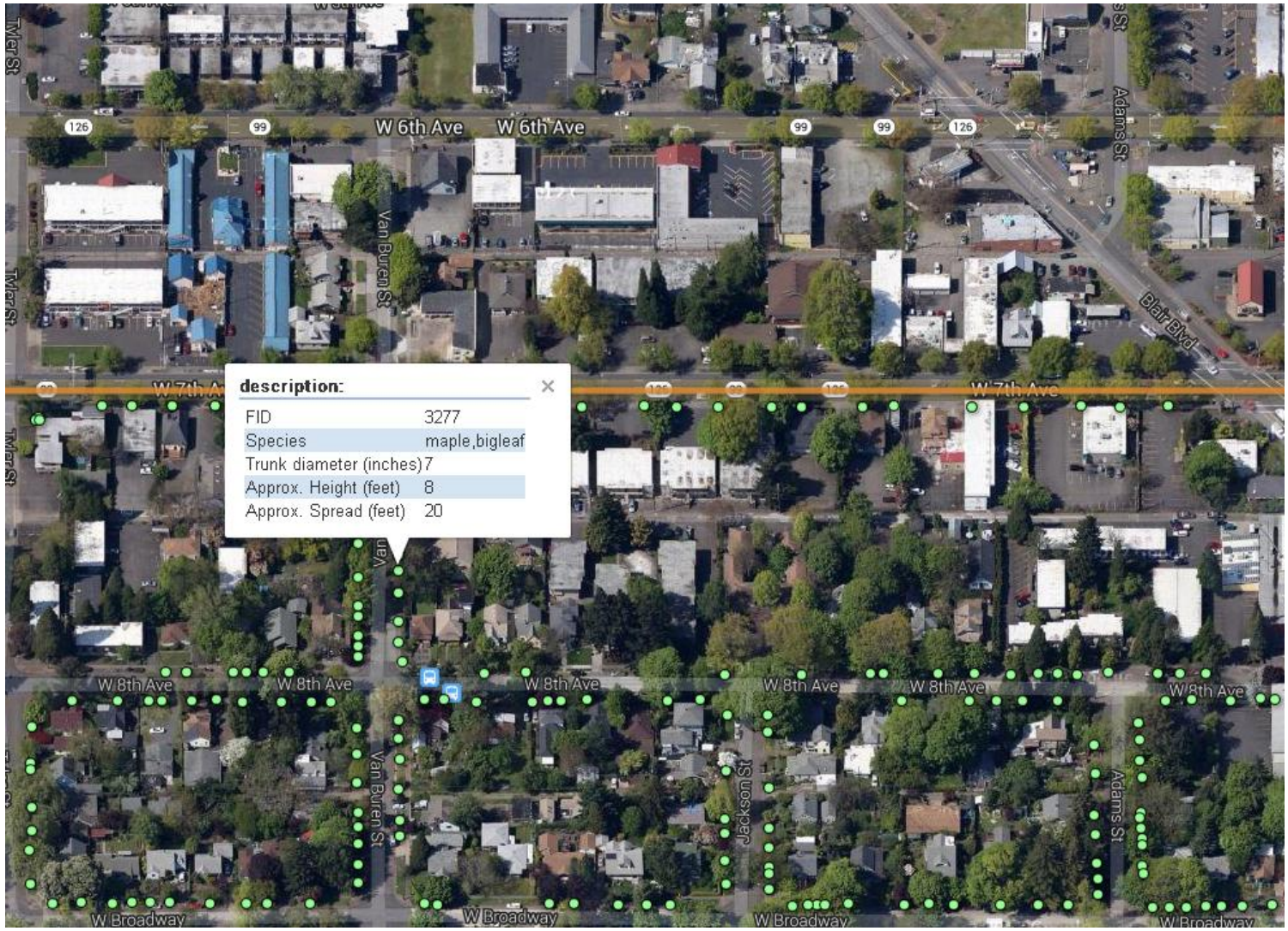
MAINTENANCE

- Encourage early structural pruning to ensure establishment of healthy, well-formed crowns.
- Monitor mature trees for pruning and other health needs to ensure longevity, safety, and compatibility with their surroundings.
- Identify strategies for resolving infrastructure conflicts to protect and preserve large healthy trees by recommending adjustment of sidewalks or other infrastructure as an alternative to tree removal.
- Explore new technologies and materials to reduce infrastructure and sidewalk conflicts (such as root pruning, root barriers, hinging sidewalk joints, non-rigid panels, and soil cells/suspended sidewalks).

EDUCATION/OUTREACH

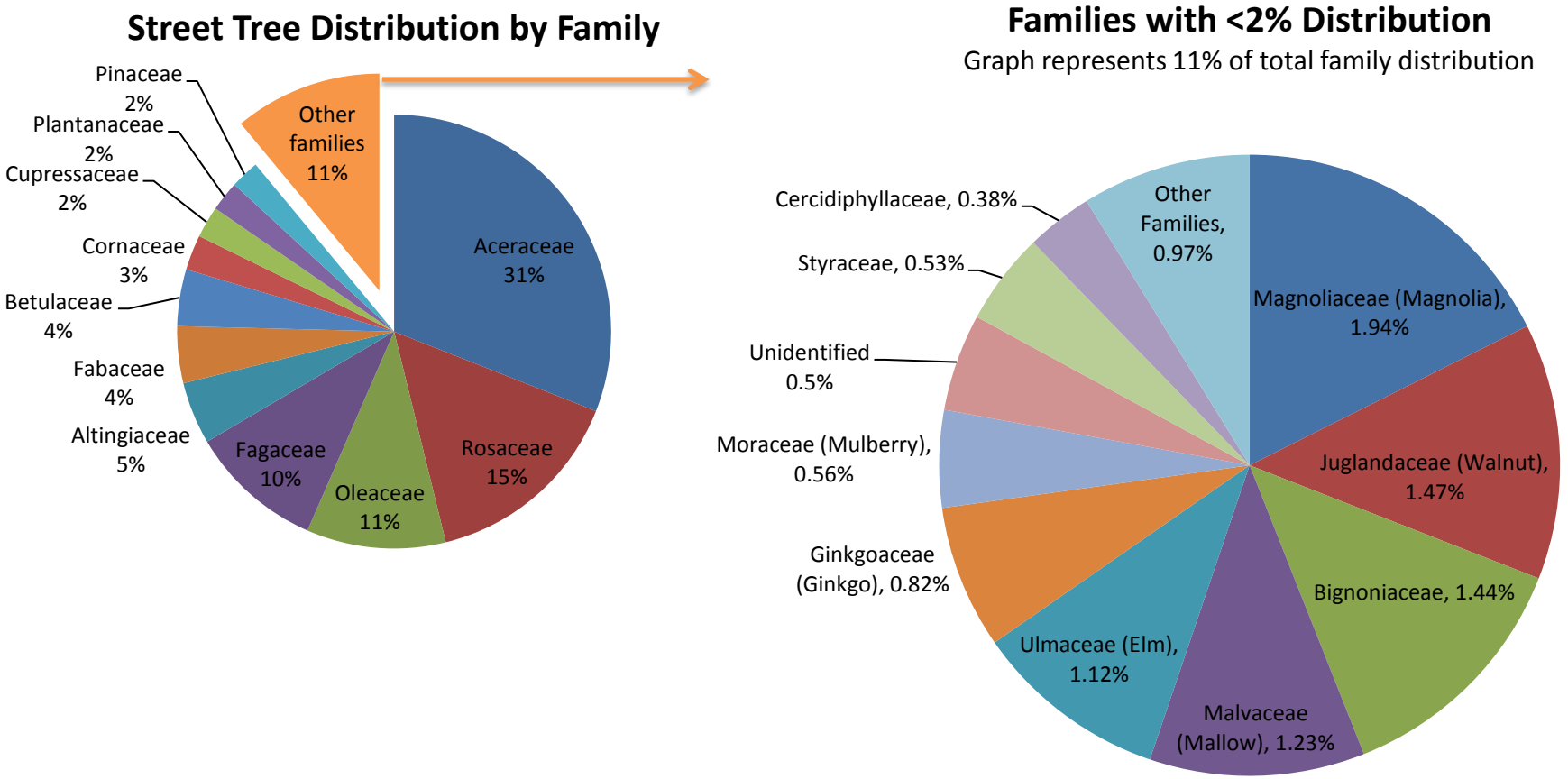
- Avoid planting any unapproved species and discourage homeowners and contractors from doing so.
- Educate property owners about proper care and watering during establishment period.
- Encourage replacement of underperforming or constrained trees in poor condition with more appropriately sized, higher-functioning trees.
- Promote the importance and benefits of large, mature trees in the community.
- Continue to engage neighborhood residents, Friends of Trees, Eugene Park Stewards, and other community groups and citizens in order to build collaboration with tree monitoring, data collection, tree planting, and tree maintenance efforts.

APPENDIX A **Bird's Eye View of JWN Tree Canopy**



This screenshot from the interactive Google map shows Jefferson Westside Neighborhood's street tree canopy from an aerial view. Users can click on the green dots to view individual tree details. The orange line indicates the neighborhood boundary line. Map available online: JWN Google Fusion Table *You can turn on the 'Satellite' View by clicking the box in the upper right of the map window*

APPENDIX B


Street Tree Distribution by Family
Pinaceae 2%
Plantanaceae 2%
Cupressaceae 2%
Cornaceae 3%
Betulaceae 4%
Fabaceae 4%
Altingiaceae 5%
Fagaceae 10%
Oleaceae 11%
Rosaceae 15%
Aceraceae 31%
Other families 11%
Families with <2% Distribution
Graph represents 11% of total family distribution
Cercidiphyllaceae, 0.38%
Styraceae, 0.53%
Unidentified 0.5%
Moraceae (Mulberry), 0.56%
Ginkgoaceae (Ginkgo), 0.82%
Ulmaceae (Elm), 1.12%
Malvaceae (Mallow), 1.23%
Bignoniaceae, 1.44%
Juglandaceae (Walnut), 1.47%
Magnoliaceae (Magnolia), 1.94%
Other Families, 0.97%

APPENDIX C

Condition of Existing Trees

APPENDIX D

Potential Planting Sites

APPENDIX E

Table E1: Sites With Overhead Primary Electric Lines

Planting Strip Width	Existing Trees	Stumps	Vacant Planting Sites	Total Spaces	Stocking Level
Under 6 feet	54	1	3	58	93.1%
6-7 feet	141	4	43	188	75.0%
8-9 feet	298	14	51	363	82.1%
10-19 feet	50	0	25	75	66.7%
Over 19 feet	11	0	7	18	61.1%
Totals	554	19	129	702	78.9%

Table E2: Sites Without Overhead Primary Electric Lines

Planting Strip Width	Existing Trees	Stumps	Vacant Planting Sites	Total Spaces	Stocking Level
Under 6 feet	276	5	31	312	88.5%
6-7 feet	1,045	20	159	1,224	85.4%
8-9 feet	1,342	67	140	1,549	86.6%
10-19 feet	121	4	17	142	85.2%
Over 19 feet	59	3	21	83	71.1%
Totals	2,843	99	368	3,310	85.9%

Table E3: All Tree Sites

Planting Strip Width	Existing Trees	Stumps	Vacant Planting Sites	Total Spaces	Stocking Level
Under 6 feet	330	6	34	370	89.2%
6-7 feet	1,190	24	202	1,412	84.0%
8-9 feet	1,644	81	191	1,912	85.8%
10-19 feet	171	4	42	217	78.8%
Over 19 feet	70	3	28	101	69.3%
Totals	3,405	118	497	4,012	84.7%

APPENDIX F

Species and recommended/desirable minimum widths			
> 10'	**8-10'**	**6-8'**	**4-6'**
Abies grandis	*Acer macrophyllum*	*Acer platanoides*	*Acer campestre*
Cedrus atlantica	*Acer rubrum*	*Acer platanoides* (columnar)	*Acer ginnala*
Cedrus deodara	*Acer saccharinum*	*Acer platanoides 'Crimson King'*	*Acer palmatum*
Liquidambar styraciflua	*Ailanthus altissima*	*Acer rubrum 'Autumn Flame'*	*Acer rubrum* (columnar)
Liriodendron tulipifera	*Calocedrus decurrens*	*Acer saccharum*	*Cornus species*
Metasequoia glyptostroboides	*Catalpa speciosa*	*Betula papyrifera*	*Crataegus species*
Picea abies	*Juglans nigra*	*Betula pendula*	*Fraxinus oxycarpa*
Picea pungens	*Juglans regia*	*Carpinus betulus*	*Nyssa sylvatica*
Picea sitchensis	*Platanus acerifolia*	*Carpinus caroliniana*	
Populus trichocarpa	*Platanus acerifolia 'Bloodgood'*	*Fraxinus americana 'Autumn Purple'*	
Pseudotsuga menziesii	*Populus trichocarpa*	*Fraxinus latifolia*	
Quercus palustris	*Quercus acutissima*	*Fraxinus pennsylvanica*	
Sequoia sempervirens	*Quercus coccinea*	*Fraxinus species*	
Sequoiadendron giganteum	*Quercus ellipsoides*	*Gingko biloba*	
Ulmus americana	*Quercus frainetto*	*Gleditsia triacanthos*	
	Quercus macrocarpa	*Quercus garryana*	
	Quercus phellos	*Quercus robur* (columnar)	
	Quercus robur		
	Quercus rubra		
	Thuja plicata		

APPENDIX G

Methods

The tree inventory update data were collected in person by trained volunteers and City staff, evaluating each tree and recording attributes on paper or in a PDA using ArcPad GIS software. Data were then either manually entered into ArcView GIS or simply imported from the PDAs. The City hopes to employ digital technologies such as mobile PDAs or web-based applications for smartphones or tablets rather than paper forms in the future. When necessary, questionable or erroneous data were verified using digital (Google Street View) or field verification. With the use of a TreeWorks plug-in for ESRI ArcView, at least 6 data points for each tree were recorded (species, location, DBH, width of grow-space, presence of utilities, and condition rating). Once the inventory collection was complete, the data were exported into an Excel spreadsheet. After sorting, filtering, subtotaling and other processing, the summary data were derived, and tables and graphs generated. TreeWorks data were also exported in STRATUM format for entry into iTree Streets, and analyses were conducted in Microsoft Access. DBH classes were generated using the same classification as iTree Streets. Though noted as 0-3”, 3-6”, 6-12” etc. for legibility, actual classes are separated as 0-3”, 3.1”-6”, 6.1”-12”, etc. GIS maps were generated from ESRI ArcView. ArcGIS data were exported as KML files then uploaded to Google Fusion Tables to create the JWN interactive inventory map.