

City of Sunnyvale Urban Forest Management Plan - 2014

Prepared for:

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City of Sunnyvale, CA

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Table of Contents

| | |
|---|---------------------------------------|
| Acknowledgements | 4 |
| Executive Summary | 5 |
| Vision..... | 8 |
| 1. Introduction..... | 8 |
| 1.1. Purpose of this plan..... | 8 |
| 1.2. Scope of the plan..... | 8 |
| 1.3. Relationship of plan to other planning documents | 8 |
| 1.4. Benefits provided by the urban forest..... | 8 |
| 2. Strategic Plan | 13 |
| 2.1. Contribution of trees to the community | 13 |
| 2.2. Tree and forest health | 17 |
| 2.3. Management of the urban forest | 19 |
| 3. Status of Sunnyvale's Urban Forest..... | Error! Bookmark not defined.23 |
| 3.1. Historical context..... | 23 |
| 3.1.1. Replacement of the native forest..... | 23 |
| 3.1.2. Development of the urban forest..... | 24 |
| Street tree program..... | 29 |
| 3.2. Environmental context..... | 30 |
| 3.2.1. Climate | 30 |
| Rainfall and water demand | 30 |
| Reclaimed water for irrigation | 31 |
| 3.2.2. Soils..... | 31 |
| Basin soils | 32 |
| Recent alluvial fan and floodplain soils..... | 32 |
| Older alluvial fan soils | 33 |
| Other soil units | 33 |
| 3.3. Tree resources | 36 |
| 3.3.1. City-wide canopy cover | 36 |
| Tree population estimates | 39 |
| Number of privately maintained street trees | 39 |
| Potential canopy cover goals for Sunnyvale | 40 |
| 3.3.2 City maintained street trees | 45 |
| City-maintained street trees | 45 |
| Vacant planting sites | 46 |
| Species diversity | 46 |
| Changes in species selection | 49 |
| Size of city maintained street trees | 50 |
| Damage to city street trees | 554 |
| 3.3.3. Park trees..... | 554 |
| 3.3.4. Heritage trees | 58 |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| | |
|---|-----------|
| 4. Status of Current Tree Management | 59 |
| 4.1. Urban forest management responsibilities..... | 59 |
| 4.2. Street tree management by Street Tree Services | 61 |
| 4.2.1. Pruning..... | 61 |
| 4.2.2. Tree removal and planting | 63 |
| Inspection of new plantings | 63 |
| Tree nursery | 64 |
| 4.2.3. Other program activities | 64 |
| Tree inventory maintenance..... | 65 |
| 4.2.4. Budget | 66 |
| 4.3. Concrete maintenance..... | 67 |
| 4.3.1. Current status | 67 |
| 4.4. Park tree management..... | 70 |
| 4.4.1. Program structure..... | 70 |
| 4.4.2. Tree pruning | 71 |
| 4.4.3. Tree removal and planting | 71 |
| 4.4.4. Tree inventory | 71 |
| 4.4.5. Budget | 71 |
| 4.5. Existing ordinances, policies, and plans related to the urban forest | 71 |
| 4.5.1. City of Sunnyvale General Plan..... | 72 |
| 4.5.2. Sunnyvale Municipal Code | 72 |
| Chapter 13.16. City trees | 72 |
| Chapter 19.37. Landscaping, irrigation, and usable open space..... | 73 |
| Chapter 19.38. Required Facilities..... | 73 |
| Chapter 19.94. Tree preservation..... | 74 |
| Chapter 19.96. Heritage preservation | 75 |
| California Solar Shade Control Act | 75 |
| 5. Community | 76 |
| 5.1. Values | 76 |
| 5.2. Demographics | 76 |
| 5.2.1. Social characteristics..... | 77 |
| 5.2.2. Economics | 77 |
| 5.2.3. Housing | 78 |
| 5.3. Nonprofit volunteer urban forest support group | 78 |
| 5.4. Tree management on private properties..... | 78 |
| 6. Resource Data..... | |
| 6.1. Soil types..... | 80 |
| 6.2. Canopy cover assessment | 83 |
| 6.3. Tree inventory tabulation..... | 84 |
| 6.4. List of trees whose numbers are being increased | 87 |
| 6.5. List of trees whose numbers are being decreased | 88 |
| 6.6. Street tree species composition by block face | 92 |
| 7. Planning documents, policies and city code related to trees..... | 90 |

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Executive Summary

The overall goal of the plan is to help sustain, protect, and enhance the urban forest in the City of Sunnyvale in order to maximize the many benefits that it provides to city residents. The urban forest is comprised of three main groups of trees including trees located on city-owned property including parks, trees located on private property in the public right-of-way (ROW) and trees located on private property outside of the ROW. On a typical street (although there may be exceptions in particular neighborhoods), the private property extends to the center line of the street. The ROW is an easement that extends 31 feet back from the center line of the street. Common improvements within the ROW include street surfacing, street lighting, sewer laterals, curbs, sidewalks and street trees. Although trees planted on private property within the ROW are the property of the property owner, the City regulates their maintenance, removal and planting and provides limited maintenance services for public benefit per Sunnyvale Municipal Code (SVMC) 13.16-City Trees. This plan addresses all major segments of Sunnyvale's urban forest, but is largely focused on the City's Street Tree Program, which manages the street trees located in the public right-of-way. The major sections of the plan are described below.

1. Introduction - benefits of the urban forest. This section discusses the benefits that trees provide in an urban environment. Important benefits for Sunnyvale include:

- Trees save energy by shading buildings and paved surfaces.
- Trees improve air quality by filtering airborne pollutants and lowering temperatures.
- Trees increase property values.
- Trees reduce storm water runoff by holding water on their stems and branches.

2. Strategic plan for Sunnyvale's urban forest. This section discusses issues and trends that are affecting Sunnyvale's urban forest and presents goals for managing and enhancing Sunnyvale's tree resources. Objectives and actions for managing and enhancing Sunnyvale's tree resources are provided for each goal. Major goals of the plan include:

- Increase tree canopy cover to maximize ecosystem benefits provided by the urban forest.
- Choose and locate new trees in all vacant planting spaces to maximize tree-related benefits and minimize maintenance costs
- Develop an urban forest canopy that is stable over the long term.
- Maintain city trees appropriately to maximize benefits and minimize hazard, nuisance, hardscape damage, and maintenance costs.
- Facilitate collaboration among City departments related to issues and projects involving trees.
- Foster community support for maintaining and improving Sunnyvale's urban forest.
- Encourage proper tree management on private property.

An implementation plan should be developed in the future to show how the actions listed in the strategic plan will be carried out. In addition, a monitoring plan should be developed that will enable the City to track its progress toward the plan's goals. The implementation plan should include priority rankings for specific actions and a timetable for implementation. It should also

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

indicate sources of funding and identify personnel responsible for administering and carrying out actions.

3. The current status of Sunnyvale's urban forest. This section describes the extent and condition of the urban forest. It includes estimates of overall tree canopy cover and the number of trees in the city. Results of an analysis of the street tree inventory maintained by Street Tree Services are presented, including the net annual benefits provided by these trees. Major findings include:

- The Street Tree Inventory contains 41,637 inventoried tree planting spaces of which 37,100 are planted leaving 11% vacant.
- Almost all of Sunnyvale's urban forest consists of trees planted within the past 50 to 60 years.
- Tree canopy covers approximately 18% of the land area of Sunnyvale.
- City managed street trees are an important component of tree canopy in both residential and commercial areas.
- The city-managed population of trees are primarily medium or large statured. About two-thirds of the city managed street trees have reached their mature size.
- As the population of city managed street trees continues to age, more trees will need to be replaced as they reach the end of their useful lives.
- The annual net benefit of city maintained street trees as calculated by iTree software (developed by the US Forest Service and others) is \$1,079,336 in 2008 (in which year?)

4. The current management of Sunnyvale's urban forest. This section discusses the existing policies, issues, and programs that affect Sunnyvale's urban forest. Major findings include:

- Privately managed trees account for about 80% of the tree canopy citywide, but only 50% of trees located between fronts of houses/buildings and streets.
- Street Tree Services is responsible for 88% of city-managed trees. The Parks program manages the other 12% or 5,000 trees in parks and other open spaces.
- Street Tree Services and Concrete Maintenance have had well-organized management programs with clear objectives
- Due to budget reductions, street trees regular preventative maintenance pruning intervals were increased from 4 to 12 years over time and eventually ceased altogether in FY 2011-12
- Beginning FY 2011-12 the Public Works Dept. was reorganized. Parks Division was moved from Community Services into Public Works. The Street Tree Services assigned to the Parks while the Concrete Maintenance was assigned to Public Works Operations (Street Maintenance)
- FY 2012-13 Council approved funding for supplemental contracted street tree maintenance with primary emphasis on routine structural pruning with the goal to

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

restore at least a seven year average pruning cycle for all trees in the street tree inventory.

- Although street tree planting outpaced tree removal (FY 2008-09 data), plantable vacant sites are likely to remain empty for more than a decade at current planting and removal rates.
- Over 20,000 trees are planted in parkway strips less than 5.5 ft. wide. Innovative techniques are being used to manage damage by tree roots to sidewalks, gutters, and curbs, and maintain Sunnyvale's investment in street trees.
- The Street Trees program is managed by certified arborists. This safeguards the City's investment in street trees and maintains affected trees in a safe condition.

5. Community. This section discusses the value of trees to the community. Major findings include.

- The urban forest is considered by city government to be an important contributor to the attractiveness and livability of Sunnyvale.
- There is strong interest on the part of some Sunnyvale residents in forming a citizens group to advocate and care for the urban forest.
- The City will need to maintain and develop an ongoing program of outreach and education residents to ensure the community has the information they need to make good tree care decisions,

6. Resource Information.

- Status of Sunnyvale's Urban Forest.
- Status of current tree management.
- Community information.
- Resources data.
- Planning documents, policies and city code related to trees

7. Planning documents, policies and city code related to trees.

A manual that includes the city's technical specifications and standards for urban forest management is being developed separately as a supplement to the plan.

Vision

Sunnyvale's urban forest is an attractive, safe and environmentally sustainable mix of species that are predominantly drought tolerant. All available planting spots along streets are filled with trees that are adapted to their sites and provide as many benefits as possible to residents. Trees are recognized by the City and its citizens as an essential environmental, economic, and community asset. Therefore, the City and its residents use current best management practices to maintain their trees, avoid removing healthy trees, and work to accommodate existing trees. Sunnyvale has an active community nonprofit group that supports the urban forest and works cooperatively with the city tree program and other community nonprofit groups in the region.

1. Introduction

1.1. Purpose of this plan

Many different City planning and management actions, especially those that occur during redevelopment, have a large impact on the character and condition of the urban forest. Urban forest planning and management actions taken over the past decades, as well as those made in the next decades, will shape the future of Sunnyvale's urban forest for the next half-century or more.

A thriving and well-maintained urban forest provides a wide variety of benefits to the community. To help ensure that Sunnyvale's urban forest will continue to prosper, the City has developed this long-term plan to account for the needs of trees in the urban environment. Tree growth and tree decline are typically slow processes. To develop and maintain desired urban forest conditions, necessary management actions need to be executed in a timely manner. This urban forest plan provides an overall strategy that will help the City maximize the benefits the urban forest will provide in the years to come.

1.2. Scope of the plan

This plan applies to all trees in the City of Sunnyvale and has a planning horizon of 20 years. The plan emphasizes street trees managed by the city.

1.3. Relationship of plan to other planning documents

Sunnyvale consolidated its General Plan in 2011 and is in the process of updating the land use and transportation section. This Urban Forest Management Plan will be adopted to support and further the goals of the General Plan.

1.4. Benefits provided by the urban forest

The Sunnyvale General Plan recognizes the importance of the urban forest to the attractiveness of Sunnyvale. A positive effect on property values is one of the most important economic benefits of the urban forest. However, trees provide many other important benefits in the urban

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

environment. These benefits make trees a key element of urban infrastructure. Major benefits of the urban forest are summarized below.

Trees provide important urban services

- Tree canopies intercept rainfall, moderating storm water runoff and reducing the amount of pollutants that wash off buildings and paved surfaces into surface water and storm drains (Xiao et al, 1998, Xiao and McPherson 2003, Geiger 2003).
- Trees planted along roadways can have a “traffic calming” effect, which reduces driving speeds by visually narrowing the road (Otak, Inc. 2002).
- Trees planted between vehicle lanes and sidewalks provide a physical barrier to improve pedestrian safety.
- Tree shade over pavement slows down pavement deterioration by lowering the street surface temperature and reducing volatilization of the oil binder (McPherson et al 1999, McPherson and Muchnick 2005).

Trees help save energy

- Trees in residential yards that shade western and eastern facing windows, roofs, and walls can reduce energy needed for cooling by as much as 34% (Simpson and McPherson 1996).
- Trees help reduce the urban heat island effect, a phenomenon that makes urban areas significantly hotter than surrounding undeveloped land (<http://www.epa.gov/heatisland/>).
- Trees and other vegetation reduce summer temperatures through direct shading of surfaces and transpiration (the evaporative loss of water from plant leaves). By helping to reduce the urban heat island effect and maintain cooler summer temperatures, trees reduce energy needed for cooling.
- Trees serve as windbreaks, which helps save energy by reducing the amount of outside air that infiltrates into heated or cooled building interiors (Heisler 1986).
- Trees shading cars in parking lots keep internal temperatures down avoiding the need for the initial use of air conditioning, thus saving fuel.

Trees improve air quality

- Trees improve ambient air quality by directly removing gaseous air pollutants and particulates from the air (Scott et al, 1998).
- Although the majority of human-caused smog precursors come from moving vehicles, parked cars emit volatile hydrocarbons into the atmosphere that react to form smog. Cars parked in shade are much cooler and release fewer volatile hydrocarbons. Cooler air temperatures from tree shade also result in lower nitrogen oxide emissions when parked vehicles are started (Scott et al, 1999).

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- As trees reduce the urban heat island effect, they also reduce the formation of photochemical smog because the chemical reactions that form smog are favored by higher temperatures (<http://eetd.lbl.gov/HeatIsland/AirQuality/>).

Trees provide direct economic benefits

- Many studies show that trees increase residential property values. People pay more for homes with attractive trees, that are in neighborhoods with attractive trees, or that are near open space areas with trees (Anderson and Cordell 1988, Wolf 1998b).
- A study by researchers in the State of Washington found that consumers perceive business districts with trees to be higher quality than those without trees. Consumers were willing to pay up to 10% more for goods bought in tree-lined business districts (Wolf 2003a,b).

Trees provide social and health benefits

- A growing body of research has shown that the presence of trees in neighborhoods and views of trees and nature contribute to both physical and mental health of urban residents.
- Children in particular show positive effects to health, cognitive development, physical activity level, and stress levels when their living, learning, and play environments include trees and other elements of nature (Charles and Senauer 2010).
- Trees are associated with lower crime rates, and improved mental health, stronger ties between neighbors, and greater feelings of safety and well-being of city residents (Kuo 2003).
- Researchers have shown that office workers who can see natural elements such as trees from their desks have 23% less time off sick and report greater job satisfaction than those who do not have views of nature (Wolf 1998).
- Hospital patients with views of trees recover significantly faster than those who do not see any natural features (Ulrich 1985).

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Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

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General sources of information on tree-related benefits

Urban Ecosystems and Social Dynamics Program (formerly Center for Urban Forest Research), Pacific Southwest Research Station, USDA Forest Service website - <http://www.fs.fed.us/psw/programs/uesd/uep/>

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Center for Urban Horticulture, College of Forest Resources, University of Washington website -
<http://www.cfr.washington.edu/research.envmind/>

Human-Environment Research Laboratory; University of Illinois at Urbana Champaign website -
<http://www.herl.uiuc.edu/>

2. Strategic Plan

This section summarizes important issues and trends that are affecting Sunnyvale's urban forest. Based on these issues, local concerns/ priorities, and general urban forest management principles, goals were developed to help guide the overall management of Sunnyvale's urban forest. Objectives associated with each goal and actions for attaining these objectives provide the framework for the sustainable management of Sunnyvale's tree resources.

Issues and related goals have been organized into three general topic areas:

Contribution of trees to the community includes overall tree canopy cover and its distribution.

Tree and forest health addresses the long-term health and sustainability of both individual trees and the forest as a whole.

Management of the urban forest addresses issues related to the care and maintenance of the urban forest by city employees and the public.

These main topic areas, as well as the goals and objectives listed under them, are highly interrelated. Objectives listed under one goal may in fact support several other goals as well.

Two additional elements are needed to implement the Sunnyvale Urban Forest Strategic Plan:

An **implementation plan** should be developed to show how the actions listed in the strategic plan will be carried out. The implementation plan should include priority rankings for specific actions and a timetable for plan implementation, including phasing that would occur. It should also indicate funding needs and sources, and identify personnel responsible for administering and carrying out actions.

In addition, a **monitoring plan** should be developed that will enable the City to track its progress toward each of the plan's goals. The purpose of the monitoring plan is to indicate how the City will collect and analyze the data needed to track its progress toward specific goals. The plan should indicate what types of data will be collected, when and how it will be gathered, and who will compile and analyze the data. Monitoring data should allow the City to understand what factors are aiding or impeding its progress towards each goal. With this information, the City will be able to adapt its management of the urban forest by making appropriate adjustments as needed.

The development of the monitoring and implementation plans was not included in the scope of developing this plan. However, these are critical components of a successful urban forest management plan and should be developed operationally after plan adoption.

2.1. Contribution of trees to the community

Issues and trends

- *Almost all of Sunnyvale's urban forest consists of trees planted in developed areas within the past 50 to 60 years. Almost nothing remains of the oak forests and other native vegetation that once covered the area that is now the City of Sunnyvale.*

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- *Tree canopy in Sunnyvale covers about 18% of the City's land area, based on 2007 aerial images.*
- *Trees along streets account for about a third of Sunnyvale's tree canopy. Street trees make up a slightly larger percentage of the total canopy cover in commercial land uses (42% of all tree canopy in commercial zoning) than in residential areas (35% of all residential tree canopy).*
- *Increasing overall city canopy to 20.5% would require planting an additional 15,000 trees in residential areas and 14,000 trees in commercial areas.*
- *About half of all trees along streets are managed by the city street tree program. This includes almost all of the street trees in residential areas but only a portion of the street trees in commercial areas.*
- *City-maintained street trees provide a net annual benefit of \$1,079,336, or about \$29.25 per tree per year (calculated using iTree software, developed by the US Forest Service and others).*
- *Approximately 11% of inventoried planting spaces along streets are vacant.*
- *Mean summer temperatures will tend to rise due to the urban heat island effect (localized heating of urban areas associated with pavement and other heat absorbing surfaces) and overall global climate change. Increased tree canopy cover can help moderate this temperature rise.*
- *Sunnyvale residents are concerned about the environment but many do not understand the importance of urban trees and how they contribute to environmental quality and sustainability.*

Goal 1. Increase tree canopy cover to maximize ecosystem benefits provided by the urban forest

Objective 1.1 Achieve full planting of inventoried street tree planting spaces.

Actions

- Identify streets with limited or unplantable Right-of-way (ROW) street tree sites and develop a plan of action for ROW modification or off-ROW street tree planting.
- Designate unplantable ROW sites as unsuitable for planting rather than vacant in the street tree inventory.
- Phase replanting of plantable vacant sites to achieve complete planting within 10 years.
- Identify other possible sources of funding, sponsorships, and/or volunteer resources to accomplish replanting.

Objective 1.2 Promote conservation of existing public and private trees

Actions

- Conduct education and outreach efforts to inform residents about the value of mature trees and City regulations related to trees.
- Conduct education and outreach to commercial landowners and landscape managers to provide information about proper tree care practices and city regulations related to maintenance of trees and landscaping.
- Consider local licensing of tree care contractors (city-issued tree care business licenses) working within Sunnyvale to ensure that tree care activities and tree removals follow city regulations.
- Revise Chapter 13.16 of the Municipal Code, City Trees, to strengthen protection of City street trees and provide a means of claiming compensation for damage to City street trees.
- Revise Chapter 19.94 of the Municipal Code, Tree Preservation, to specify greater protection for roots of protected trees, improve the definition of protected trees and provide objective standards for issuing tree removal permits.

Objective 1.3 Encourage additional tree planting by city residents on private property.

Actions

Provide information on tree species selection, choosing nursery stock, planting practices and young tree care to residents via city website and other means.

- Encourage development of local volunteer/nonprofit to promote tree planting and assist residents with tree planting and tree care.

Goal 2. Choose and locate new trees to maximize tree-related benefits and minimize maintenance costs.

Objective 2.1 Match species to sites to the greatest degree possible.

Actions

- Provide guidelines on tree selection and placement to residents to promote planting the right tree in the right place and avoid tree/site combinations that will result in shortened tree life or excessive maintenance costs (e.g., redwoods on saline soils, big trees planted in small places, tall trees under electric distribution lines, etc.)
- Continue to select suitable species and place trees appropriately to minimize conflicts with infrastructure along streets (e.g., signs, traffic signals, streetlights).
- Develop a Street Tree Master plan that matches trees to site conditions and provides several alternative trees for each block (e.g., irrigated vs. non- or low-irrigation sites,

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

alternative species with similar physical characteristics, allow for some smaller accent trees for small planting spaces).

Objective 2.2 Increase the use of large-canopy trees where practical to maximize tree benefits relative to costs.

Actions

- Include large-statured trees in planting plans for parks, streets, and other public lands where practical.
- Where space permits the use of large-statured trees, consider greater use of locally native oak species derived from local seed sources to help reestablish elements of Sunnyvale's former oak woodlands.

Objective 2.3 Locate new tree plantings to maximize energy conservation in buildings and shading of pavement.

Actions

- Provide homeowners with information on where to plant trees to maximize energy conservation.
- Where ROW space does not allow for large canopy trees, use higher densities of smaller trees to achieve pavement shading.
- Use the planning and design review processes to develop streetscape designs that provide greater amounts of pavement shading.
- Conduct periodic monitoring of canopy cover in parking lots subject to the City's parking lot shading standards to determine whether the as-built designs and subsequent maintenance are adequate to achieve target levels of shading. Develop measures to correct deficiencies and increase parking lot shade levels.

Goal 3. Foster community support for maintaining and improving Sunnyvale's urban forest

Objective 3.1 Provide ongoing education and outreach to promote awareness of the importance of the Community Forest.

Actions

- Increase the amount of urban forest information available on the City of Sunnyvale website.
Identify ways to impart information on Sunnyvale's urban forest to residents.
- Expand relationships with local schools to provide educational opportunities related to trees and the urban forest.
- Encourage public participation in tree planting and tree stewardship activities.

- Use available city information resources to inform residents about urban forest issues and opportunities.
- Maintain and publicize Sunnyvale's Tree City USA status.

Objective 3.2 Support the development of a local urban forestry non-profit / volunteer organization.

Actions

- Partner with an existing or new non-profit urban forestry group to help launch a non-profit urban forestry organization in Sunnyvale.
- This organization will pursue grant funding for tree planting, tree care, and public education, and help to organize community volunteer efforts in support of the urban forest.
- Utilize the organization as a resource for various city boards and commissions, e.g., Planning, Sustainability, for issues related to the urban forest.

2.2. Tree and forest health

Issues and trends

- *The population of street trees maintained by the City is extremely diverse. Over 190 species occur in the street right-of-way. Only three species occur at frequencies greater than 5% of the city maintained street tree population. A high level of diversity within the urban forest helps reduce the risk of serious pest and disease epidemics.*
- *California Municipal Forest Health Threat Assessment published in July 2012 evaluated Sunnyvale's municipal forest health with an overall grade of B+. Tree species and size diversity is good with only two tree species exceeding 10% of the total inventory. Age diversity is good averaging one third of street trees at maturity to senescent. Species diversity rates Sunnyvale's pest threat relatively low.*
- *Street Tree Services has changed the mix of tree species planted in response to problems that have developed over time: 75 species or varieties of trees present in the city ROW are being reduced in numbers and 22 varieties or species are being used in increasing amounts.*
- *Approximately 48 percent of Sunnyvale native soils have properties that can constrain tree growth. Excessive salinity, which can reduce tree growth and cause leaf damage, occurs primarily north of US 101. Soils in various parts of the city are affected by slow drainage and high water tables, which may lead to shallow roots and increased hardscape damage.*
- *Water conservation will continue to be a local and regional issue that can affect the urban forest. Reclaimed water has a high salt content and its use for irrigation may worsen already existing salinity problems in soils, resulting in more tree health problems.*

Goal 4. Develop an urban forest canopy that is stable over the long term

Objective 4.1 Continue to maintain a high level of species and genetic diversity within large plantings and within the urban forest as a whole.

Actions

- Establish upper limits for the percentage of the tree population that a single variety or species should comprise within planning areas or citywide. Use these percentages to aid in species selection for new and replacement tree plantings to reduce the risk that a large percentage of the urban forest canopy could be lost or degraded by damage due to new diseases, pests, or problems that affect only a single species or variety.
- Where possible, substitute trees of different species or varieties for overused species/varieties when planting new or replacement trees.
- Ensure that adequate species diversity is included in commercial landscapes and other private plantings during the planning process.

Objective 4.2 Maximize the effective age diversity of plantings to avoid even-aged stand problems.

Actions

- In new plantings where even-aged plantings cannot be avoided, use a mix of species with different useful life spans. For example, oaks may live for well over 100-150 years whereas flowering pears may have a maximum useful life closer to 30-50 years.
- When planting replacement trees, avoid using trees that will reach the end of their useful life at the same time as existing trees in the planting.

Objective 4.3 Increase the percentage of drought- and salt tolerant trees in Sunnyvale’s urban forest.

Actions

- Monitor compliance with existing policies that emphasize the use of drought tolerant trees in new plantings and consider additional policies and practices to increase the use of drought tolerant trees.
- Reduce or eliminate the use of trees with high water use requirements in harsh street tree and parking lot sites.
- Increase the overall percentage of low water use trees in City street tree plantings and in parks and private development by using more drought-tolerant species in new and replacement plantings when feasible (e.g., species from Mediterranean climate regions, other drought-adapted species).

Increase use of salt-tolerant species in areas that may have salt-affected soils. Consider expanded use of soil testing to identify salinity-affected sites.

2.3. Management of the urban forest

Issues and trends

- *The City of Sunnyvale manages a significant portion of all trees along streets, but private landowners manage most trees in the city.*
- *About two-thirds of the city managed street trees have reached their mature size. As this population of street trees continues to age, more trees will need to be replaced as they reach the end of their useful lives.*
- *The city street tree and concrete maintenance programs have been funded through the city's general fund, which has experienced several rounds of reductions in recent years. Beginning in 2009, lower city general fund revenues have led to significant reductions in the staffing levels of the street tree and concrete maintenance programs.*
- *Cuts in the street tree program budget have reduced the re-inspection and pruning interval for city street trees. This has led to a change to reactive rather than proactive management of street trees.*
- *Longer inspection and maintenance intervals for city street trees may increase the incidence of failures among these trees.*
- *In 2013 Sunnyvale funded contract tree care services so that a minimum of 5,000 street trees receive preventative maintenance pruning annually. Each tree will be pruned every seven years on average depending upon the species. Including street trees pruned by city staff the total number of street trees pruned each year should be over 7,000 per year.*
- *Concrete maintenance will be an ongoing need due to the presence of narrow parkway strips and shallow rooting depths in soils in many areas of Sunnyvale. Street Tree Services has developed a successful program for mitigating root damage to sidewalks using methods that minimize the need to damage or remove trees.*
- *Urban Landscape Manager and City Arborist continue to be utilized in the planning and design phases of development to integrate urban tree requirements into the city's infrastructure design to maximize urban tree performance and minimized infrastructure conflicts and damage.*
- *The street tree inventory needs to be kept current to continue to be useful as a management tool.*

Goal 5. Maintain street trees appropriately to maximize benefits and minimize hazard, nuisance, hardscape damage, and maintenance costs

Objective 5.1 Develop a stable funding source for street tree maintenance.

Actions

- Investigate other potential sources of funding that can be dedicated to street tree care activities.

Objective 5.2 Use best management practices for tree planting and care on city properties to maintain the City owned trees in a safe and healthy condition as cost-effectively as possible

Actions

- Monitor tree health on public lands (parks, streets, open space areas, and public buildings) to identify developing pest and disease problems and implement corrective actions.
- Continue to update the list of tree species potentially suitable for landscape uses in Sunnyvale to reflect new pest problems that may render a tree unsuitable for continued planting.
- Plant good-quality, preferably locally-grown, disease-free nursery stock to help assure long-term tree survival. Implement the use of updated tree nursery stock standards to ensure the use of good quality stock.
- Continue existing pre-and post-planting inspections conducted by City staff. Conduct additional training of building inspectors to improve compliance with city planting standards for street trees planted by developers.
- Continue early training of new trees to establish proper long-term structure and avoid future maintenance problems.
- Continue use of current ANSI pruning standards and International Society of Arboriculture BMP (best management practices) for pruning conducted by City staff and tree care contractors.
- Continue to provide adequate training and continuing education opportunities to ensure that Street Tree Services staff has up-to-date knowledge about trees, and tree care practices.
- Develop and implement standards for assessing and improving soil conditions prior to planting to improve long-term tree health and survival.

Assess and remediate site conditions prior to replanting trees that have died. Record sites that are unsuitable for tree planting in the street tree inventory.

Objective 5.3 Integrated management of street trees and sidewalk/curb concrete maintenance.

Actions

- Provide best management practices and processes within the Department of Public Works to ensure the integration of street tree services and sidewalk/curb concrete and street maintenance
- Provide adequate training and continuing education opportunities to ensure that staff has up-to-date knowledge about trees, root growth, and methods used to minimize root/hardscape conflicts.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- Consider developing a "call before you dig" program that would notify Street Tree Services before activities that could damage roots are scheduled to occur within a given radius of a City street tree. Authorize Street Tree Services to provide procedures to minimize any adverse impacts to City street tree roots in these situations.

Objective 5.4 Development of a program for identifying and correcting tree-related hazards on public properties.

Actions

- Explore development of a program for systematically locating and evaluating potentially hazardous trees on public lands and public rights-of-way.
- Maintain or shorten current preventative maintenance pruning interval of every seven years for each tree on average depending upon species to maintain safe tree structure and minimize failure potential of trees along streets and high-use public areas.
- Continue to respond to all requests from residents and property owners to assess a tree's condition within 10 days or less depending upon the conditions.
- Continue to abate all potentially hazardous conditions in trees within 90 days or less depending upon the conditions.

Objective 5.5 Develop and maintain inventories for all city-managed trees to facilitate tree management.

Actions

- Maintain and update the existing street tree inventory so that it will reflect current conditions.
- Explore possibilities for compiling and linking geospatial coordinates for individual trees to the existing inventory data, which would allow tree data to be displayed as a city GIS layer.
- Develop and maintain a current, complete inventory of trees maintained by Parks with records for individual trees with data related to management needs. The inventory should include spatial information on tree location to permit use in the city GIS.

Goal 6. Manage City's urban forest resources to facilitate collaboration among City departments related to issues and projects involving trees.

Objective 6.1 Continue to have a highly qualified professional arborist as the head of Street Tree Services.

Actions

- Maintain the Urban Landscape Manager position within Street Tree Services and designate that position as the "City Arborist".

Objective 6.2 Continue use of Street Tree Services as the City's internal arboricultural consultant for all City departments

Actions

- Develop best management practices and processes to ensure the Street Trees Services program is included in all areas involving the urban forest including community development.
- Provide information to other city departments and divisions to raise awareness of trees and tree management to meet goals of the urban forest plan.

Objective 6.3 Integrate urban forest management as a component of the City's framework for Sustainability

Actions

- Work with Sunnyvale's Environmental Sustainability Coordinator, the Sustainability Commission, the Horizon 2035 Advisory Committee, and the Dept. of Community Development to integrate urban forestry into the framework for Sustainability.

Goal 7. Encourage proper tree management on private property.

Objective 7.1 Develop an ongoing program to educate the public about tree selection, placement and care.

Actions

- Provide locally-appropriate technical tree care information to residents through a variety of media to emphasize good tree selection and placement, optimal planting techniques, proper pruning of young and mature trees.
- Make city-approved BMP guidelines for tree planting and maintenance available to permit applicants and the public to encourage better tree selection, planting and care.
- Encourage participation of local groups in public tree planting and tree care projects.
- Continue enforcement of landscape maintenance requirements in commercial properties.
Continue existing pre-and post-planting inspections conducted by City staff, and implement new inspections or monitoring programs where necessary.

3. Status of Sunnyvale's Urban Forest

3.1. Historical context

Key Findings

- Almost nothing remains of the oak forests that once covered the area that became the City of Sunnyvale.
- The vast majority of Sunnyvale's urban forest consists of trees planted in developed areas, mostly within the past 50 to 60 years.
- Almost all new construction in Sunnyvale involves redevelopment. Existing mature urban trees are commonly removed when parcels are redeveloped.
- Sunnyvale's first tree protection ordinance was enacted in 1991.
- Sunnyvale has been a Tree City USA every year since 1989.
- Sunnyvale's city services were restructured in 2011 and the Street Tree Services program was separated from the Concrete/sidewalk program although both remained in the Department of Public Works. Street Tree Services was integrated into the Parks Division which had been relocated to Public Works, and remained under the purview of the Urban Landscape Manager. Concrete/sidewalk Services remained in the Field Operations Division but was shifted to the Street Maintenance program.
- Real estate development activity has increased dramatically since 2012 with some loss urban forestry planning coordination within city departments and divisions.

3.1.1. Replacement of the native forest

Due to its development pattern, almost nothing remains of the oak forests and other native vegetation that once covered the area that is now the City of Sunnyvale. Accounts of early explorers and settlers indicate that much of Sunnyvale was once covered by dense oak forests. One of Sunnyvale's earlier names, Encinal, is a reference to the coast live oak, which was called the Encina by the Spanish. Both coast live oak and valley oak historically occurred in this portion of the Santa Clara Valley.

Clearing for fuel wood and grazing land began during the Spanish period and intensified after the Gold Rush when wheat farming became important. Starting in about the 1870s, orchards producing fruit and nut crops and some row crops became the dominant land uses in Sunnyvale and much of the Santa Clara Valley. This resulted in the removal of almost all remnants of the original forest, although some oaks persisted in and around fields and home sites. Most of the scattered oaks that remained in agricultural areas by the mid-20th century were removed as the lands were subsequently converted to residential and commercial development. As a result, the vast majority of Sunnyvale's urban forest consists of trees planted in developed areas, mostly within the past 50 to 60 years.

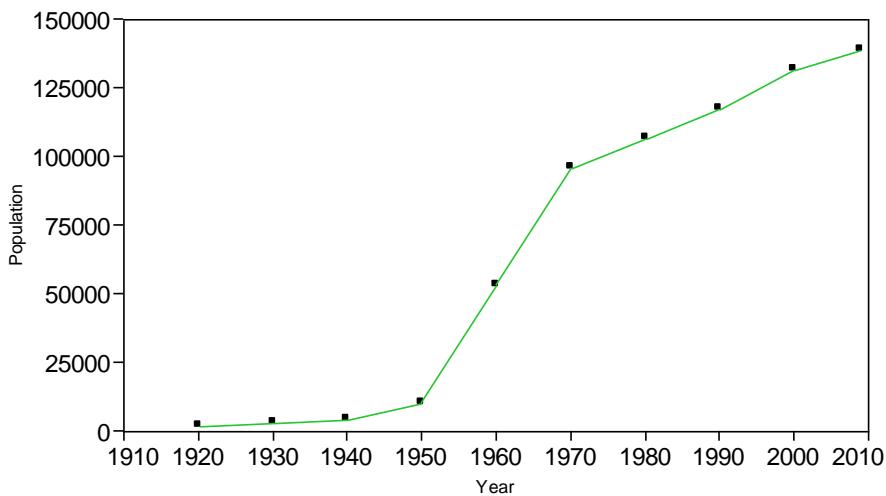
3.1.2. Development of the urban forest

In the post-war period, facing the shutdown of a major employer (Hendy Iron Works) the City of Sunnyvale intensified efforts to attract industrial development. Sunnyvale adopted a council-manager City government structure and a development plan in 1949. Spurred by large defense industry employers that moved to the area (Westinghouse Electric Company at the Hendy site and Lockheed near Moffett Field) and other industrial development, Sunnyvale underwent a phase of rapid development and population growth between 1950 and 1970 (*figure 3-1*). Most of the agricultural lands within the current city boundary were converted to urban uses during this period.

In 1948, Sunnyvale's urban area occupied about 1 square mile and was surrounded by orchards and agricultural fields. By 1981, less than 6 percent of the city's current area (21.9 square miles) was classified as vacant or agricultural. Virtually all remaining fragments of agricultural land were developed by about 2000. Other than some vacant lands within industrial areas, virtually all new construction within Sunnyvale now involves redevelopment. Land use and canopy cover changes associated with development and redevelopment are illustrated with aerial images from 1948, 1991, and 2007 (*figures 3-2 and 3-3*).

When parcels are redeveloped, existing site trees are reviewed for potential preservation. New tree planting is typically required as a component of redevelopment. Even with these policies, redevelopment of built parcels can lead to loss of existing urban trees and may lead to fewer potential planting sites if the footprint of the built area increases.

Sunnyvale's first tree protection ordinance was enacted in 1991. If trees covered under the ordinance were removed, the applicant was required to either provide on-site compensation (e.g., plant more trees and/or larger specimens) or to pay in-lieu fees to fund tree planting in public rights-of-way. Standards for parking lot shading took effect in 2002. The standards apply to new construction, including redevelopment, and require tree planting sufficient to develop 50% shading of parking lots after 15 years.

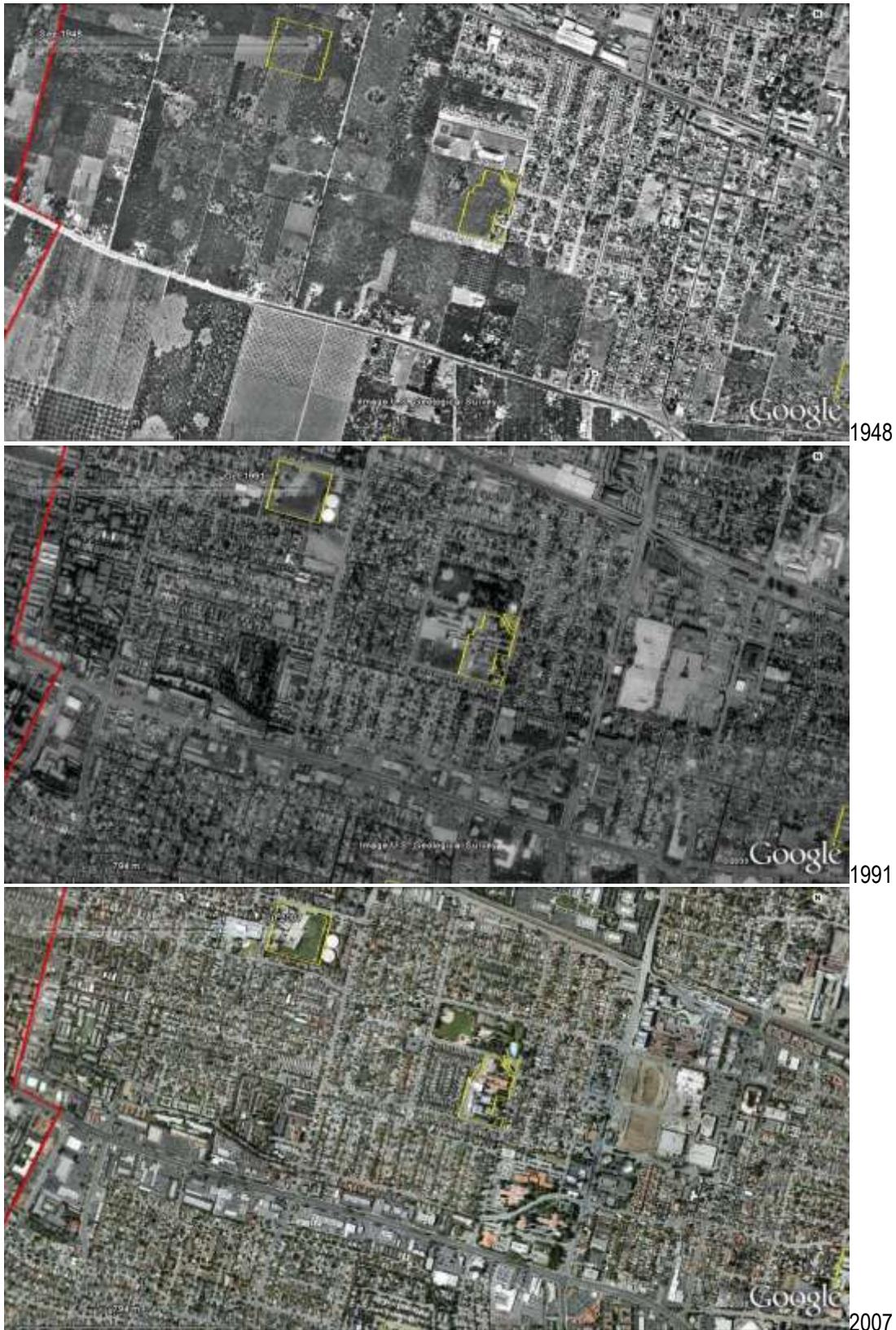


Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Figure 3-1. Population of Sunnyvale, 1920-2009. Data from California Dept. of Finance, Demographics Research Unit. (<http://www.dof.ca.gov/research/demographic/reports/>)

Figures 3-2 and 3-3, following pages: Aerial images of Sunnyvale showing changes in land use and tree canopy from 1948 to 2007. Figure 3-2 shows an area west of downtown Sunnyvale. The intersection of El Camino Real and Mathilda is near the bottom right hand side of the image. The city limit is shown as a red line at left; yellow lines outline school properties. Figure 3-3 shows a closer view of the vicinity of the intersection of Mathilda and Central Expressway. Heritage Park (Murphy home site) is visible near lower right. Rounded patches visible in orchards in the 1948 images are root rot centers most likely due to the fungus *Armillaria mellea*, which indicates the former presence of oaks in these areas. Redevelopment occurring between 1991 and 2007 is visible on some commercial properties in both sets of images.
Images: Google Earth.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA



Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Figure 3-2. Aerial images showing changes in land use and tree canopy from 1948 to 2007 west of downtown Sunnyvale near intersection El Camino Real and Mathilda.



Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

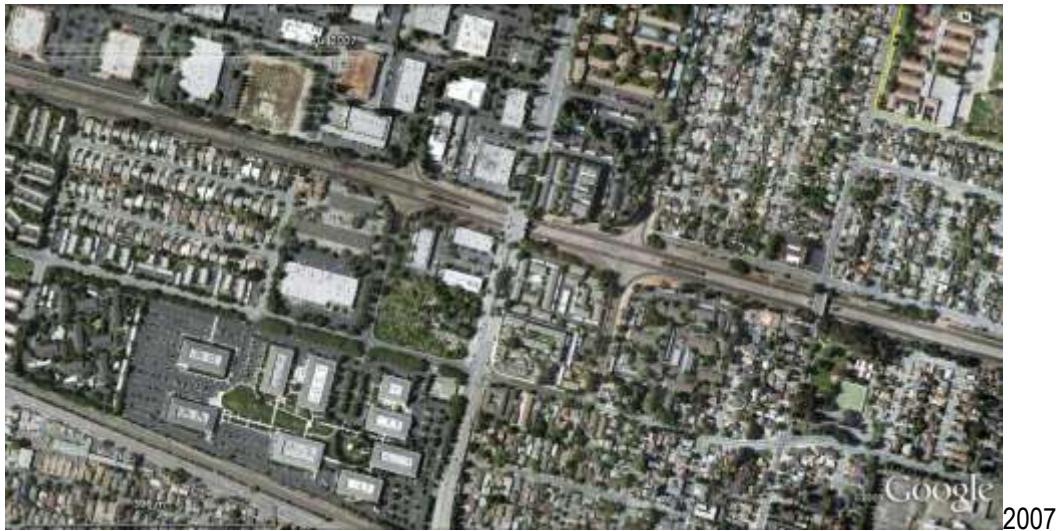


Figure 3-3. Aerial images showing changes in land use and tree canopy from 1948 to 2007 at intersection of Mathilda and Central Expressway.

Street tree program

Sunnyvale's city street tree program was originally operated under the Parks and Recreation Department. In 1987, responsibility for maintaining public trees along streets and medians was shifted to the Public Works Department. This was done to minimize damage to street trees when curbs, gutters, or sidewalks were repaired. In July 2010, responsibility for street median trees was shifted back to the Parks Department.

Until June 2011, Sunnyvale's street tree program was unusual in that responsibility for maintaining sidewalks and curbs and gutters is included in the responsibilities of the Urban Landscape Manager. The program consists of two interrelated programs: Concrete Maintenance and Street Tree Services. These programs were in the Tree and Landscape division of Public Works and were funded through the General Fund. The combination of the street tree services and right-of-way concrete maintenance programs began in 1989. These programs are described in more detail beginning on page 40.

Most of Sunnyvale's city street trees were planted by developers when subdivisions were built. Street tree planting has been required as a condition of project approval since well before 1987. Since 1989, the City's policy relative to street trees has been to replace trees as necessary and add new trees on demand. In addition, trees planted within the ROW by residents are added to the city street tree inventory if they are acceptable to Street Tree Services.

In 1989, the City Council initiated a program to increase trees in the inventory. Funding to plant trees at vacant sites was set aside as a capital project. After these funds were expended, the program was discontinued. The City did not pursue grant opportunities to fund additional street tree planting. At the time, the City Manager did not favor expanded street tree planting because of the associated increase in ongoing operating costs for tree maintenance.

The City's street trees were inventoried and entered into a computerized database in 1986 by Golden Coast. The Davey Resource Group, a division of The Davey Tree Expert Company, subsequently acquired this inventory system. In 1994, Street Tree Services began using the online internet-based version of Davey's TreeKeeper software to manage its tree inventory and associated maintenance scheduling and reporting. The inventory database is maintained on computer servers belonging to Davey Tree. The Urban Landscape Manager administers access to the inventory.

Tree City USA. The City of Sunnyvale has been awarded Tree City USA® status every year since 1989. The Arbor Day Foundation, in cooperation with the USDA Forest Service and the National Association of State Foresters, sponsors the Tree City USA® program. To qualify as a Tree City USA® community, a town or city must meet four standards established by The Arbor Day Foundation and the National Association of State Foresters. These standards were established to ensure that every qualifying community would have a viable tree management plan and program. These standards are:

1. A tree board or department
2. A tree care ordinance

3. A community forestry program with an annual budget of at least \$2 per capita
4. An Arbor Day observance and proclamation

3.2. Environmental context

Key Findings

- Sunnyvale has a mild Mediterranean climate with low annual rainfall.
- Because of limited water availability, trees in Sunnyvale's urban forest must be drought tolerant or receive supplemental irrigation.
- About half of the land area of Sunnyvale has native soils that could be limiting for tree growth. These soils occur primarily in the northern half of the City.
- Soil limitations include shallow water tables, salinity, and heavy (clayey) soil types subject to slow drainage and soil compaction.
- Increased use of salt-tolerant species should be considered in both salt-affected areas and in areas that use reclaimed water.
- Soil modification may be needed in sites such as ROW plantings, commercial landscapes, and redeveloped areas to correct soil problems that will interfere with tree growth or encourage the development of shallow roots.

3.2.1. Climate

Sunnyvale has a moderate Mediterranean climate. Most of the city is in the *Sunset Western Garden Book* climate zone 15 (Coast Range cool winter areas). Portions of the city from about US 101 to the San Francisco Bay are mapped to the somewhat milder zone 17 due to the moderating effects of the bay and more frequent fog. Average winter lows are a mild 40°F in December and January, although a record low of 16°F was recorded in 2003. High temperatures in the summer usually average around 80°F, although record high temperatures over 100°F have been recorded. The moderate climate makes Sunnyvale favorable for growing a wide variety of temperate zone trees species as well as subtropical species that can tolerate occasional temperatures near or below freezing.

Rainfall and water demand

Average annual rainfall in Sunnyvale is about 15 inches. Reference evapotranspiration (ET, a measure of water demand) averaged 42.4 inches between 2004 and 2009 (California Irrigation Management Information System website <http://wwwcimis.water.ca.gov> data retrieved using the map report option in the Spatial CIMIS menu).

Under average Sunnyvale ET conditions, a tree with moderate water requirements (e.g., *Magnolia*), would require about 23 inches of water per year. In an average year, rainfall would supply less than a quarter of this need (5.2 inches) because most rain falls when water demand by

plants is low. The remainder of the tree's water needs would have to be met by water available in the summer and fall, such as irrigation or a shallow water table accessible to the tree's roots.

Trees with low or very low water requirements, such as coast live oak, generally do not require supplemental irrigation to thrive in Sunnyvale. In contrast, trees with water requirements that are classified as moderate (e.g., magnolia, sweetgum) or high (e.g., coast redwood) depend strongly on supplemental irrigation. Trees that do not receive adequate amounts of water may grow very slowly, develop thin canopies, have early leaf drop or scorched leaves, or may die back to varying degrees. Even a temporary lack of irrigation during mid to late summer can cause severe dieback or death of trees such as coast redwood. As discussed below, such problems are more severe in soils with limited rooting depth or low total soil water-holding capacity.

Reclaimed water for irrigation

To reduce demand on potable water sources, the city's water treatment plant provides recycled tertiary-treated water for non-potable uses such as irrigation. To date, this water has only been used for landscaping purposes in the northern third of the City of Sunnyvale, north of US 101. Parks, golf courses, industrial parks, and play fields obtain water at a discounted rate where available. Increased use of reclaimed water for landscape irrigation is planned for new developments.

Reclaimed water has a higher salt content than is found in municipal potable water. As irrigation water evaporates from soil, salts present in it are left in the soil. Over time, these salts can accumulate to levels that inhibit plant growth. When water with high salt levels is used for irrigation, water has to be applied in amounts well in excess of plant water needs to leach out these excess salts from the soil.

Excess salinity in soil and irrigation water makes water unavailable to plants and exacerbates effects associated with inadequate irrigation. Salinity initially causes trees to grow more slowly. As salts accumulate in plant tissues, trees may show browning of leaf edges and shoot dieback. Salt-stressed plants can also show greater susceptibility to some diseases, including root rots. Although salt-tolerant plant species can grow in the presence of excess salts, most landscape trees are relatively intolerant of high salinity. In addition, various tree species may also show sensitivity to specific salt ions present in water or soil (e.g., chloride, boron). Toxicity related to specific ions may occur even if total salinity levels are not excessive.

3.2.2. Soils

The native soils in the City of Sunnyvale are formed from deep, permeable, unconsolidated alluvium that originated mainly from sandstone and shale rocks. Three soil groups are represented within the city, which vary in properties somewhat as described below. The Soil Survey map (Gardner and others 1958) and a table of general soil properties of each soil type are presented in the Appendix (Section 6.1. Soil types, Pg. 88). Soil types with properties that may adversely affect tree growth are shown in Figure 3-4. Approximately 5,892 acres (48% of the land area of Sunnyvale) have soil types that could have adverse effects on tree growth.

Urban soils are often significantly altered due to grading, trenching, compaction, contamination by chemicals, and import of fill soil. The soil maps serve as a general guide to soil conditions

that may affect tree growth, but soil properties at a given site may differ from that of the mapped soil type due to historical construction and land uses.

Basin soils

Soils closest to the bay were developed within or at the edges of the basin that became the San Francisco Bay. They include soils in the Alviso, Bayshore, Castro, and Sunnyvale soil series. These soils extend from the bay to the vicinity of the original downtown area. These soils are generally fine- or heavy-textured (clayey) and naturally tend to have slow surface and/or subsurface drainage. These areas also historically had high subsurface water tables. The heavy soil texture and poor drainage can inhibit root growth, leading to shallow root penetration and slow tree growth. Soil compaction makes these limitations more severe.

In addition, salt levels in some of these soils may be high enough to reduce growth or cause salt damage symptoms in salt-sensitive tree species. High levels of sodium found in some of these soils can also exacerbate slow drainage. Sodium can cause soil aggregates to disperse, which results in smaller pore spaces in the soil. Portions of Sunnyvale experienced significant amounts of land subsidence due to the pumping of groundwater for agriculture in the early 20th century. This subsidence may have allowed bay water to extend further inland and increased salt intrusion into soils closer to the bay shore. The soil types with the most potential for drainage and salinity problems in this group are noted below, along with their approximate acreage in Sunnyvale.

- Alviso clay (An) - 707 acres
- Castro clay (Cd) and Castro silty clay (Ce) - 1,942 acres
- Sunnyvale clay (Sx) - 2,266 acres

Tree species used in these soils may need to be tolerant of salinity, poor drainage, and shallow rooting depth. In addition, planting sites should be prepared to minimize compaction and improve drainage. Depending on soil chemistry, incorporation of calcium (as gypsum = calcium sulfate) and organic matter may improve soil structure and rooting conditions.

Recent alluvial fan and floodplain soils

Soil series in this group include the Campbell, Sorrento, and Zamora series. These were among the most productive soils for agricultural production before the area was urbanized. Soils are generally very deep and favorable for tree root growth, with at least moderate permeability rates and good water holding capacity.

The only soil in this group with potential limitations for tree growth is Campbell silty clay (Cb), which covers about 460 acres in Sunnyvale. This is a deep soil with slow permeability. Permeability is further reduced if the soil is compacted, which occurs readily under wet conditions. However, orchard crops were successfully grown on these soils in the past, so good tree growth on this soil is possible with proper species selection, good water management, and minimal soil compaction.

Older alluvial fan soils

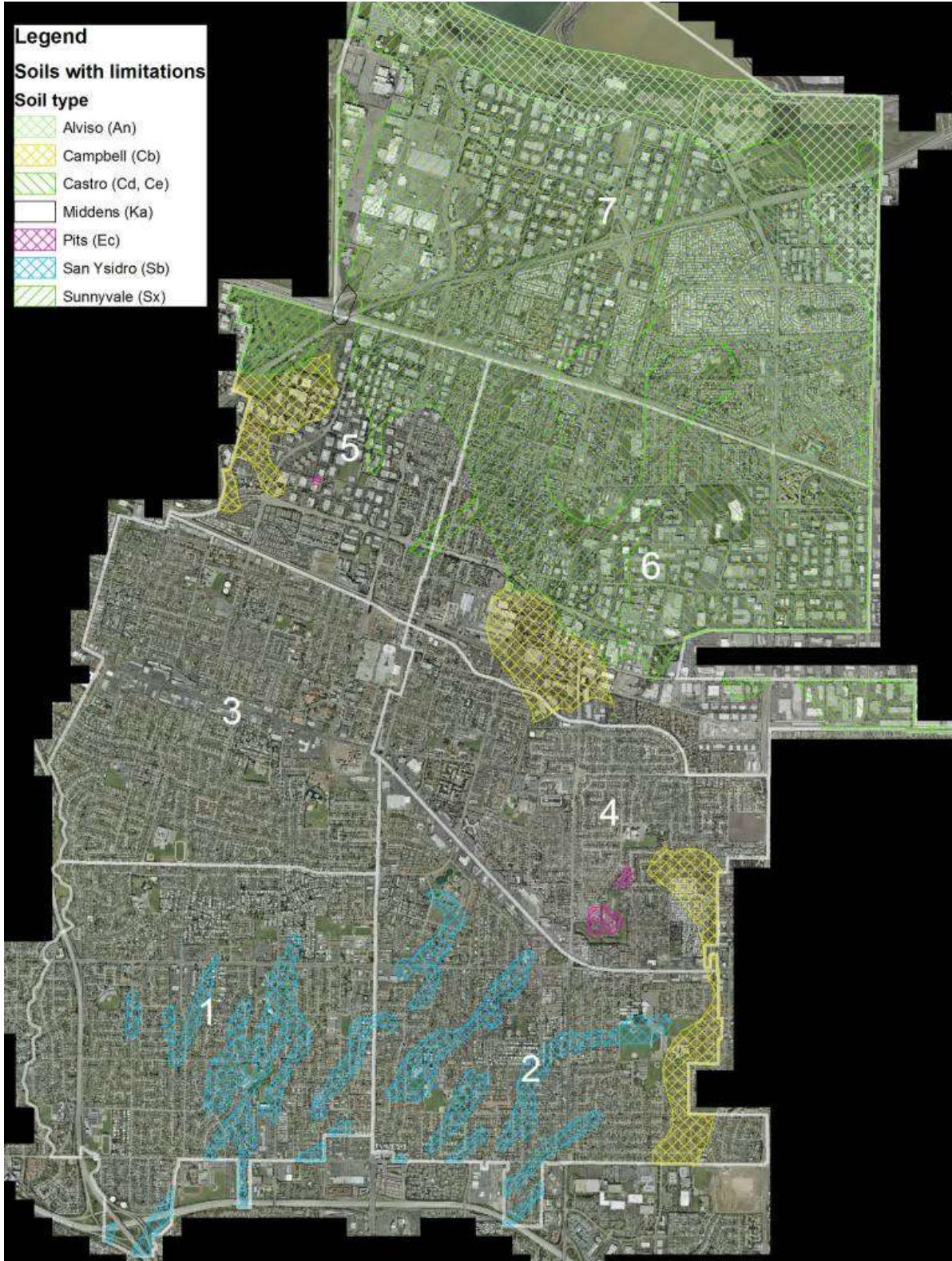
Soil series in this group include the Pleasanton and San Ysidro series. They are found in the southern portion of the city, primarily south of Fremont Avenue. The Pleasanton soils are deep loams with mostly moderate permeability. They do not have any significant limitations for tree growth unless the surface soil or subsoil is compacted, which can reduce permeability.

The San Ysidro soil occurs in finger-like streaks in the Pleasanton soils. About 517 acres of these soils are found in Sunnyvale. San Ysidro loam (Sb) is underlain by a highly impermeable clay layer at a depth of about 20 to 36 inches. This reduces rooting depth and makes the soils more subject to ponding during the rainy season or under heavy irrigation. Diseases favored by wet soils, such as Phytophthora root rots, may be more common on these soils.

Other soil units

In addition to the mapped soils, the soil survey includes a few areas that were historically excavated for gravel or other building materials. These are shown as pits (soil symbol Ec) in figures 3-4 and A1). The soil survey also notes that soil properties in one small area (Kitchen middens – Ka) were altered due to the former presence of a Native American settlement in the area. That area is now occupied by the Highway 101-State Route 237 interchange.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA



Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Figure 3-4. Distribution of soil types that have potential limitations for tree growth. Numbered zones outlined in white are management zones for city street trees. Background imagery provided by City of Sunnyvale.

3.3. Tree resources

Key Findings

- Overall tree canopy cover in the land area of Sunnyvale was estimated to be 18.4%.
- Trees in residential areas accounted for 62% of Sunnyvale's tree canopy.
- Trees in commercial areas accounted for 28% of Sunnyvale's tree canopy.
- Street trees account for about a third of the city's canopy cover, including 42% of all commercial tree canopy and 35% of all residential tree canopy.
- There are an estimated 231,000 trees in Sunnyvale, including about 70,000 along street rights-of-way.
- Increasing overall city canopy to 20.5% would require planting an additional 15,000 trees in residential areas and 14,000 trees in commercial areas.
- About half of the trees located along street rights-of-way are managed by Street Tree Services.
- Trees managed by Street Tree Services provide a large fraction of the canopy cover in both residential and commercial areas.
- Parks Division manages about 5,800 trees in parks and around city facilities.
- Private landowners are responsible for the care of most of the trees in Sunnyvale's urban forest.

3.3.1. City-wide canopy cover

Most of the benefits provided by the urban forest are directly related to levels of tree canopy cover. Canopy cover refers to the percentage of ground area that has tree cover directly overhead, and is most commonly assessed from overhead aerial imagery. Canopy cover is affected by both the number of trees per unit area (tree density) and the canopy spread of individual trees.

Tree canopy cover within the city can be increased by adding additional trees, but due to the small size of newly planted trees, tree canopy growth has a larger influence on canopy cover. A few mature trees with large canopies can have more canopy cover than a much larger number of young trees. Consequently, increasing tree canopy cover is typically a slow process. In contrast, decreases in tree canopy can occur much more quickly. A large mature tree can be removed in a single day, eliminating tree canopy that required decades to develop.

To assess tree canopy cover in Sunnyvale, we used a random dot grid to quantify tree cover within various land uses from 2007 aerial photography available from Google Earth. A robust estimate of canopy cover can be obtained by determining what percentage of the spatially random sample dots superimposed over the aerial image (*figure 3-5*) intercept tree canopy. Additional information on tree distribution was obtained by categorizing the land use associated with each sample dot. We used GIS layers and photo interpretation to assign sample points to the

following categories:

Residential (including single and multiple-unit zonings),
commercial/industrial,
city parks,
schools,
other city-owned properties.

Within these categories, we also noted whether a sample point was located within a public street ROW. Detailed information on the methods used is presented in Appendix 6.2 (page 86).

From this analysis, the overall canopy cover in the land area of Sunnyvale was estimated to be $18.4 \pm 2.1\%$. Other cities with canopy covers recently estimated at 18% include Seattle, Los Angeles (<http://www.sej.org/publications/tipsheet/some-cities-push-for-increased-tree-canopy>) and Rocklin, CA. In an analysis of canopy cover in 21 California cities and towns based on 1988-1992 aerial photos (Rowntree and Kerkman 1997), only five of the cities had tree canopy cover greater than 18%. These included Atherton, with the highest percent canopy of any city surveyed (1992 canopy cover 48%) and Menlo Park (1992 canopy cover 24%).

Canopy cover levels by land use category are summarized in Figure 3-6. Parks showed the highest percent canopy cover overall. If municipal golf courses are removed from the parks sample, the park canopy cover drops to 23%. Residential areas had higher levels of canopy cover overall than commercial/industrial areas. The aggregate of other land uses (schools, other city-owned land) had the lowest total canopy cover. Across the entire city, canopy cover associated with trees in the street ROW was 6.4%.

Another way to look at canopy cover is to consider how much of the total city canopy cover comes from different segments of the urban forest. These are shown below:

- Residential land uses — 62% of total city canopy cover
- Commercial/industrial land uses — 28% of total city canopy cover
- Parks, schools, and other city-owned land— 10% of total city canopy cover

According to this analysis, although residential areas cover 43% of the City, trees in residential areas accounted for 62% of Sunnyvale's tree canopy.



Figure 3-5. Aerial imagery of Sunnyvale (photo date July 2007) used for determining tree canopy cover. Top image shows the distribution of random points across a section of the city with polygon boundaries that indicate specific land uses (blue line = a city park, yellow line = school, green line = other city owned property). Latitude/longitude grids were used to help keep track of position during the counting process. Determination of whether sample points intercepted tree canopy were made under greater magnification, as shown in bottom image. Lower image shows a close-up with two sample points, one on a street tree (upper right) and the other on non-canopy beyond the ROW (lower left) within a residential area. The apex of each triangle was used as the actual sampling point. Imagery: Google Earth.

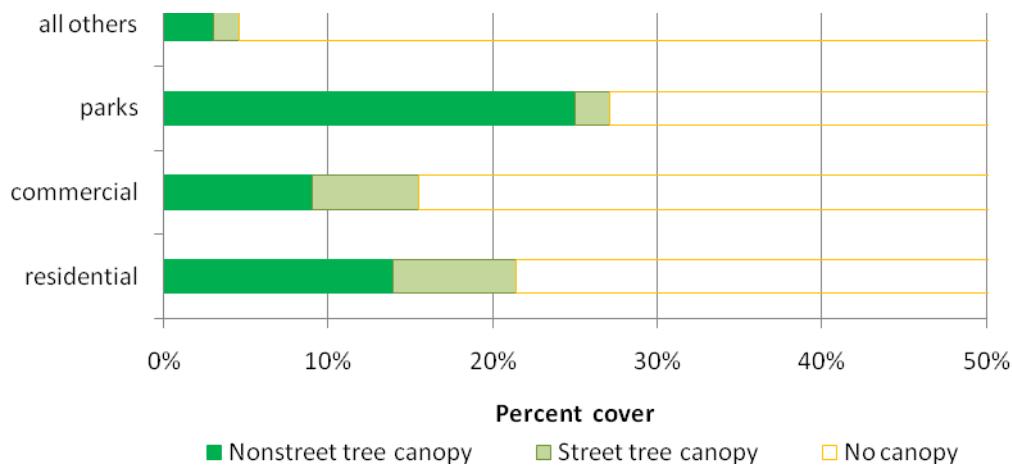


Figure 3-6. Tree canopy cover within land use categories by tree location (for this chart, street tree= trees within apparent city right-of-way).

Trees along streets accounted for more than a third of Sunnyvale's tree canopy (*figure 3-7*). Street trees made up a larger percentage of the total canopy cover in commercial land uses (42% of all commercial tree canopy cover) than in residential areas (35% of all residential tree canopy cover). Our sample indicated that the total amount of canopy cover over paved portions of city streets (curb to curb) was about 10%. In other words, only about 10% of the street pavement in Sunnyvale is directly under tree canopy.

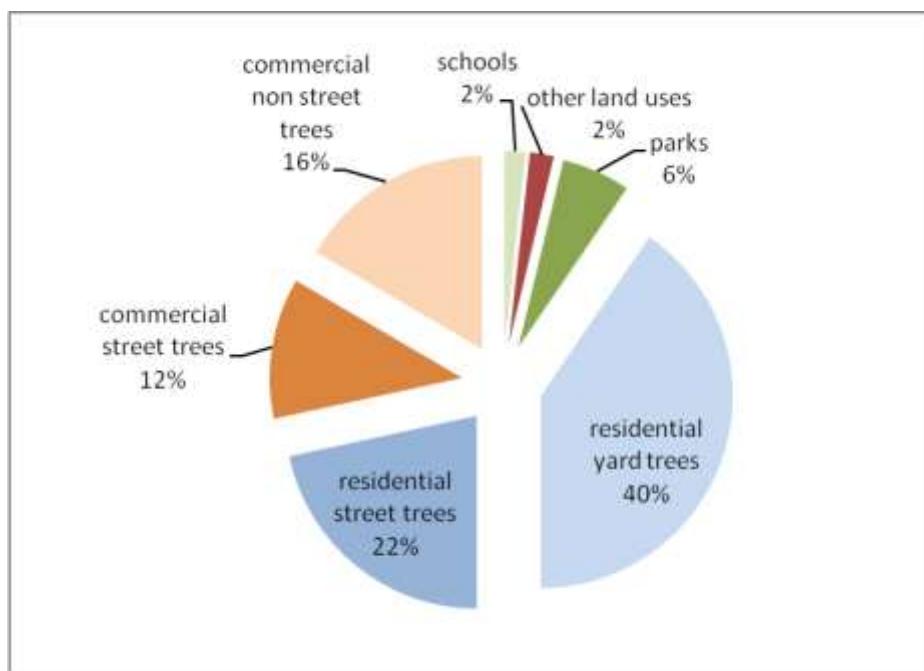


Figure 3-7. Distribution of City of Sunnyvale canopy cover.

As noted above, the City enacted standards for parking lot shading with a target of 50% shading of parking lots after 15 years for new construction. Although we did not quantify actual levels of tree canopy cover in parking lots, we visually assessed parking lot canopy cover in a large sample of parking lots throughout the city using available 2010 aerial imagery. Very few existing parking lots approach the 50% shading standard. It was clear that most parking lots have so few trees that they are not likely to approach the 50% standard at any point. A substantial number of parking lots had no trees at all.

References

Rowntree, R.; Kerkman E. 1997. Urban forest canopy cover in California: analysis of 21 cities and towns. Unpublished technical report. USDA Forest Service, Pacific Southwest Research Station. Albany, CA.

Tree population estimates

We used estimates of average tree canopy area and the actual area covered by tree cover to estimate total numbers of trees. The portion of the city included in the evaluation covers about 19.25 square miles. Within this area, tree canopy covers more than 3.5 square miles and includes an estimated 231,000 trees. This is equivalent to:

- 1 tree per about 2,300 square feet;
- about 19 trees per acre; or
- about 1.66 trees per resident (based on 2009 population estimates).

Some other tree population estimates based on canopy cover:

- residential zoning areas: 142,455 trees
- commercial zoning areas: 60,392 trees
- trees along street ROW: 70,148

From the estimated tree numbers and the total length of streets within Sunnyvale, we estimate that the density of trees along the street ROW is about 378 trees per street mile. This compares to 353 trees per street mile in Rocklin, CA, measured in 2006.

Number of privately maintained street trees

The tree inventory maintained by Street Tree Services showed 36,898 city street trees as of January 2010. Subtracting public trees managed by Street Trees Services and boulevard median trees managed by Parks starting in July 2010 from the estimated 70,148 trees along the street ROW leaves an estimated 34,000 trees along streets that are under the care of private residential and commercial property owners. In many locations, particularly where streets have been widened over time, trees planted close to the street (and rated as in the ROW in our aerial photo interpretation) are not in the official public ROW. This situation is more common in commercial areas than in residential areas. Many of the trees within landscaped strips adjacent to the street or on the far side of monolithic sidewalks in commercial areas are private trees rather than inventoried street trees (*figure 3-8*).



Figure 3-8. Trees along the apparent street right of way may be either public trees managed by Street Tree Services or privately owned and managed trees. The sweetgum trees along the street on the left side of this image are private trees on a commercial parcel. The trees in the median are managed by the City.

Potential canopy cover goals for Sunnyvale

Based on canopy cover measurements, we know that Sunnyvale can support at least 18.4% tree canopy cover. This level of canopy cover would increase over time through tree growth if no trees were removed. However, because trees are removed on an ongoing basis, canopy cover levels will drop if tree canopy is removed at a greater rate than can be offset by the growth of the remaining trees. In addition, replacing large-canopied trees with trees that are smaller at maturity can lead to long-term reductions in tree canopy cover.

A newly planted tree can take many years to reach the canopy size of a mature tree. For example, a single tree with a canopy diameter of 68 ft. (e.g., the large trees on the left side of *figure 3-9*) provides more canopy cover than 46 trees with a 10 ft. canopy diameter or 11 trees with a 20 ft. canopy diameter. To maintain stable canopy cover levels over time, replacement trees need to be in place and growing before mature trees are removed. This means that it will be necessary to

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

plant many more trees than are removed over a period of years, especially if many existing large trees are reaching the end of their useful life.

For planning purposes, Sunnyvale should determine how much more tree canopy cover could be supported within the city. There is no set formula or methodology for calculating the maximum achievable canopy cover for an urban area, and factors that constrain tree cover vary between cities. In Sunnyvale, the area occupied by buildings, streets, and impervious hardscape is the primary factor that limits the space available for both tree canopies and tree roots.

Much of Sunnyvale is dominated by relatively small residential lots with limited space for large trees. To see how much canopy cover might be supported within Sunnyvale's residential areas we examined current aerial imagery to find areas with high levels of canopy cover. After scanning the entire city, we selected ten residential areas that included patches of high canopy cover. We superimposed a 14-acre square (780 ft. on a side) sampling frame over each of these relatively high canopy cover areas and assessed canopy cover within the frames. Invariably, these sampling frames included areas with more modest canopy cover in addition to the high canopy cover patches that we had noted.

Among these ten residential samples, 26% canopy cover was the maximum tree cover seen within the 14 acre square (e.g., *figure 3-9*). The average canopy cover of these ten areas was 23.6%. These results suggest that it should be feasible to increase residential canopy cover in Sunnyvale to at least 24%, which is about 112% of the existing residential canopy cover of 21.4%.

Assuming that existing tree canopy is maintained, about 15,000 additional trees would need to be planted to increase average canopy cover in residential areas to 24% (assuming the new trees would average 22.5 feet canopy diameter, the current average tree canopy spread in residential areas). This is equivalent to one tree for every 15,000 square feet of residential property. Increasing residential tree canopy cover to 24% would increase citywide canopy cover to 19.4% (Table 3-1).

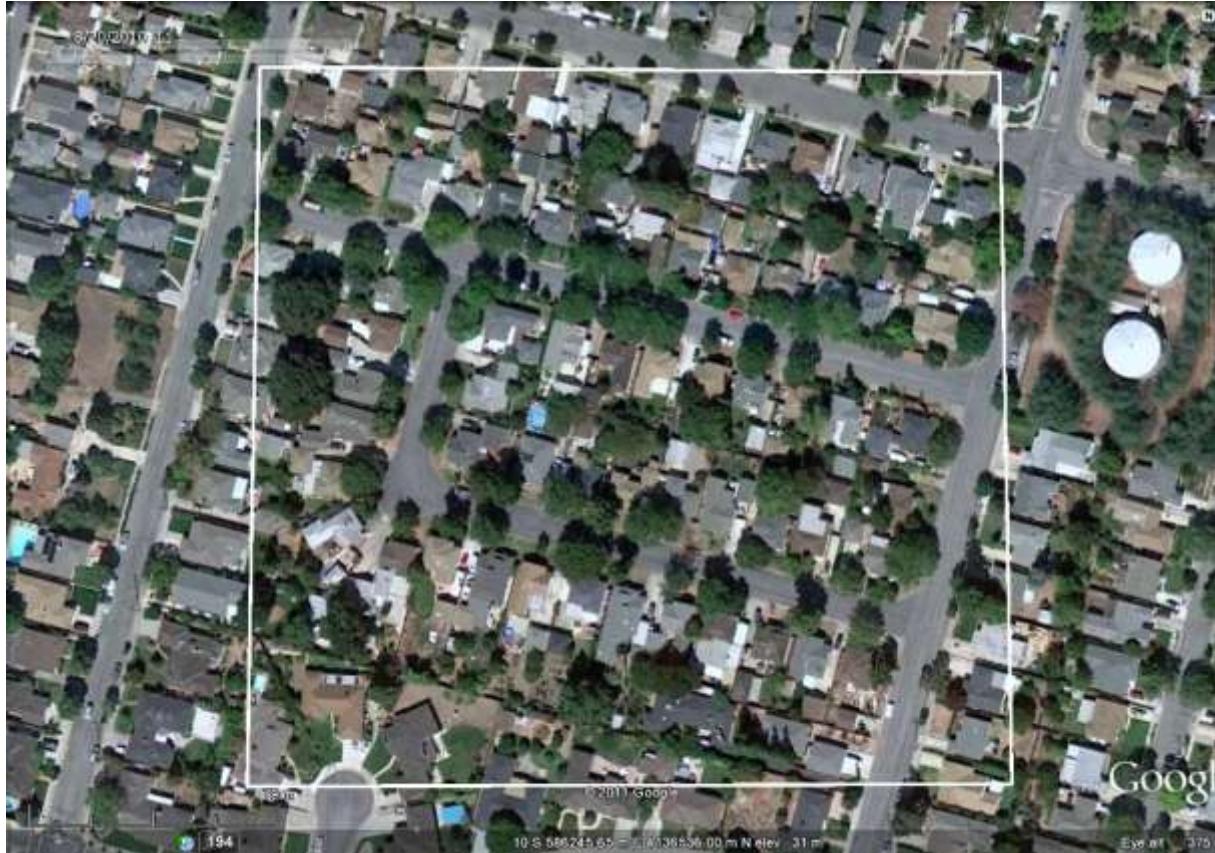


Figure 3-9. Residential area within Sunnyvale showing relatively high canopy cover. Canopy cover within the 14 acres delimited by the white box was about 25%. Image: Google Earth; image date 20 August 2010.

Table 3-1. Scenarios for increasing canopy cover in Sunnyvale through additional tree planting. All scenarios assume that existing tree canopy is maintained at constant levels though replacement planting and growth of existing trees.

| Scenario | Residential canopy cover | Commercial canopy cover | Estimated additional number of trees needed | Estimated citywide canopy cover |
|--|--------------------------|-------------------------|---|---------------------------------|
| current conditions | 21.5% | 15.5% | | 18.4% |
| increase residential canopy cover | 24% | 15.5% | 15,000 ¹ in residential areas | 19.4% |
| increase commercial canopy cover | 21.5% | 20% | 14,000 ² in commercial areas | 19.4% |
| increase residential and commercial canopy cover | 24% | 20% | 29,000 (= 15,000 residential + 14,000 commercial) | 20.5% |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

¹ Assumes trees have a canopy diameter of 22.5 feet, the estimated average size of residential trees in Sunnyvale.

² Assumes trees have a canopy diameter of 24 feet, the estimated average size of commercial trees in Sunnyvale.

Commercial and industrial areas occupy about 28.5% of Sunnyvale's land area. Canopy cover within these land uses is relatively low (15.5%, Table 3-1) because much of the land area is covered by large buildings and extensive parking lots. Many parking lots had little or no tree canopy (*figure 3-10*), whereas others had much higher levels of canopy cover. The results show that parking lot canopy cover can be increased substantially by using good tree selection and adequate planting designs (*figure 3-10*).

Increasing canopy cover in commercial areas would require both replanting vacant planting spaces in parking lots and retrofitting parking lots to create areas for planting additional trees. Because limited rooting space constrains tree growth in parking lots, designs that provide greater rooting volume should be used in both new construction and retrofitting. Planting parking lot trees in long strips or swales rather than in small pavement cutouts allow trees to grow larger and provide greater canopy cover. The use of pervious pavement near trees, possibly in combination with structural soils, would also improve conditions for root growth, allowing trees to grow larger.

By modifying parking lots to accommodate more and larger trees, it should be possible to increase canopy cover in commercial and industrial zonings to 20%. This would require planting about 14,000 additional trees, or about one new tree per 11,000 square ft. of commercial property. Increasing canopy cover in commercial areas to 20% in combination with an increase in residential canopy cover to 24% would increase citywide canopy cover to about 20.5% (Table 3-1), or about 111% of the current estimated canopy cover. Most of the approximately 29,000 additional trees would be planted on private lands, although replanting the several thousand vacant City street tree planting sites (see section 3.3.2) would help contribute to reaching this goal.

Increasing tree canopy cover in schools, city parks, and other city-owned facilities would also help increase citywide tree canopy cover. However, because these properties make up a relatively small proportion of the city's area, increasing canopy on these lands would have a lower impact on citywide canopy cover. In addition, large open areas including playing fields and water treatment facilities near the bay are not candidates for tree planting.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

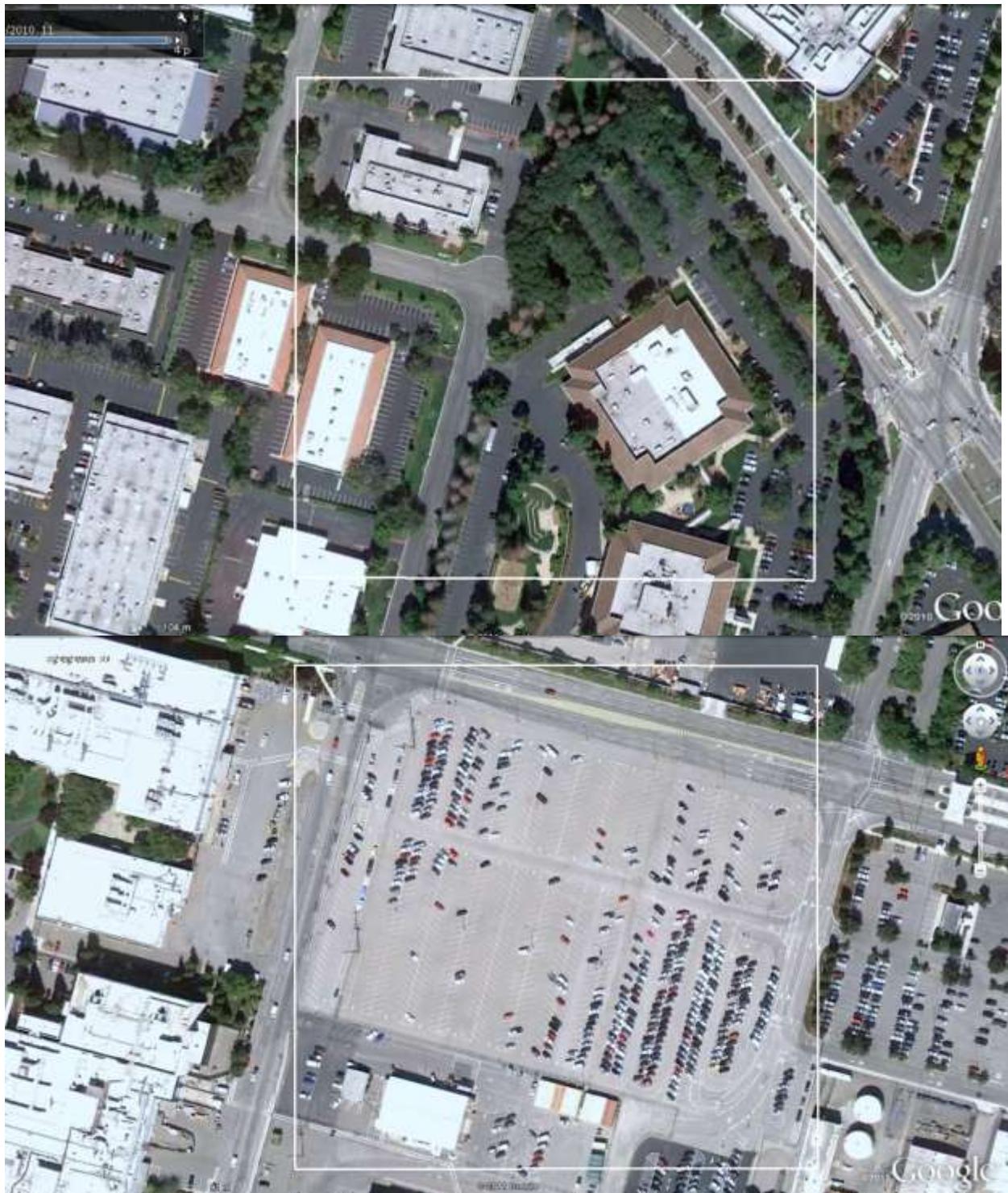


Figure 3-10. Tree cover in north Sunnyvale commercial areas with large parking lots. Canopy cover within the white square in top photo was approximately 29%. Canopy cover within the square in the bottom photo is less than 1%. The two sites shown are less than a mile apart.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

White square in each photo represents 14 acres. Images: Google Earth, image date 20 Aug 2010.

3.3.2 City maintained street trees

Key Findings

- The Street Tree Inventory contains 41,357 inventoried tree planting spaces along streets and in medians; about 11% of these spaces were vacant in January 2013.
- City street trees are predominantly broadleaf (hardwood) species (91%). Conifers (8%) and palms (1%) account for the balance of city street trees.
- Street trees are extremely diverse with over 190 different species represented.
- The three most common city street trees are Southern magnolia (13% of total inventory), American sweetgum (10%), and Chinese pistache (8%).
- Street Tree Services has discontinued planting some species, e.g., American sweetgum, due to various problems associated with them, and has increased the use of other species.
- City street trees are primarily species that are medium- to large- statured at maturity, and a large percentage has reached mature size.
- Large-statured street trees are especially important contributors to city canopy cover and overall tree-related benefits, but these trees need to be maintained properly to maximize their useful life.
- Because many of the current large canopied street trees were planted during Sunnyvale's postwar development era, an increasing number of these trees will be reaching the end of their useful life in the coming decades. Maintaining tree canopy cover will require an active replanting program.
- Sunnyvale derives a net financial benefit from the funds it invests in maintaining its street trees. These tree resources and the benefits they provide will be at risk if the City fails to provide for their maintenance.
- Damage to roots of City Street trees has been minimized by the joint administration of Street Tree Services and Concrete Maintenance. Recent administrative separation of these programs will require new mechanisms to prevent costly damage to tree resources. A "call before you dig" program should be instituted that would apply to excavation or hardscape removal near street trees. This should apply to work performed by the city, businesses, or private landowners.

City-maintained street trees

The Street Tree Inventory maintained by Street Tree Services lists 41,357 tree planting spaces in the public right-of-way (ROW) along streets and in medians. As of January 2013, the inventory listed 36,898 city street trees in these spaces. Street Tree Services had complete responsibility for

maintaining city street trees until a recent (July 2010) realignment that shifted the responsibility for boulevard median trees to the Parks Division. Median trees that were too tall to prune from the ground were still pruned by Street Tree Services under this arrangement. These 1,164 median trees are included in the overall analyses of city-maintained street trees below. A tabulation of all species in the inventory is presented in Appendix 6.3.

Vacant planting sites

Eleven percent of the planting spaces (approximately 4,430 spaces) in the Street Tree Inventory were listed as vacant in January 2013, but not all of these listed sites are plantable. Notes for some of these records indicate that trees could not be planted due to conflicts with signs, lights, or other infrastructure. Some other sites were already overtopped by nearby trees. In some cases, adjacent property owners refused to have trees planted in vacant sites.

About 650 of the vacant sites listed in the inventory were in planting sites that were no more than 2.5 ft. wide. These highly constrained planting sites can only support small trees and would not be a high priority for replanting due to maintenance issues. In some instances where the parkway planting site is very small, the adjacent homeowner has agreed to have the city street tree planted in their front yard instead of in the narrow parkway strip. These front lawn trees are dedicated street trees.

Fifty-four percent of vacant sites are listed as open planting sites, which are sites on the yard or landscape side of a monolithic sidewalk. Most of these sites can support medium or large trees and typically would be high-priority sites for replanting. Street Tree Services improves planting sites whenever legally possible.

Species diversity

Slightly more than half of the city-managed street trees are deciduous broadleaf (i.e., hardwood) trees. Most of the remaining trees are evergreen broadleaf trees (*figure 3-11*). The species composition of the street tree population is remarkably diverse. Sunnyvale's street tree inventory includes over 190 tree species. Only Southern Magnolia, American sweetgum, and Chinese pistache are present at more than 5% of the overall street tree population (*figure 3-12*). Maintaining a diverse tree population can reduce risks associated with introduced pests and diseases.

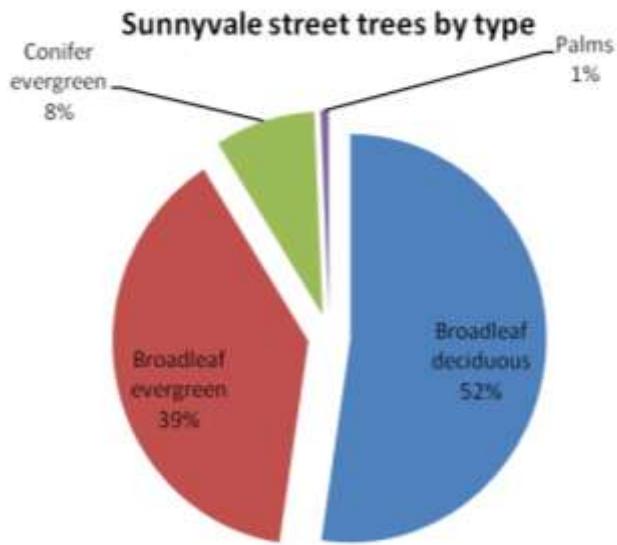
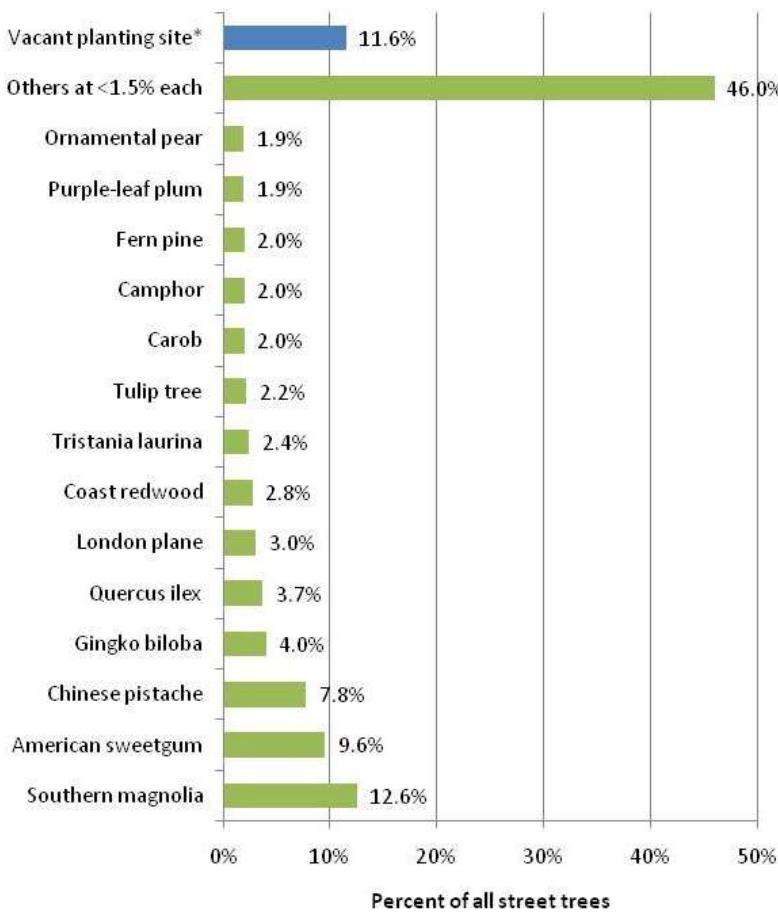


Figure 3-11. Sunnyvale street trees by type (source: Street Tree Inventory Jan 2010 and i-Tree).



Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Figure 3-12. Species mix of the city-managed street trees (source: City of Sunnyvale street tree inventory, Jan 2010).

*Vacant planting sites based on 41,357 inventoried planting sites.

Although the street tree population is diverse on a citywide basis, plantings along individual blocks typically utilize a relatively small number of species to provide a uniform appearance. We queried the tree inventory to develop a list of the most common street trees along 3,688 individual block face street segments (Appendix 6.6, Street tree species composition by block face, page 97).

The mean number of trees per block face was 10.3 and half of the block faces had seven or fewer City street trees. Most blocks (53%) have no more than two street tree species, although about 10% had more than five species represented (*figure 3-13*). The maximum number of species per block face was 19. The number of species per block face generally tends to increase with the number of trees on the block face (regression line $R^2=0.37$, $p<0.0001$). For example, the block face with 19 species had 55 trees. However, several of the block faces with the largest numbers of trees have low diversity. On the block face with the greatest number of trees (Caribbean Dr., from Mathilda to Borregas), 176 of the 179 trees were blue gum eucalyptus. These eucalyptus trees line the bay side of the street, near the wastewater treatment facility.

Even on blocks with relatively high numbers of species present, one or two species were usually dominant, making up more than 60% of the block face trees. Southern Magnolia was the dominant species on 13.8% of block faces, followed by American sweetgum (9.9% of block faces), and Chinese pistache (9.3% of block faces). As shown in Figure 3-13, 115 block faces (3%) showed only vacant planting spaces in the inventory.

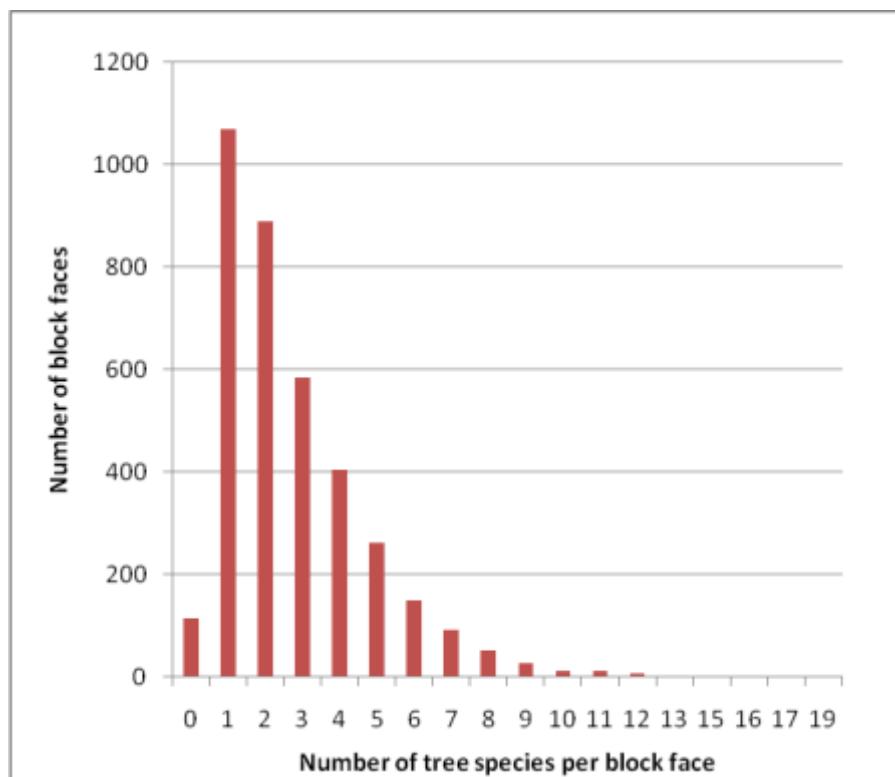


Figure 3-13. Number of city street tree species present along individual block faces (street segment between two intersections) based on data in the City of Sunnyvale street tree inventory (Jan 2010).

Changes in species selection

In any urban forest, some tree species may develop specific problems over time. Trees may perform poorly or have short life due to incompatibility with local growing conditions, pest or disease problems, a propensity to fail. Some species may also be more likely to damage sidewalks, especially when planted in narrow strips. Experience is the best indicator of how trees perform under local conditions; trees that are successful in some cities may perform poorly in others due to different soils, climate, or other conditions.

Due to various problems that have developed over time, Street Tree Services has stopped using some species that were planted along streets in the past (Appendix 6.5). Analysis of inventory data indicates that about 75 species or varieties of trees that are present in the city ROW are being reduced in numbers. These trees are either being phased out entirely or are gradually being eliminated from some planting situations in which they cause problems. At the same time, Street Tree Service is increasing its use of 22 species or varieties (Appendix 6.4). Some of these represent improved varieties of species currently in use, such as disease-resistant varieties. Others represent species that have performed well in limited plantings and are being used to replace more problematic species.

American Sweetgum - *Liquidambar styraciflua*

American sweetgum, or Liquidambar, is one of the more prominent trees that is no longer planted in Sunnyvale. Sweetgum is one of the most common street trees in Sunnyvale and many other California cities. It has been widely planted due to its relatively fast growth and tolerance of varied soil conditions. However, this species commonly produces roots at or near the soil surface that can cause hardscape damage. Furthermore, sweetgum produces its seed in a hard, spiny seed ball that can pose a nuisance, especially in streetscapes. Great numbers of these seed balls drop in late winter and can pose a tripping hazard if they are not regularly removed during the drop period. In addition, many of the older sweetgum trees lack a central leader. These trees are more prone to branch failure and need more frequent pruning to reduce the likelihood of failure.

In response to citizen complaints, the City council began allowing removal of sweetgums from the city ROW in 2005. Property owners can obtain a permit to remove sweetgum trees and replant with replacement trees. The City initially provided some funding to remove and replace these trees, but it funding was suspended for economic reasons until 2013. Limited public funding was reinstated in May 2013. Criteria are in place to minimize the rate of canopy loss associated with replacement of this common tree. No more than 10% of the sweetgums on a block may be removed and two adjacent sweetgums cannot be removed at the same time. As an alternative to removal, the City allows citizens to spray trees with ethephon (Florell®) to suppress production of seed balls.

About 100 sweetgum street trees have been removed by property owners under the permit program. Prior to FY 2009-10, property owners could pay to have Street Tree Services do the

work, which includes tree removal, stump grinding, and planting of a replacement tree (\$1200). The work was typically done by City crews because it is logistically difficult to line up the multiple contractors needed to do the entire job. This service was discontinued as the result of staff reductions related to reduced City revenues. As of October 2013 public funded sweetgum removals are being performed by contractor.

Street Tree Services is reducing its sweetgum inventory. New plantings of this species are limited to seedless varieties. The variety ‘Rotundiloba’ is seedless and variety ‘Cherokee’ reportedly sets few or no seeds. Also deciduous oak species Shumard, Scarlet and Red oak have performed well as sweetgum replacements.

Tuliptree scale

Tuliptree (*Liriodendron tulipifera*) constituted about 2% of the City street trees in December 2010 (Appendix 6.3). An important pest of this tree is tuliptree scale (*Toumeyella liriodendri*), a large soft scale insect. This insect pest is widespread in the eastern US, and has been spreading throughout the San Francisco Bay Area since the late 1990s. These scales infest the twigs of tuliptrees and some other species. They feed on tree sap, and in the process produce large amounts of honeydew, a sticky liquid that drops from the insects and coats surfaces under the trees. Feeding by the scale can also cause major and minor limbs to die back, which increases pruning needs.

In April 2011, staff identified nearly 200 sites that were affected by tulip tree scale. The City hired a professional tree care company to apply a soil treatment to control the scale. In 2012 and 2013 addition Tuliptrees were treated to control tuliptree scale. The treatments were started to protect the trees from long-term structural damage. Due in large part to this pest problem, tuliptree is on the list of street tree species that are being reduced in numbers (Appendix 6.5).

Southern Magnolia – *Magnolia grandiflora*

Southern Magnolia is the most numerous single tree species in the Sunnyvale street tree inventory. As of October 2013 there are 4,612 magnolias on Sunnyvale streets representing 11% of the street tree inventory. Southern magnolia is a native of the southern US and thus is adapted to abundant summer water. Also in its native environment is very shallow rooted with extensive surface roots. Southern magnolia is not adapted to Sunnyvale’s Mediterranean climate and thus requires summer irrigation to perform well. The aggressive surface roots cause significant infrastructure damage. Southern magnolia is being reduced in number with alternative evergreen trees species.

Size of city maintained street trees

The municipal street tree population is composed primarily of medium- to large-statured trees. Estimated canopy size at maturity for the current city street tree population is:

32% large trees (generally more than 40 ft tall at maturity)

53% medium trees (generally 20-40 ft tall at maturity)

15% small trees (generally less than 20 ft tall at maturity).

Tree canopy size is important because many of the benefits provided by trees are proportional to canopy size. Trees with large canopies provide substantially greater benefits than small trees.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Based on January 2010 inventory data, about 34% of all city street trees are over 30 feet tall (*figure 3-14*). These include trees of 128 different species or varieties. However, nine species account for the majority (65%) of trees over 30 ft tall (Table 3-2).

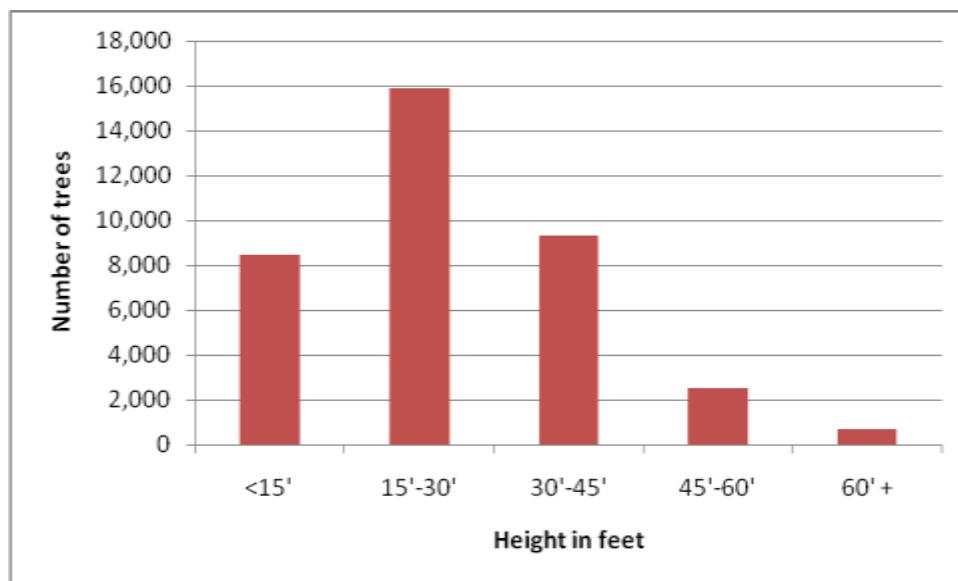


Figure 3-14. Height distribution of Sunnyvale street trees (source Street Tree Inventory Jan 2010).

Table 3-2. Tallest trees in the municipal street tree inventory (Jan 2010) by species.

| Species | Number over 30 ft. tall | Percent of tall (>30 ft) trees |
|-------------------|------------------------------------|--|
| American sweetgum | 2713 | 22% |
| Southern magnolia | 1372 | 11% |
| Chinese pistache | 683 | 5% |
| Coast redwood | 663 | 5% |
| Holly oak | 661 | 5% |
| Tulip tree | 565 | 5% |
| London plane | 510 | 4% |
| Maidenhair tree | 507 | 4% |
| Shamel ash | 417 | 3% |
| Total | 8091 | 65% |

Tree diameter (measured at 4.5 ft, known as diameter at breast height or DBH) data from the inventory correlates well with the tree height data. About 29% of the trees in the inventory have a DBH of 12 inches or more (*figure 3-15*). Nine species account for 62% of these larger trees (Table 3-3). The top nine species by trunk diameter includes all of the species shown in Table 3-2 except London plane. Carob ranks in the top nine for trunk diameter, but is not in the top nine for height.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

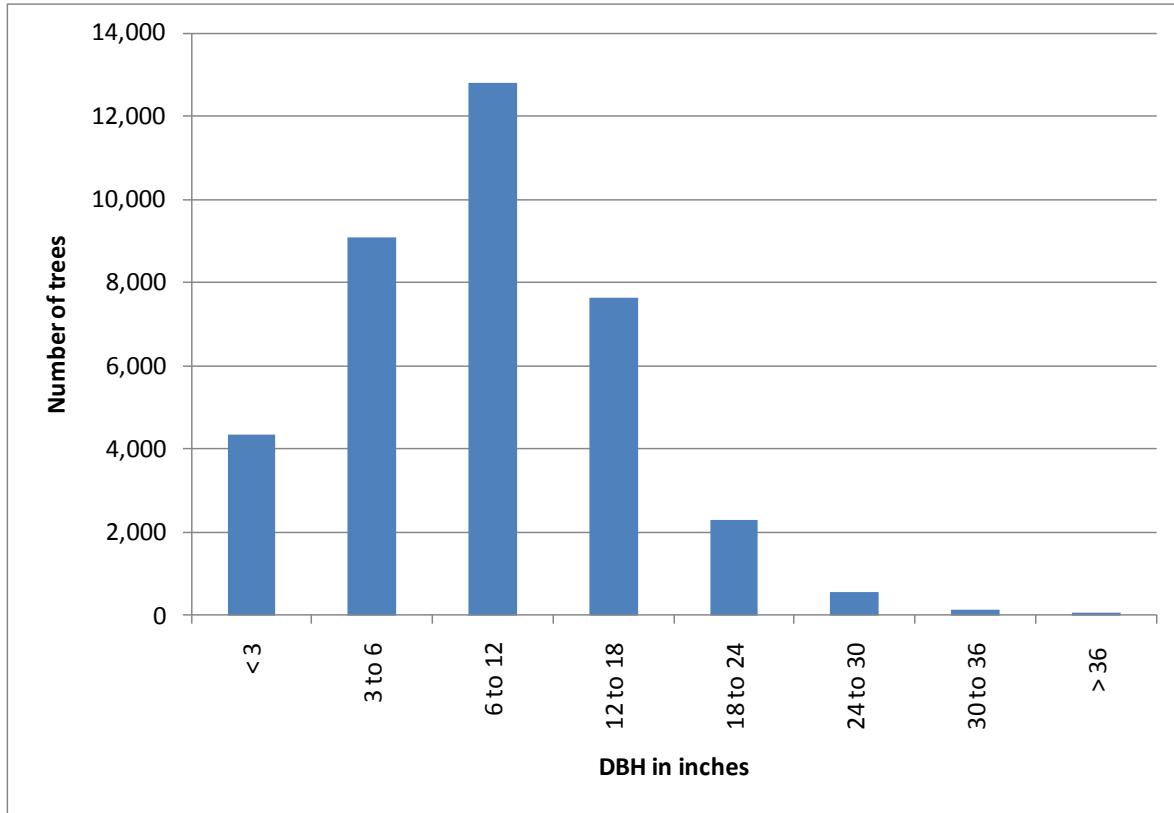


Figure 3-15. Diameter (DBH) distribution of Sunnyvale street trees (source Street Tree Inventory, Jan 2010).

Table 3-3. Largest diameter trees in the municipal street tree inventory (Jan 2010) by species.

| Level | Number with DBH of 12 inches or more | Percent of large diameter ($\geq 12"$) trees |
|-------------------|--------------------------------------|--|
| Sweetgum | 1598 | 15% |
| Southern magnolia | 1559 | 15% |
| Holly oak | 733 | 7% |
| Chinese pistache | 638 | 6% |
| Carob | 522 | 5% |
| Coast redwood | 484 | 4% |
| Tulip tree | 373 | 4% |
| Shamel ash | 372 | 3% |
| Maidenhair tree | 335 | 3% |
| Total | 6614 | 62% |

To estimate the percentage of street trees that are near their mature size, we cross-tabulated inventory height and DBH data against tree size classes at maturity. This analysis indicates that

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

at least one third (about 12,500 trees) of existing city street trees are currently below their mature size. This suggests that a wide majority of existing city street trees are close to their potential mature size. The preponderance of relatively large-statured, mature trees in the street tree population accounts for the large contribution that street trees make to the City's overall canopy cover. A challenge for the future will be maintaining street tree canopy cover as increasing numbers of these mature trees reach the end of their useful life.

Damage to city street trees

Given both the overall values provided by City Street trees and the City's investment in these resources, it is important to prevent avoidable damage to these trees. Damage can result in the premature loss of trees, with associated loss of benefits. Additional costs are incurred when damaged trees need to be prematurely removed and replaced.

Soil excavation that damages tree roots is one of the most common causes of avoidable damage in urban tree populations. Damage to roots of City street trees has been minimized by the joint administration of Street Tree Services and Concrete Maintenance. Sidewalk and curb repairs near trees, if conducted without proper care, have the potential to severely affect tree health and create hazardous situations that may lead to tree failure. A recent reorganization (May 2011) of Public Works has administratively separated Street Tree Services and Concrete Maintenance programs. Without close coordination of these programs, costly damage to City street tree resources could become more common.

In addition, no mechanism currently exists to identify other public and private construction activities near street trees that have the potential to affect tree root systems. One possibility would be to institute a "call before you dig" program similar to, and perhaps coordinated with, the Underground Service Alert (USA) program. Under such a program, Street Tree Services would receive notification when excavation, trenching, pavement removal, or other activities are scheduled to occur within a given radius of a City street tree. Street Tree Services would assess the situation and specify procedures to prevent negative impacts to tree roots. City inspectors would enforce specified tree root protection measures.

3.3.3. Park trees

Key Findings

- The Parks Division manages about 5,800 trees in parks and around public facilities in Sunnyvale.
- As of July 2010, responsibility for the 1,164 trees in street medians was transferred to Parks.
- Most park and facility trees are medium-statured to large-statured at maturity.
- Overall park and facility species diversity is high, but coast redwood is present at high levels (28%) indicating that it is overused in parks and facilities plantings.
- Expanded use of native species including locally native should be considered where appropriate.

Sunnyvale has 21 city parks that offer a variety of recreational activities. The parks are categorized as mini, neighborhood or community parks depending upon their size and have many amenities including tennis courts and basketball courts, sports fields, playgrounds, picnic areas and landscaping including trees. The Neighborhood Parks and Open Space program in the Parks Division maintains parks, public grounds, regional open space and the open space at various school sites through joint-use agreements with school districts. In addition, the Median

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Boulevards program in Public Works was absorbed by this program in 2010. These trees are included in the above section on street trees.

According to the tree inventory maintained by the Parks Division, there were 5,824 trees planted in parks and around other facilities as of the 1999/2000 inventory. The Street Tree inventory lists 1,164 trees on street medians.

Most park and facilities trees are evergreen conifers and broadleaf trees (*figure 3-16*). There is a higher percentage of conifers among parks and facilities trees than among street trees (*figure 3-11*). This is in large part due to extensive plantings of coast redwood, as noted below. The most widely planted broadleaf tree in parks and facilities is Chinese pistache (7.8% of all trees), which is also one of the most common street trees.

Approximately 135 different tree species are planted in City parks and other facilities (Table 3-8). Plantings at most parks and facilities are diverse, but some locations have only a few tree species. In many locations, most of the trees are of only two or three species. Although overall species diversity is relatively high, coast redwood (*Sequoia sempervirens*) accounts for 28% of all trees in the inventory. This is a high percentage for a single species, which suggests that coast redwood has been overused to some degree.

Sunnyvale is not within the natural range of coast redwood. Coast redwood is relatively sensitive to salinity and requires moderate to high levels of irrigation to remain in good condition in Sunnyvale's climate. Although coast redwoods grow quickly in a variety of sites when young, they can outgrow their rooting space and become chronically water stressed. This accounts for the poor condition of redwoods seen in some areas (e.g., smaller planting beds near City Hall).

In contrast to coast redwood, coast live oak and valley oak are trees that are native to Sunnyvale and are better adapted to local weather and soil conditions. However, these native oaks make up less than 2% of all trees in the inventory.

We used the tree size classifications from i-Tree's software package to determine the potential size distribution of these trees at maturity. This analysis shows that most trees in parks and city facilities are large-(55%) or medium-statured (32%) at maturity. Only about 9% of the trees in parks are small-statured trees, but small trees are more common (about 13% of all trees) around city facilities and schools maintained by the Parks Division. Judging from aerial photos, many of the trees in these sites are at or near their mature size, but the Park Division tree inventory did not include current tree size data.

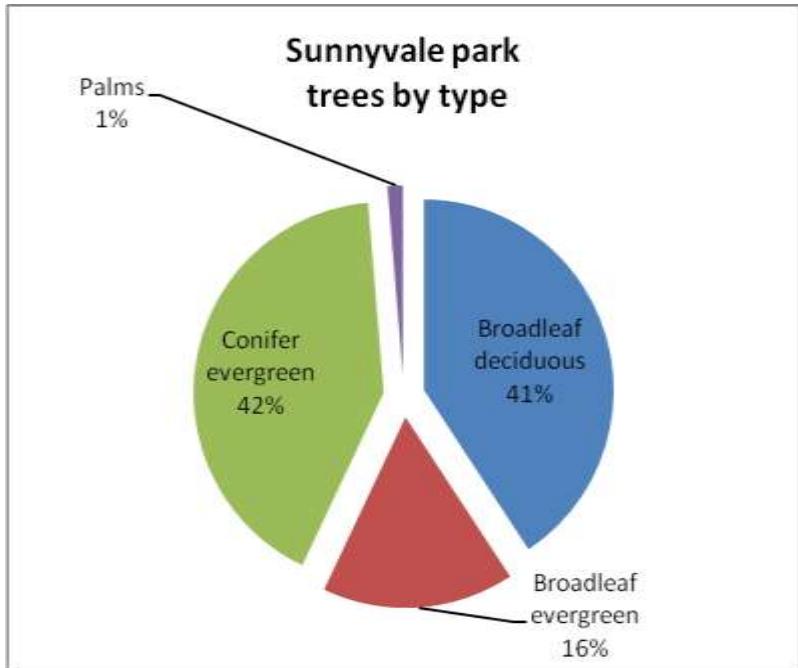


Figure 3-16. Sunnyvale park and facility trees by type.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Table 3-8. Summary of trees in the Parks Division 1999/2000 tree inventory.

| Site | Number of species | Number of trees | Acres |
|-------------------------|-------------------|-----------------|-------|
| Bishop School | 3 | 28 | 3.2 |
| Braly | 10 | 114 | 5.6 |
| Braly School | 4 | 14 | 4.0 |
| Butcher's corner | 4 | 33 | .7 |
| Cannery | 2 | 23 | 0.7 |
| Cherry Chase School | 4 | 60 | 5.2 |
| Civic Center campus | 22 | 531 | 13.4 |
| Columbia Park/School | 13 | 186 | 14.7 |
| Community Center | 25 | 428 | 33.1 |
| Cumberland School | 6 | 72 | 4.9 |
| Cupertino Middle School | 5 | 250 | 12.9 |
| De Anza | 21 | 220 | 9.4 |
| De Anza School | 5 | 12 | 5.8 |
| Ellis School | 8 | 51 | 3.6 |
| Encinal | 11 | 120 | 4.2 |
| Fair Oaks | 28 | 198 | 15.3 |
| Fairwood Park | 3 | 67 | 1.9 |
| Fairwood School | 7 | 129 | 4.6 |
| Greenwood Manor | 3 | 11 | 0.4 |
| Hollenbeck School | 8 | 88 | 5.0 |
| Lakewood Park | 21 | 213 | 10.7 |
| Lakewood School | 7 | 34 | 4.6 |
| Las Palmas | 27 | 489 | 24.3 |
| Murphy | 22 | 192 | 5.4 |
| Nimitz School | 8 | 84 | |
| Orchard Gardens | 5 | 27 | 2.6 |
| Ortega | 26 | 365 | 18 |
| Panama | 11 | 69 | 4.9 |
| Ponderosa | 21 | 224 | 9.1 |
| Ponderosa School | 3 | 24 | 4.0 |
| Raynor | 27 | 285 | 14.7 |
| San Antonio | 8 | 110 | 5.8 |
| San Miguel School | 4 | 71 | 3.0 |
| Serra | 34 | 507 | 11.5 |
| Serra School | 7 | 26 | 5.8 |
| Sunnyvale Middle School | 10 | 122 | 15.1 |
| Vargas School | 3 | 51 | 3.5 |
| Washington | 31 | 244 | 11.9 |
| West Valley School | 1 | 24 | 4.6 |

3.3.4. Heritage trees

Trees may be designated as heritage landmarks following the provisions of Chapter 19.96. Heritage Preservation, in the Sunnyvale municipal code (see section starting on page 79). As of January 2009, trees at 14 addresses were listed in the Heritage Resources Inventory (Table 3-9). Trees at one additional address were listed in the Local Landmark inventory (Table 3-9).

Table 3-9. Trees protected by the Heritage Preservation Chapter of Sunnyvale Municipal code as of January 2009.

| Species | Street | Address |
|--|---------------------|--|
| Coast Live Oak | Bernardo Avenue | 1650 S. Bernardo |
| Coast Live Oak | Calgary Drive | 1748 Calgary Drive |
| Palm Trees | California Avenue | 130 E. California (Site of Murphy Homestead) |
| Dawn Redwood | Dartshire Way | 814 Dartshire |
| American Chestnut | Hendy Avenue | 501 E. Hendy |
| Sycamores | Hollenbeck Avenue | 880-882 Hollenbeck (Bocks Ranch) |
| Valley Oak | Ives Terrace | |
| Coast Redwood | Manzanita Avenue | 755 Manzanita |
| Coast Redwood | Pastoria Avenue | 467 S. Pastoria |
| Coast Live Oaks | Picasso Terrace | 674 Picasso |
| California Live Oak | Remington Drive | 550 E. Remington (Community Center) |
| Coast Live Oak | Sheraton Drive | 696 Sheraton Drive |
| Monkey Puzzle | Sunnyvale Avenue | 545 S. Sunnyvale |
| Variety Tree Grove | Town Center Lane | 2502 Town Center Lane (Town Center Trees) |
| Coast Live Oak | Tiffany Court | 679 Tiffany Court |
| Removed from the inventory | | |
| Valley oak | W. El Camino Real | 1111 W. El Camino Real |
| Casa Delmas Magnolia | Heatherstone Avenue | 960 Heatherstone |
| California Black Walnut | Murphy Avenue | 529 S. Murphy |
| City of Sunnyvale local landmarks adopted in 1979 | | |
| Vargas Redwood Trees ¹ | Carson Drive | 1004 Carson Drive |

¹These Coast Redwoods were planted in 1900 by Manuel Vargas, "Mr. Sunnyvale." The saplings were gathered during a family outing to Pescadero, and planted at the entrance to the Vargas family home. Source: <http://sunnyvale.ca.gov/NR/rdonlyres/CD341FEE-80EF-42BE-8009-F1370455CB9D/0/HeritageResourcesandLandmarkAlterationFINAL.pdf> Dated 1/09 for Heritage trees and 7/07 for Landmark trees.

4. Status of Current Tree Management

Key Findings

- Privately managed trees account for about 80% of the tree canopy citywide, but only 50% of trees along streets.
- Street Tree Services cares for 88% of city-managed trees.
- Starting in the 1980s, Street Tree Services has had a well-organized management program with clear objectives and quality measures.
- Until 2010, most pruning of city street trees was done on a planned program basis.
- Due to budget reductions, as of FY 2010-11 Street Tree Services staffing levels have been reduced to the level that it is no longer possible to follow a scheduled pruning cycle.
- As of July 2010, the Urban Landscape Manager implemented a priority pruning plan. Trees are prioritized on an immediate need/hazard basis and pruning is scheduled weekly by priority.
- Although street tree planting outpaced tree removal (FY 2008-09 data), plantable vacant street tree sites are likely to remain empty for more than a decade at current planting and removal rates. Parks planted more trees than they removed in FY 2009-10.
- As of January 2013 Sunnyvale has contracted with West Coast Arborists to prune city street trees on a block grid basis. Minimum contract pruning is 5,000 trees per year. Between city staff and contract staff approximately 7,000 street trees are pruned each year.
- As of July 2013 tree removals and new tree planting are done by contract.
- Management of trees by the Parks Division relies primarily on frequent visual inspections by city staff.
- Parks uses contractors or contracts with Street Tree Services for pruning on larger trees (above 14 ft. or beyond pole saw range) and for removal of trees above 20 ft. in height.
- The tree inventory maintained by Parks is a summary of species by location and cannot be used for scheduling or tracking maintenance.

4.1. Urban forest management responsibilities

In Sunnyvale, as in most cities, private landowners manage most of the trees in the urban forest. We estimate that privately managed trees account for about 80% of the tree canopy citywide.

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Residential property owners, including apartment complex owners, manage about two thirds of these private trees. Commercial and industrial property owners manage the remaining trees.

The City of Sunnyvale is responsible for most of the city's remaining canopy cover (about 20% of total). Most of these trees occur in highly visible, high-use areas. CalTrans manages trees along state highways that pass through the City of Sunnyvale, which make up a small fraction of the trees managed by public agencies. Street Tree Services manages trees within the ROW along City streets, which account for about 88% of the trees under municipal management. The Parks Division manages the remaining municipal trees, as shown in Table 3-7. If the City fails to manage its portion of the urban forest effectively, it cannot provide the leadership and direction needed to promote care of the urban forest on private properties.

Table 4-1 below summarizes which entities had responsibility for maintaining the various components of Sunnyvale's urban forest as of July 2010. Further reorganization of the units responsible for municipal tree care occurred in May 2011 (Table 4-1a). Although almost all maintenance of private trees is the responsibility of landowners, some activities are regulated by the City through the Community Development Department.

Table 4-1. Entities responsible for tree care-related activities on public and private lands in Sunnyvale as of July 2010. Regulatory / oversight relationships are shown in italics.

| Activities | Trees on public lands | | | Trees on private lands | |
|--|-----------------------|-------|------------------|--|--|
| | ROW* | Parks | Other facilities | Residential | Commercial |
| Planting | | | | | |
| new sites - planting requirements | STS, Parks* | Parks | Parks | owner/developer <i>Community Dev.</i> | owner/developer <i>Community Dev.</i> |
| replacement plantings - replacement requirements | STS, Parks* | Parks | Parks | owner | owner <i>Community Dev.</i> |
| Pruning | | | | | |
| scheduled | STS, Parks* | Parks | Parks | owner | owner |
| storm/emergency | STS | Parks | Parks | owner | owner |
| utility clearance (electrical transmission and distribution lines) | PG&E | PG&E | PG&E | PG&E | PG&E |
| street safety clearance (visibility and physical clearance) | STS, Parks* | Parks | Streets | STS (non-inventoried street trees) | STS (non-inventoried street trees) |
| Tree removal | | | | | |
| Hazard & dead/dying trees - Permits - protected trees | STS, Parks* | Parks | Parks | owner <i>Community Dev.</i> | owner <i>Community Dev.</i> |
| Clearance (for flood control, traffic visibility, fire safety, etc.) - Permits - protected trees | STS, Parks* | Parks | Parks | owner <i>Community Dev.</i> | owner <i>Community Dev.</i> |
| Other reasons - Permits - protected trees | STS, Parks* | Parks | Parks | owner <i>Community Dev.</i> | owner <i>Community Dev.</i> |
| Root system work | | | | | |
| Sidewalk/curb repair and replacement | CM | | | -- | -- |
| Excavation for utilities - Permits | contractors CE | | | contractors | contractors |
| Construction | contractors | | | owner/developer | owner/developer |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| | | | | |
|-----------|-----|--|----------------|----------------|
| - Permits | STS | | Community Dev. | Community Dev. |
|-----------|-----|--|----------------|----------------|

STS=Street Tree Services; CM= Concrete Maintenance; CE = City Engineer

* As of July 2010, management of street trees on medians was transferred to Parks. STS performs emergency work for median trees and contractors provide all planned work that can't be done from the ground. As of July 2011 STS was moved into the Parks Division and CM was moved to PW Street Operations.

Table 4-1a. Recent reorganization affecting city departments that care for trees.

| Unit | Department | |
|----------------------|--------------|--|
| | July 2010 | May 2011 |
| Street Tree Services | Public works | Parks Division , now within Public Works |
| Concrete Maintenance | Public works | Street Operations, within Public Works Operations Division |

4.2. Street tree management by Street Tree Services

Starting in the 1980s, Street Tree Services has had a well-organized management program with clear objectives and quality measures (Appendix 6.7 page **Error! Bookmark not defined.**). Recent budget and staffing cuts have reduced the ability of the Urban Landscape Manager to meet these objectives and quality measures.

4.2.1. Pruning

Until 2010, most pruning of city street trees was done on a planned program basis. Each tree in the inventory was assigned to a pruning cycle. In the early 1980s through 2002, each tree was checked on a four year interval. Beginning with the 2003-2004 fiscal year, the pruning cycle was expanded to a 5.5-year cycle to reduce costs. With further budget reductions and staff hiring freezes, the pruning cycle was expanded for some trees and the average trim cycle length was about 7 years, with a median trim cycle length of about 6 years. Figure 4-1 shows the distribution of trees by trim cycle before the 2010-11 budget cutbacks.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

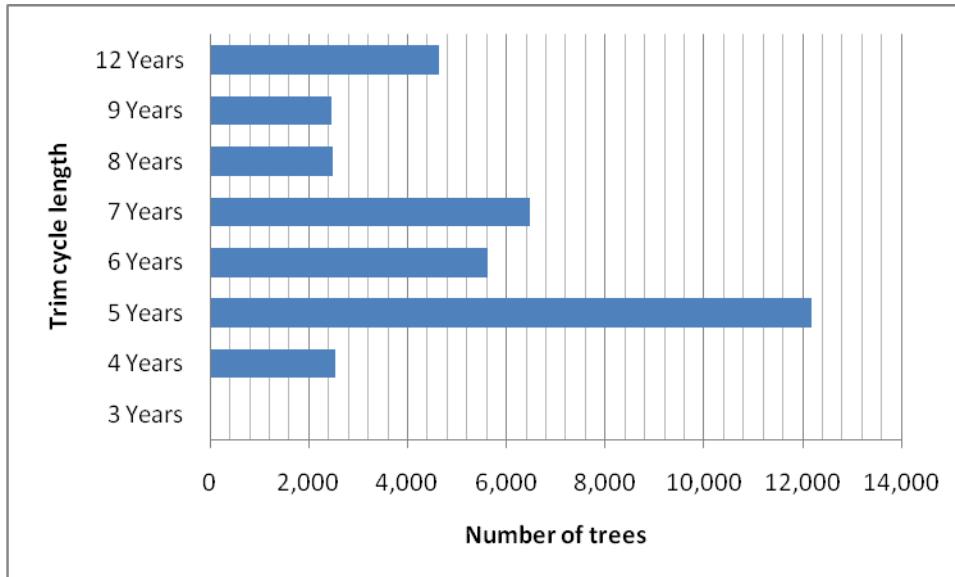


Figure 4-1. Trim cycle lengths shown in the Street Tree Inventory. Only 25 trees were assigned to the 3 year pruning cycle, so the bar is too short to show in the graph.

Operating under this system, Street Tree Services performed scheduled structural pruning on 5,152 trees in larger size classes in FY 2008-09 (Table 4-2). An additional 1,259 young trees had structural pruning. Altogether, about 17% of the street trees received scheduled maintenance in FY 2008-09. Emergency pruning was conducted on 409 trees, or approximately 1% of the street trees, due to broken branches. In addition, 52 non-inventoried trees were pruned for safety reasons identified by traffic engineering, such as line-of-site improvements at intersections or street light clearance.

Due to budget reductions, as of FY 2010-11 staffing levels were reduced to a level that it was no longer possible to follow a scheduled pruning cycle. As of July 2010, the Urban Landscape Manager implemented a priority pruning plan. Trees are prioritized according to immediate need/hazard and pruning is scheduled by priority. The primary tree species that warranted priority pruning in 2010 were Chinese Pistache, Liquidambar, and Carob.

City residents made service requests for specific street trees for a wide variety of tree care related issues, but most requests for pruning were denied. Street Tree Services received 2,036 requests for service in FY 2008-09, and pruned 148 trees in response to these requests. Prior to staff reductions that occurred in FY 2003-04, Street Tree Services performed more pruning related to service requests than it does at present.

Table 4-2. Pruning by Street Tree Services of trees in the ROW for fiscal year ended June 2009.

| Unit | Units completed | Per unit cost | Total |
|---------------------------------------|-----------------|---------------|----------|
| tree pruned - service request | 148 | 162.34 | \$24,026 |
| tree pruned - limb down on duty hrs. | 353 | 76.96 | \$27,167 |
| tree pruned - limb down off duty hrs. | 56 | 279.81 | \$15,669 |
| tree structure pruning <15 ft. tall | 893 | 28.71 | \$25,638 |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| | | | |
|---|-------------|---------------|------------------|
| tree structure pruning 15-30 ft. tall | 1984 | 72.06 | \$142,967 |
| tree structure pruning 30-60 ft. tall | 2193 | 153.86 | \$337,415 |
| tree structure pruning >60 ft. tall | 82 | 268.06 | \$21,981 |
| non-inventoried tree safety clearance pruned | 52 | 120.09 | \$6,245 |
| equipment maintenance [costs associated with pruning] | | | \$65,536 |
| Total - pruning activities | 5761 | 115.72 | \$666,644 |

Street Tree Services follows International Society of Arboriculture Best Management Practices for pruning, which is based on the ANSI A-300 Pruning Standards. Most service requests for pruning fall outside of these standards. Most trees that are pruned as a result of service requests are trees that have an elevated likelihood of limb failure if not pruned before the next scheduled pruning.

In addition to pruning of mature trees, Street Tree Services has a program to prune young trees within the first three years from planting to develop their permanent structure conforming to ISA structural integrity standards. This structural training (Table 4-3) is important for developing good primary structure in young trees that reduces future pruning cost by avoiding weak or problematic branch structure.

4.2.2. Tree removal and planting

In FY 2008-09, 363 city street trees were removed. Street Tree Services most commonly removes street trees because an imminent hazard has been identified. Specific reasons for removal include:

- Catastrophic limb failure has occurred and the remaining portion of the tree poses a hazard
- Significant decay in trunk/roots
- Dead or seriously declining tree
- Declining performance of tree beneath power lines – City cooperates with PG&E for removal
- Sweetgum removal - by property owner expense + limited annual city funding

Branches and waste wood from removals and pruning operations is ground to chips if possible. Some chips may be used on site, but most waste material, including wood too large to be chipped with mobile chippers, is taken to the Sunnyvale Materials and Recovery Transfer (SMaRT) Station® for composting. Street Tree Services currently pays about \$1,300 per year for disposal of waste wood at this facility.

Street tree planting outpaced tree removal by 166 trees, with 529 trees planted in FY 2008-09 (Table 4-3). As of January 2010, the street tree inventory had at least plantable 2,200 empty sites, assuming that about half of the inventory's empty sites were priority planting sites (i.e., no serious limitations). If planting continued to outpace removal by 166 trees per year, it would take over 13 years to fill these priority planting sites.

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Newly planted trees typically require several years of irrigation until they become established. Where other sources of water are not available, new trees up to 2008-09 irrigated from a water truck for three years. Although the cost of the water is insignificant, irrigation via water truck delivery is relatively intensive in terms of labor and equipment costs. Street Tree Services has historically checked to see if adjacent property owners would provide irrigation. Beginning in FY 2009-10, Street Tree Services began a more formal campaign to have the adjacent property owners water newly planted trees. Starting in FY 2010-11, a written agreement to provide irrigation will be made between the owner and the City for all new street tree planting. For FY 2010-11, Tree Services has a small amount of funds set aside to water trees in locations where the adjacent property owner is unwilling to provide irrigation or does not have responsibility over the land where the tree is planted. As of 2012-13 funding for supplement street tree watering was eliminated. If the city cannot get a commitment from the adjacent property owner to irrigate newly planted trees then trees are not planted. Citizen volunteers under the oversight of a non-profit urban forestry organization could be utilized to monitor and water trees in such situations.

Inspection of new plantings

Trees planted by city staff are inspected prior to planting. Circling roots are removed or pruned prior to planting. Trees with severe root deformations are rejected and not planted. At the time of structural training pruning, trees are inspected for growth and performance.

For city street trees planted by developers, Street Tree Services is supposed to be notified so that nursery stock can be inspected before it is planted. Street Tree Services also ensures that proper planting procedures are followed. However, at the height of the most recent construction boom, Street Tree Services has not been able to inspect all developer plantings. In many cases, Street Tree Services was not notified about impending plantings. The Urban Landscape Manager believes that educating other City building inspectors about Street Tree Services' requirements would help boost compliance and improve timeliness of notification.

Tree nursery

Street Tree Services maintains a small nursery facility that is used to hold trees obtained from commercial nurseries until they can be planted. Most trees are ordered in advance of fall/winter planting. Orders for nursery stock are scaled to match demand to the degree possible so that material does not need to be held in the nursery beyond the planting season. A drip irrigation system on a battery/solar controller is used to keep trees watered.

Table 4-3. Activities of Street Tree Services related to planting and removal of trees in the ROW for fiscal year ended June 2009.

| Units | units completed | per unit cost | total |
|----------------------------|-----------------|---------------|-----------|
| tree removed down to stump | 363 | 305.86 | \$111,027 |
| contract stump ground | 470 | 172.17 | \$80,920 |
| contract tree planting | 459 | 168.93 | \$77,539 |
| tree planting by staff | 70 | 105.4 | \$7,378 |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| | | | |
|--|-------|--------|------------------|
| private tree removal permit application reviewed | 442 | 60.49 | \$26,737 |
| project plan reviewed | 16 | 302.84 | \$4,845 |
| tree watering | 6497 | 6.54 | \$42,490 |
| young tree structural training | 1259 | 15.53 | \$19,552 |
| maintain tree nursery | 89.57 | 62.18 | \$5,569 |
| equip maintenance related to tree replacement | 538 | 30.52 | \$16,420 |
| Total - planting and removal activities | | | \$392,477 |

4.2.3. Other program activities

One of the program goals of Street Tree Services is to provide a high level of customer service to city residents and other City divisions. By responding to residents' service requests, Street Tree Services provides important community outreach as well as making use of information provided by residents to more quickly locate and address maintenance issues. Street Tree Services also assists the Risk and Insurance Division in evaluating claims against the City. As shown in Table 4-3, Street Tree Services also assists Community Development by reviewing project plans.

Street Tree Services also reviewed 442 private tree removal permit applications (Table 4-4). The Planning Division has the authority to issue permits for removals of private trees that are protected under the City's Tree Preservation ordinance. Street Tree Services advises the Planning Division relative to private tree removal requests, but does not approve or deny permit requests. The Planning Division approves about 90% of the submitted requests for tree removal. The number of tree removals that occur on private properties outside of the permit process is unknown.

Table 4-4. Other Street Tree Services program activities for fiscal year ended June 2009.

| Units | units completed | per unit cost | total |
|--|-----------------|---------------|-----------------|
| respond and investigate a service request | 2036 | 25.3 | \$51,511 |
| structural integrity survey | 3 | 10.24 | \$31 |
| investigate claims from Risk and Insurance | 24 | 47.74 | \$1,146 |
| Total-other program activities | | | \$52,688 |

Tree inventory maintenance

Street Tree Services uses the online internet-based version of Davey's TreeKeeper software to manage its tree inventory. The inventory database is maintained on computer servers belonging to Davey Tree. The Urban Landscape Manager administers access to the inventory. The fields in the inventory are shown in Table 4-4a.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

When the street tree program operated with a scheduled pruning cycles, the inventory could be used to schedule tree work. Due to budget cutbacks scheduled pruning was essentially eliminated until funding was restored in 2013 for contract tree care (primarily pruning) services. However, the inventory database is used to record what maintenance has been done on trees and provides information about the street tree population. The current contractor, West Coast Arborists, has their own tree inventory database, Arbor Access. All of Sunnyvale's the tree data in TreeKeeper was imported into Arbor Access. As of 2013 both systems are being used as staff become familiar with Arbor Access.

Table 4-4a. Fields in the Street Tree Inventory accessed Jan 2010.

| Field name | Information | Notes |
|------------|--|--|
| ID | A unique number for each planting site | Current range: 1 -41,358 |
| Unique id | Same as ID | |
| Address | Street address of tree | |
| Suffix | X or x- indicates fictitious address | Used for trees on streets with no address |
| Street | Street name of tree address | |
| On_Str | Street on which tree is physically located | |
| From_Str | Cross street 1 | |
| To_Str | Cross street 2 | |
| Side | Location of tree relative to address parcel | Front, side, or median |
| Site | Planting site number if multiple trees at same address | |
| Spp | Species | “vacant” if empty planting space |
| DBH | DBH (inches) by size range | |
| HT | Height (ft) by size range | |
| Trunks | Number of trunks | Not current |
| MT | Maintenance | Various notes about maintenance |
| Tr_cycle | Trim cycle the tree is assigned to | |
| STK | Stake present yes or no | |
| Grow | Growing space available | Open for monolithic sidewalks, otherwise width (ft) of parkway strip |
| Curb | Distance to curb for trees outside of the right-of-way | |
| Staff | Mostly blank, apparently not used | |
| Inspect | Y/N, apparently not used | |
| Area | Tree management zone | 1-7 (shown in figure 3-4) |
| Inv_Date | Date tree was added to the inventory | |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| | | |
|------------|---|----------------------|
| Inv_time | Not used | |
| Inspect_DT | Date of last inspection | |
| Inspect_TM | Time of last inspection in 24 hour time | |
| Notes | Notes about the tree | |
| Active | | All records have “1” |

Like any active database, the street tree inventory needs to be updated and maintained. In our analyses, we discovered a small number of data errors, including misassigned species and erroneous tree size data. The Urban Landscape Manager reported in January 2010 that updating of the inventory is backlogged due to a lack of staff resources. He was exploring the possibility of having community volunteers assist in maintaining the inventory.

The current tree inventory is based on street addresses and does not include actual geographic coordinates needed to display tree locations in a GIS. Georeferencing of the tree inventory would need to be performed to make the database GIS compatible. This would be a significant undertaking, but could be performed by trained volunteers largely by utilizing available aerial imagery and software (e.g., Google Earth). West Coast Arborist has volunteered to update the street tree inventory database with updated tree data as well as georeferencing into Arbor Access as their crews perform block/grid pruning activities.

4.2.4. Budget

Currently, Street Tree Services is funded from the city general fund. As such, its budget is subject to fluctuation along with other general fund programs during times of decreased revenues. The budget and staffing levels of Street Tree Services have undergone several rounds of reductions over the past decade, decreasing its capabilities. However, maintenance needs of the city street trees do not decrease even if budgets decrease. Deferring tree maintenance, such as young tree training, can result in much higher future costs. Timely maintenance can prevent trees from becoming hazardous or developing structure problems and is more cost efficient than trying to correct these problems. With the restoration of funding from additional city revenues, the street tree program has a \$475,000 funding increase as of FY 2012/13. This new funding is directed to contract tree work primarily block or grid structural pruning and additional services including tree removals and planting.

4.3. Concrete maintenance

Key Findings

- Concrete Maintenance has had a well-organized program with clear objectives and quality measures through FY 2010-11.

- Concrete repair around existing city trees through FY 2010-11 performed by personnel with knowledge of tree physiology and structure. This safeguards the City's investment in street trees.
- Beginning FY 2011-12 Concrete Maintenance program was transferred to Street Maintenance Operations manager. Street Tree Services and City Arborist become advisory to Public Works Project Administration.
- City Arborist called upon to advise PW inspectors regarding tree root mitigation associated with right-of-way concrete maintenance/replacement.
- Parkway planting strips were discontinued in new development in 1963, approximately 20,000 street trees occur in parkway strips 5.5 ft. or less in width. Post 1963 all sidewalks were installed monolithic to the curb [sidewalk is at the curb]
- In 2013 parkway strips were reestablished in industrial zones and in ITR [industrial to Residential] zones
- Concrete repair will be an ongoing need for hardscape near trees in narrow parkway strips.

4.3.1. Current status

Sunnyvale has 375 miles of public streets. Based on our aerial photo analysis, approximately 20% of Sunnyvale's land area is covered by streets and highways. Almost all (98%) city streets have curbs, and 80% have sidewalks. Typical residential streets have a public right of way that extends 11 feet from the curb face. Some of the older streets have been widened over time, and as a result, the ROW became narrower as the paved portion of the street increased in width.

The standard width for a sidewalk in most of Sunnyvale is 4.5 ft. Among streets with sidewalks, 65% are designed with parkway strips (sidewalk is separated from curb and gutter, figure 4-4) and 35% are monolithic (sidewalk, curb and gutter are in one solid slab, figure 4-5). Monolithic sidewalk construction was the standard in new development between 1965 and 2013. Industrial zones off-road ROW has a 4 ft. parkway strip with a 6 ft. sidewalk.

Parkway strips allow for planting between the sidewalk and the curb. Among tree planting sites in the Street Tree Inventory, 57% are in parkway strips. Since the sidewalk is usually 0.5 ft. inside the edge of the right of way, and the curb is about 0.5 ft. wide, the standard parkway strip is 5.5 ft. wide (i.e., 11 ft. [ROW]-4.5 ft. [sidewalk] -0.5 ft. [curb]-0.5 ft. [sidewalk setback]=5.5 ft. parkway width).

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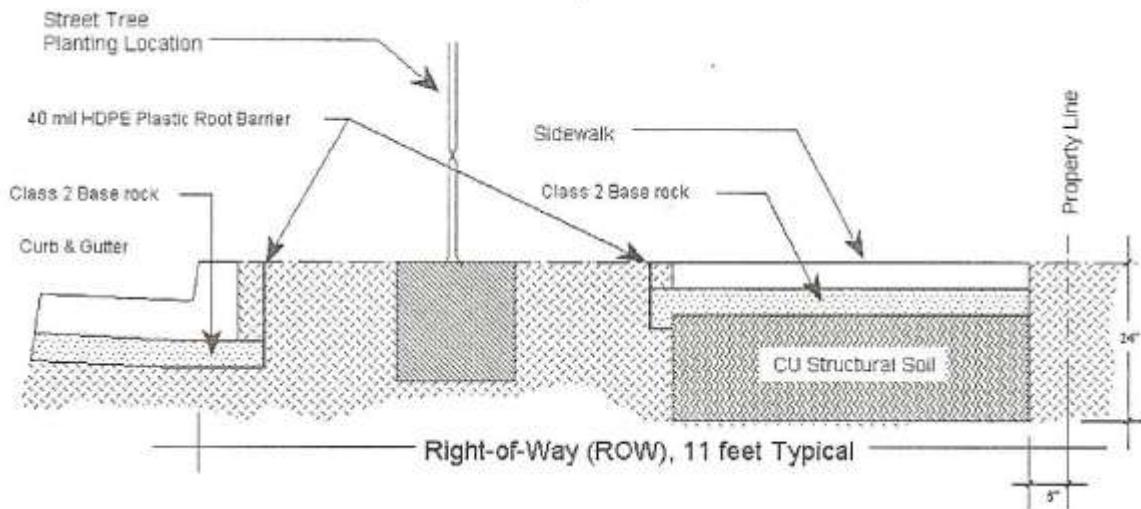


Figure 4-4. Tree planting diagram for parkway sidewalk construction.

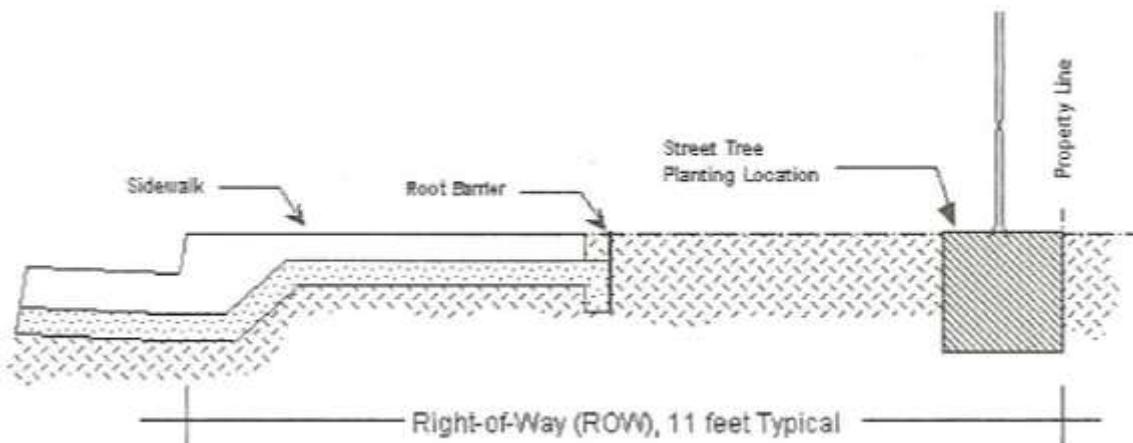


Figure 4-5. Tree planting diagram for monolithic sidewalk construction.

The center of a tree planted in the center of a 5.5 ft. wide parkway is about 2.75 ft. from both the edge of the curb and sidewalk. Most parkway planting strips in Sunnyvale are narrower than 5.5 ft. (figure 4-6). Approximately 20,000 street trees occur in parkway strips 5.5 ft. or less in width. Although many of these trees are small, others are large statured, and the parkway configuration does not provide enough room for root expansion. As a result, lifting of sidewalks and curbs is common around mature trees in the narrower parkway strips.

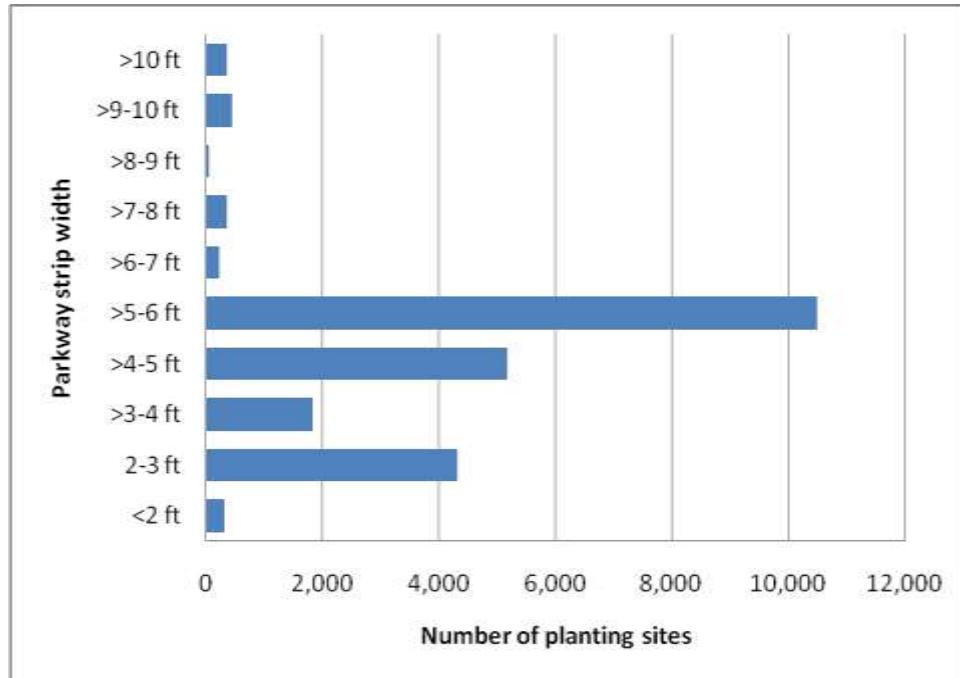


Figure 4-6. Number of planting sites by width of parkway strip. Fifty seven percent of all planting sites are parkway strip situations (source Tree inventory Jan 2010).

The Urban Landscape Manager functioned as the Concrete Maintenance Manager from 1989 to June 2011 and was responsible for concrete maintenance in the city ROW. This arrangement ensured that the needs and limitations of trees were considered when concrete repairs were conducted. Until FY 2011-12, Concrete Maintenance has had a well-organized program with clear objectives and quality measures (Appendix 6.8 page 100). Reorganization of the Public Works department in 2011 has reduced the ability of the Urban Landscape Manager to meet these objectives to insure healthy street trees in public ROW.

Concrete Maintenance and Street Tree Services worked hard to develop and implement solutions that retain as many street trees as possible while maintaining sidewalks that are pedestrian friendly and ADA compliant. Sidewalk defects are found through citizen reporting and staff reporting.

Street Tree Services is testing several innovative methods to repair sidewalks. The current technical specifications for repairing sidewalks and retaining trees are included in the Technical Practices and Standards Manual. Methods being used include:

- lag bolting steel plates to roots or around roots, and then either repouring the sidewalk or replacing the sidewalk with pavers. The root cannot expand in diameter beyond the surface of the steel.
- curving sidewalks and curbs around root flares
- Removing offending roots if it can be done without compromising the physical support structure of the tree. Roots are pruned to a maximum depth of 10 inches. Roots deeper than 10 inches generally do not fracture concrete.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- Testing alternate sidewalk construction techniques. Rubber sidewalks were installed in 10 test locations in 2008 (Appendix page <need this info from LD in a word document>).

Concrete Maintenance puts temporary asphalt ramps on sidewalks with displacements of more than 1 inch. Sidewalks with less than 1 inch of horizontal displacement are ground.

An estimated 95% of the concrete repair budget is for concrete maintenance related to tree root damage. In addition to mitigating tree root problems associated with mature trees, until 2011 the Concrete Maintenance program also installed appropriate mitigations for newly planted trees to prevent future problems. Since 2011 the Street Tree Services program installs root mitigation by staff or by contract. Concrete repair is not limited to repair adjacent to inventoried street trees. The City repairs concrete sidewalks, curbs, and gutters damaged by tree roots irrespective of tree ownership. Budgets for Concrete Maintenance are shown in Figures 4-2 and 4-7.

The Street Tree Inventory data fields do not have a direct relationship with concrete maintenance activities. Concrete Maintenance activities are tracked using spreadsheets.

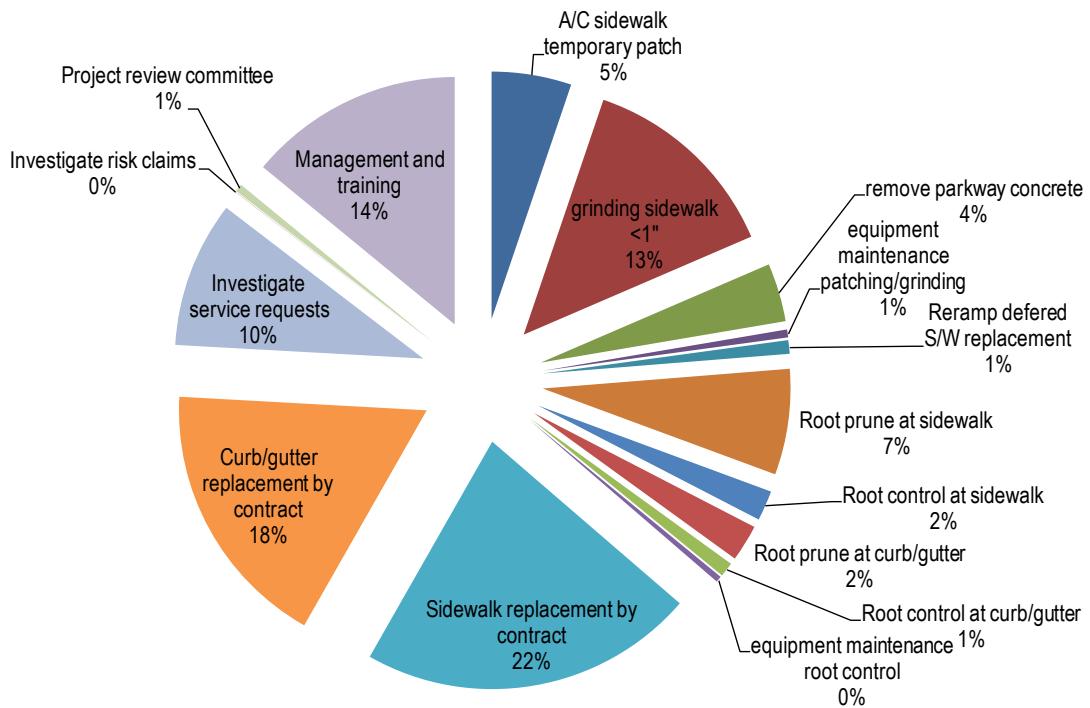


Figure 4-7. Concrete maintenance budget 2008-2009 fiscal year.

4.4. Park tree management

4.4.1. Program structure

Parks employees performed all tree planting and pruned trees from the ground with pole pruners up to a height of 14 feet. Parks staff also removed trees up to 20 feet tall. Emergency tree work

needing to be done within 72 hours was done by the Street Tree Services (Public Works) and billed to the Parks program. Street Trees Services also handled work on taller trees on boulevard medians. Based on January 2010 street tree inventory data, about 73% of all boulevard median trees are more than 15 ft. tall. Contractors pruned trees above 14 feet and removed trees taller than 20 feet. Contractors were required to have ISA certified arborists. Specifications included in the request for proposals for tree work required that contractors follow ANSI/ISA pruning standards and practices.

4.4.2. Tree pruning

In FY 2009-10, approximately 1,380 of the 1,492 tree-related services performed on trees managed by parks were related to pruning. All sites managed by Parks are inspected daily for all hazards, including tree-related hazards. All hazards are logged and abated within 24 hours.

4.4.3. Tree removal and planting

In FY 2009-10, 80 trees were planted and 32 trees were removed by Parks. Removed trees are replaced at the overall site where the removal occurred, but trees are not necessarily replanted in the same spot. Replacement species are selected on a case-by-case basis from the Parks Standard Plant List.

4.4.4. Tree inventory

Unlike the street tree inventory database, which includes a separate record for each tree, the inventory of park and facility trees is a summary table. The inventory is maintained as a word processing document that lists the number of trees per location by species. The current inventory dates to 1999-2000 and there is no set interval for updating the inventory. Descriptive data for individual trees is not available in the inventory, so it cannot be used to schedule maintenance activities or store other management data.

4.4.5. Budget

In FY 2011/12 the budget for supplies and tree work performed by city park staff was approximately \$125,000. The budget for pruning and removals by contractors was approximately \$50,000.

4.5. Existing ordinances, policies, and plans related to the urban forest

Key Findings

- The City of Sunnyvale's General Plan includes limited references to the city's urban forest and its importance.
- Several sections of city code regulate certain basic activities associated with the urban forest and nominally protect certain classes of trees. Some of these sections would be more effective if revised and updated.
- The city's updated General Plan should more clearly recognize the importance of the urban forest as a major part of the City's the biological infrastructure. Maintenance of

the urban forest is necessary to ensure that critical ecosystem services (e.g., urban floodwater runoff mitigation) continue to be provided.

- Section 19.38.070 (Landscaping, irrigation, and usable open space) should be revised to reference specifications for adequate soil testing and preparation prior to planting. Mechanisms for monitoring and enforcing maintenance and parking lot shading standards should be more clearly stated and implemented.
- The tree preservation ordinance (Chapter 19.94) should be revised to specify greater protection for roots of protected trees, improve the definition of protected trees relative to multi-trunked trees, and provide more objective standards for issuing tree removal permits.
- Current protection for city street trees in City code, chapter 13.16, is weak, as there is no mechanism for achieving compensation if a city street tree is damaged. Ordinance 13.16 should be strengthened to protect city-maintained trees in the public right-of-way.

The City of Sunnyvale has a number of existing policies and ordinances that pertain to the urban forest. Key provisions from these are briefly summarized below. We have also noted potential limitations or other issues that may influence the effectiveness of these policies and regulations. Tree-related provisions in these documents are included in the Appendix. Note that Sunnyvale is in the process of streamlining and reorganizing its General Plan. In the re-organization process sub-elements are being eliminated, therefore citations for some of the text cited below will change.

4.5.1. City of Sunnyvale Consolidated General Plan (2011)

The General Plan was consolidated in 2011 and is supportive of the urban forest although much of the language specific to the urban forest was removed. Those goals from the Community Vision section relating to trees are contained in section 7.

4.5.2. Sunnyvale Municipal Code

Chapter 13.16. City Trees

This is primarily the city's street tree ordinance. Its intent includes "Ensure the preservation of the city's urban forest" and calls for planting a minimum one tree per lot when new development occurs. It also calls for the planting of city street trees (in the public ROW) where feasible. The city superintendent of trees and landscaping is designated as the enforcing authority for regulating ROW tree planting, maintenance, and removal.

The code includes a number of standard provisions regulating tree management in the ROW. Intentionally damaging trees in ROW is designated as unlawful, but no sanctions are specified for violations. Therefore, city street trees have less protection than protected trees on private property: the Tree Preservation ordinance, Chapter 19.94, does not apply to street trees. We recommend that fines be established for damaging city street trees and that city

street trees be granted a level of protection at least equal to that provided to protected trees as defined in Chapter 19.94.

The code requires a permit to plant, remove, prune, or fertilize a ROW tree. It also establishes an official tree list to guide planting in the city ROW and forbids planting by residents in the ROW of trees not on the list. In practice, it has generally not been possible to enforce these provisions completely. Unapproved plantings are common, and these "unofficial city trees" account for much of the diversity of tree species found in the public ROW (see Species diversity page 47).

As an alternative, the city could develop a list of recommended and acceptable street tree species. This list would include information on suitable planting situations and specific limitations of listed species. Such a list would be advisory and would be subject to update as new species or varieties become available, or as new problems develop among trees on the list. The City should also develop a list of prohibited trees that should not be planted due to known problems (e.g., short life, pest/disease problems, invasive spread, etc.). These lists could provide guidance for planting without unduly restricting options for species selection.

The code also requires immediate removal of damaged trees that could be hazardous and calls for replacement of removed trees. This code section also defines public nuisances in the ROW as landscape plants or other materials that may pose safety hazards or have the potential to harm city street trees. City costs to abate these nuisances can be charged to adjacent property owner.

Chapter 19.37. Landscaping, irrigation, and usable open space.

Chapter 19.38. Required Facilities

These sections of code call for use of water conserving plants, hydrozoning, and landscaping in new development. It includes a number of detailed planting specifications, including an outdated tree staking specification that does not match current recommendations (see <http://www.ufeis.org/standards&specs.html#plant>). The planting specifications lack any reference to soil preparation prior to landscaping. Highly compacted and contaminated soils are one of the most important contributors to poor plant growth in urban landscapes.

This code also specifies that required landscaping must be maintained and replaced as needed. It is not clear how the maintenance requirement is monitored or enforced.

The code includes parking lot landscaping requirements that call for 50% parking lot shading after 15 years for surfaced areas that did not exist prior to 2002. No monitoring or means of enforcement are specified for the parking lot shading requirement. The original proposed Planning Policy called for a field review at 2, 5, 10, and 15 years to check for compliance, but funding for staff needed was never approved.

In order to increase canopy cover citywide, more canopy cover will be needed in parking lots. To increase the number of existing parking lots that fall under the 50% parking lot shading standard, the city would need to expand the scope of discretionary permits that trigger this requirement. The city could also explore the use of incentives to offset costs associated with retrofitting parking lots to increase tree canopy cover.

Chapter 19.94. Tree Preservation

This chapter is the city's tree preservation ordinance, which was enacted in 1991 and subsequently reviewed in 2005 and amended in 2006. The chapter applies to trees above a minimum trunk size on private property and within the city and city-owned golf courses and parks. It does not include trees in the public ROW, which are regulated under Chapter 13.16.

The code defines a tree as having a minimum circumference of 13 inches at 4.5 ft. above ground (=4.1 inches DBH). Trees of "significant size", i.e., "protected trees" have a circumference of at least 38 inches (=12 inch DBH). Multi-stemmed trees are not protected unless at least one stem is 12 inches DBH or the aggregate circumference is at least 113 inches. This corresponds to an effective aggregate diameter of 36 inches DBH. A tree with three 11.5 inch DBH trunks would not be protected under this standard, even though its canopy size and biomass would likely be greater than a single 12 inch DBH stem.

One way to deal with this disparity would be to use aggregate trunk cross-sectional area rather than aggregate circumference as the basis for defining protected trees. The 12 inch DBH trunk diameter of a protected tree has a cross-sectional area of 113 square inches. In the example above, a tree with three 11.5 inch DBH stems would have an aggregate cross-sectional area of 312 square inches and would therefore be protected. A tree with two stems 8.5 inches DBH each (aggregate cross sectional area= 113.5 square inches) would be the smallest protected two-stemmed tree using this criterion.

The code specifies that it is unlawful to damage or kill a protected tree, but protected trees can be removed if the owner obtains a permit from the Department of Community Development. Tree removal permits can be obtained for a wide variety of reasons, some of which are quite vague and/or subjective. Replacement trees may be required as a condition of a removal permit at the discretion of the Director of Community Development. Tree removal permit applications did not require a fee until FY 2009-10, when a fee of \$233 was instituted. Tree removals conducted by PG&E for line clearance purposes are exempt from this fee.

The ordinance also includes standards designed to protect retained trees during development. As written, these standards are not likely to provide adequate protection for all trees. This section also includes an erroneous statement indicating "the root system generally extends to the outermost edges of the branches". In fact, tree root systems typically extend out from the trunk a distance that is twice to three times that of the canopy. The inclusion of this statement in the code may result in the approval of plans that do not protect enough tree roots to ensure the health of retained trees.

Enforcement of this chapter is the responsibility of the Director of Community Development or their designee. The director has the option to issue a stop work order for a lack of compliance with approved plans or permits. The director (or designee) may also impose fines and "reasonable expenses and landscaping" in response to violations following an administrative hearing. Violators are also subject to civil monetary penalties, which require the prosecution of a civil action by the city attorney. To date, civil action has been taken in one case, involving unauthorized removal of a row of trees. The settlement in the case was \$112,000.

Review of tree removal applications has commonly been assigned to the least senior members of planning staff. This has led to a lack of continuity and uniformity in the application of the ordinance.

Chapter 19.96. Heritage Preservation

Sunnyvale's original Heritage Resources Inventory was adopted in 1979, recognizing properties that have architectural or historic significance. Trees may be designated as heritage resources following the provisions in this chapter (see appendix O1). Roughly eight of the 13 criteria used to nominate heritage resources (§19.96.050) could apply to trees. These criteria are related to historical significance, rarity, visual impact, and relationship to other heritage resources. A ‘Heritage’ tree is therefore quite different from a “protected” tree, which is designated by size as described above (Chapter 19.94 Tree Preservation page 76).

Only a few trees in Sunnyvale have been designated as Heritage trees. In January 2009, trees at 14 addresses were listed in the Heritage Resources Inventory. Most of these were individual trees, but some small groups of trees are listed as landmarks (Table 3-8). Trees at one additional address were listed in the Local Landmark inventory. To obtain permission to remove trees that are designated as heritage resources, an applicant must obtain both a Resource Alteration Permit approved by the Heritage Preservation Commission and a tree removal permit.

California Solar Shade Control Act

The California Solar Shade Control Act (Public Resources Code section 25980-25986) regulates potential shading of solar collectors by trees located on another property.

This code, originally adopted in 1979, was revised in 2009, as a result of the first and only prosecution that occurred under the 1979 act, which involved a property in Sunnyvale (*California v. Bissett*, No. BB727255, Cal. Sup. Ct. Santa Clara County March 28, 2008). The 2009 revision clarified and greatly restricted the scope of the original Act to reduce negative impacts to trees. The revised 2009 Act does not apply to:

- (a) Trees or shrubs planted before the solar collector was installed
- (b) Trees planted, grown, or harvested on timberland or on land devoted to the production of commercial agricultural crops
- (c) the replacement of a tree or shrub that had been growing prior to the installation of a solar collector and that, subsequent to the installation of the solar collector, dies, or is removed for the protection of public health, safety, or the environment.
- (d) Trees or shrubs that are subject to a city or county ordinance (such as a tree protection ordinance).

In addition, solar collectors that are designed and intended to offset more than the building's electricity demand (i.e., providing a profit to the solar collector owner) are not covered in the act. In addition, violations of the Act are classified as private nuisances (as defined in Section 3481 of the Civil Code), rather than public nuisances.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

The 2009 Act also indicates that local (city or county) ordinances specifying requirements for tree preservation or solar shade control have precedence within the jurisdiction. As in the original Act, a city or county can pass an ordinance to exempt the jurisdiction from the Act. The City of Sunnyvale has not exempted itself. Given that the 2009 revision has eliminated the previous shortcomings of the Act, we do not recommend that the City take action to exempt itself.

5. Community

Key Findings

- The urban forest is considered an important contributor to the attractiveness and livability of Sunnyvale.
- There is strong interest on the part of some Sunnyvale residents in forming a citizens group to advocate and care for the urban forest.
- Citizens of Sunnyvale tend to be well educated and relatively affluent, compared to residents of many other California communities.
- A large majority of the population has lived in Sunnyvale less than 10 years.
- Forty-seven percent of homes in Sunnyvale are occupied by renters.
- The City will need to maintain an ongoing program of outreach and education to ensure that residents and landowners have the information they need to make good tree care decisions. These efforts need to resonate with Sunnyvale's diverse population.
- An active urban forest volunteer group in Sunnyvale could assist with public education and outreach and provide direct assistance with planting, establishment and of City trees.

5.1. Values

As indicated by the general plan, the city council views the City of Sunnyvale as a special place. Maintaining Sunnyvale as an attractive and safe community is a general priority of elected officials, city staff, and residents. As indicated in the general plan, the council, boards, commissions and staff consider the urban forest to be an important component of making Sunnyvale a livable and attractive city.

5.2. Demographics

Citizens of Sunnyvale tend to be well educated and relatively affluent, compared to people in other California communities. For example, based on data from the 2000 census (source:

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Statjump.com), Sunnyvale ranked eighth in percent of residents with graduate or professional degrees among California cities over 50,000 population. In 2000, 6% of Sunnyvale residents had household income more than \$200,000 per year, 19th on the list of California cities over 50,000 populations. [Data accessed Jan 12, 2011, <http://www.statjump.com/lists/college-graduates-dp2c27tc.html> and <http://www.statjump.com/lists/household-income-dp3c111tc.html>]. The population is relatively mobile. A large majority of the population has lived in Sunnyvale less than 10 years. A high percentage of residents are renters. Sunnyvale also has a large percentage of residents from non-English speaking ethnic backgrounds.

The following information about Sunnyvale's population is from the 2008 American Community Survey report (source: City of Sunnyvale website accessed Jan 2010).

5.2.1. Social characteristics

Selected highlights from the 2008 American Community Survey reports include:

- 55.1% of the population was born in the United States, and of those 67.1% were born in California
- Of the foreign-born population, 37.9% are naturalized citizens, and 62.1% are not U.S. citizens
- Sunnyvale residents have a high level of educational attainment with 90.4% of the population 25 years and over achieving high school graduation or higher and 55.1% holding a bachelor's degree or higher
- Only 9.6% of the population 25 years and over have no high school diploma, compared with 14.4% in Santa Clara County and 19.8% in California
- 48.3% of the population 5 years and over speak English only at home, while 51.7% speak a language other than English
- Of the non-English speaking population, 20.8% report speaking English less than 'very well.'

5.2.2. Economics

- 60.1% of the community reported management, professional and related occupations, while 21.3% reported sales and office occupations and 7.8% reported service occupations
- Per capita income is \$45,455, compared to \$40,752 in Santa Clara County and \$29,388 in California
- Median family income is \$107,441, compared to \$104,022 in Santa Clara County and \$70,029 in California
- 4.3% of all people in Sunnyvale live below poverty level, compared to 7.4% in Santa Clara County and 13.3% in California

- 4.4% of people under 18 years of age and 4.6% of people 65 years and older live below poverty level

5.2.3. Housing

- Very few homes are unoccupied in Sunnyvale
- 81.7% of community members came to Sunnyvale after the year 1990; 64% of community members came to Sunnyvale after 2000
- 52.3% of all homes are owner-occupied, with an average household size of 2.68
- 47.7% of all homes are renter-occupied, with an average household size of 2.39
- The number of rented homes is 8.1% greater than the Santa Clara County average and 4.7% greater than the California average
- Median value for owner-occupied units is \$726,000, compared to \$729,000 for Santa Clara County and \$467,000 for California
- 40.9% of the total housing units are 1-unit, detached, compared to 55.3% in Santa Clara County and 58.3% in California

5.3. Nonprofit volunteer urban forest support group

In association with the development of the UFMP, the Urban Landscape Manager organized a focus group consisting of citizens who have expressed an interest in trees in various forums. A number of these group members and other community members have expressed interest in forming a non-profit group to support urban forestry in the community.

The Urban Landscape Manager has approached tree groups in neighboring communities for help in getting a group started in Sunnyvale.

The process of establishing and running a 501(c)3 non-profit organization can be somewhat involved. Partnering with an existing tree group from a neighboring community provides a means to accelerate the process and helps the new group avoid having to "reinvent the wheel". Our City Forest is an established nonprofit community urban forest group based in San Jose that has indicated a willingness to act as the umbrella group for Sunnyvale's new group. Our City Forest (OCF) has a variety of established programs related to tree planting, tree care, and community education and outreach. OCF has a paid Executive Director, a position that provides necessary overall program direction and continuity that is critical for a largely volunteer organization.

OCF is also a member of California ReLeaf, a statewide urban forestry organization. California ReLeaf promotes alliances among community-based tree groups, individuals, industry, and government agencies. Whether it organizes under OCF or as a separate entity, the Sunnyvale group would be able to join the California ReLeaf network and take advantages of the services they provide.

5.4. Tree management on private properties

Large, well-maintained trees are found in many residential neighborhoods and commercial properties. Improper pruning practices such as topping are relatively uncommon in Sunnyvale, compared to many other California communities. Many residents and commercial property owners appear to appreciate the contribution that trees make to property values, community image, and overall quality of life.

However, given Sunnyvale's diverse population, it is not surprising that Sunnyvale residents hold diverse views about trees. Street Tree Services annually receives and denies many requests for city street tree removals from residents that do not understand or appreciate the importance of urban trees. Attendees at the March 2010 focus meeting reported that removal of healthy trees by residents is not uncommon. Although many tree removals on private properties are nominally subject to city's tree preservation ordinance (Chapter 19.94), many residents may be unaware of this ordinance or simply choose to ignore it. Likewise, some tree service firms perform such removals without checking to see whether they comply with the tree preservation ordinance.

Other than through the tree preservation ordinance and city code related to landscaping requirements (section 4.5 above), the City of Sunnyvale has no direct influence on tree planting or tree care on private lands. The continued existence of much of Sunnyvale's urban forest depends on good tree planting and tree care decisions by its residents. Although Sunnyvale's residents are well educated, many may know little about tree care. In addition, many Sunnyvale residents have lived in the community for a relatively short time, and may not own the house they live in. To provide the information that residents and landowners will need to make good tree care decisions, the City will need to maintain an ongoing program of outreach and education, either on its own or in cooperation with a local non-profit organization.

In addition, the City may wish to explore ways to encourage proper tree planting and care by individuals and businesses. Other communities have used various types of incentive programs, such as providing free or reduced-cost trees. On commercial properties, the City may want to consider how to provide incentives for increasing parking lot shading. Polling commercial landowners may provide information on the types of incentives that would be most effective.

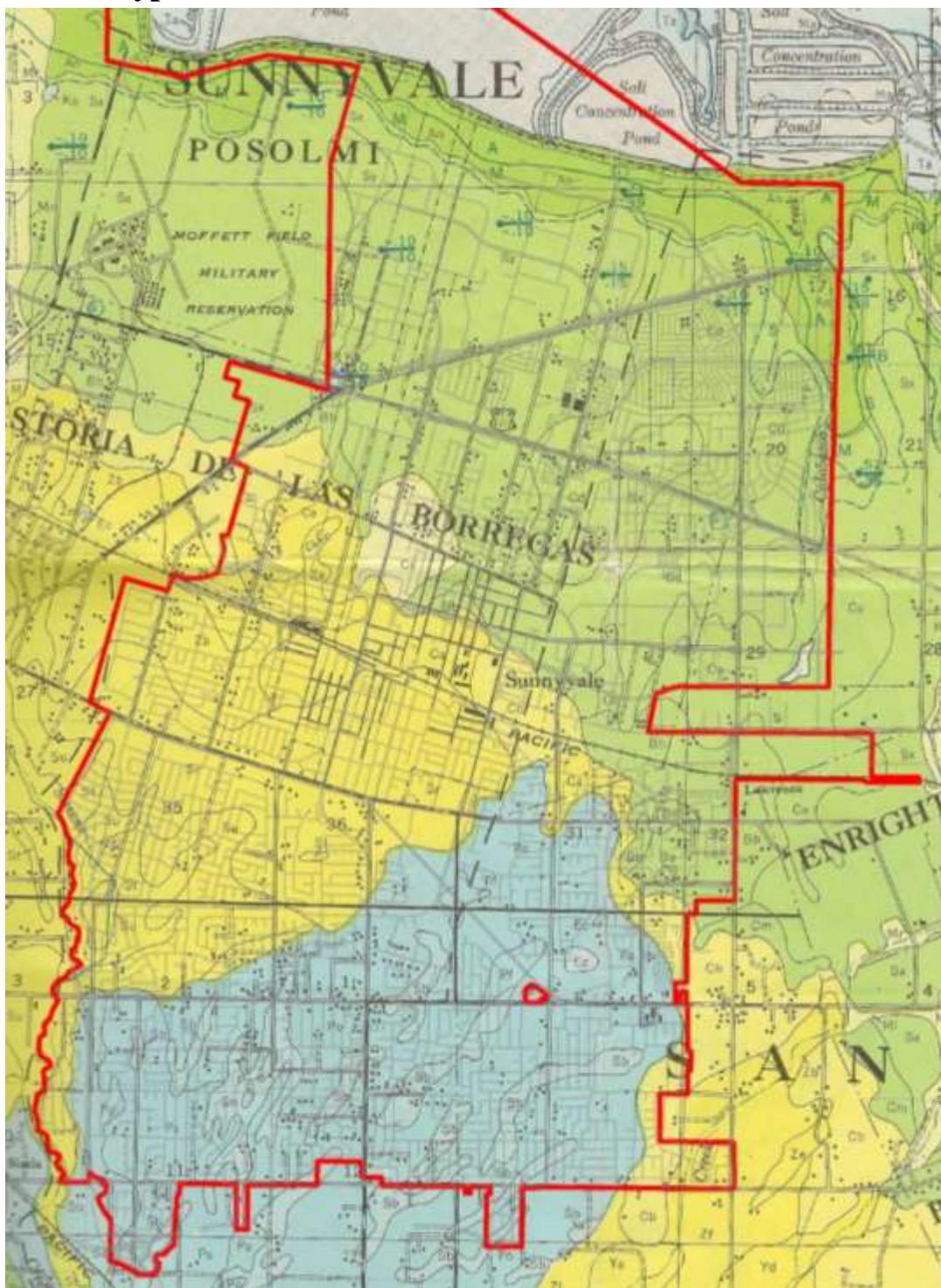
Some regulatory approaches may also be considered. For example, the City could explore the possibility of developing a local licensing requirement for businesses or individuals that provide certain tree care services (primarily pruning and removal) for hire within the City of Sunnyvale. Such a license would be required whether the business was based in Sunnyvale or not. To obtain a license, the tree care contractor would need to meet specific requirements. For example:

- Have adequate professional certification (e.g., International Society of Arboriculture);
- provide evidence of adequate liability insurance coverage;
- agree to comply with all City of Sunnyvale ordinances and standards related to tree care work.

Code Enforcement staff would have the ability to cite violators and issue stop work orders. Because poor quality tree work can pose a risk to public safety, reduce property values, and result in the loss of tree-related benefits, it is in the City's interest to reduce or eliminate the activity of unqualified contractors that conduct poor pruning or illegal tree removals.

6. Resource Data

6.1. Soil types



Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Figure A1. Soil map of Sunnyvale from Gardner and others (1958) with current city limit (red line) and current streets (gray lines) superimposed. Soil type codes are listed in TableA1.

Table A1. Soils of Sunnyvale, based on Gardner and others (1958). Soil codes are the same shown in Figure A1. General soil groups are indicated by color shading (green=basin soils, yellow=recent alluvial fans and floodplains, blue =older alluvial fans. Soils and corresponding properties shown in **bold** may constrain tree growth and performance.

| Soil code | Soil series | Depth of soil readily penetrated by roots | Permeability of surface soil ¹ | Permeability of subsoil | Water holding capacity ² | Occurrence of salinity ² |
|-----------|---|---|---|-------------------------|-------------------------------------|-------------------------------------|
| An | Alviso clay 0-1% slopes | 20-36" | Very slow | Very slow | High | General |
| Bb | Bayshore clay loam 1-3% slopes | >60 inches | Rapid | Moderate | Moderate | None |
| Ba | Bayshore clay loam 3-5% slopes | >60 inches | Rapid | Moderate | Moderate | None |
| Ca | Campbell clay loam, 0-1% slopes | >60 inches | Moderate | Moderate | High | Rare |
| Cb | Campbell silty clay, 0-1% slopes | >60 inches | Slow | Slow | High | None |
| Cd | Castro clay 0-1% slopes | 20-36" | Slow | Slow | Moderate | Occasional |
| Ce | Castro silty clay 1-3% slopes | 20-36" | Slow | Slow | Moderate | Occasional |
| Ec | Pits | Excavated areas | | | | |
| Ka | Kitchen middens | Former Native American settlement | | | | |
| Po | Pleasanton gravelly loam, 1-3% slopes | >60 inches | Moderate | Moderate | Moderate | None |
| Ps | Pleasanton loam, 1-3% slopes | >60 inches | Moderate | Moderate | Moderate | None |
| Pf | Pleasanton clay loam, 1-3% slopes | >60 inches | Moderate | Slow | Moderate | None |
| Sb | San Ysidro | variable 20 | Moderate | Very slow | Low | None |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| Soil code | Soil series | Depth of soil readily penetrated by roots | Permeability of surface soil ¹ | Permeability of subsoil | Water holding capacity ² | Occurrence of salinity ³ |
|-----------|--|---|---|-------------------------|-------------------------------------|-------------------------------------|
| | loam, 1-2% slopes | to 36 inches | | | | |
| Sr | Sorrento clay loam, 1-3% slopes | >60 inches | Moderate | Moderate | High | None |
| St | Sorrento gravelly loam, 1-3% slopes | >60 inches | Moderate | Moderate | Moderate | None |
| Su | Sorrento loam, 1-3% slopes | >60 inches | Moderate | Moderate | High | None |
| Sx | Sunnyvale clay 0-1% slopes | 36"-60" | Slow | Slow | High | Occasional |
| Sy | Sunnyvale clay loam 0-1% slopes | 36"-60" | Moderate | Moderate | Moderate | None |
| Zb | Zamora clay loam, 1-3% slopes | >60 inches | Moderate | Moderate | High | None |
| Ze | Zamora gravelly clay loam, 1-3% slopes | >60 inches | Moderate | Moderate | High | None |
| Zf | Zamora silty clay loam, 1-3% slopes | >60 inches | Moderate | Slow | High | None |

¹Permeability refers to the rate at which water can pass downward through the soil after wetting.

Permeability is a general indication of the ease of root penetration. Soils with slow permeability will absorb less than 3 inches of surface water per day. Soils with rapid permeability can absorb more than 20 inches of surface water per day.

²Water holding capacity refers to the total amount of water available to plants to the depth readily penetrated by roots when the soil is at normal field moisture capacity (the point at which water stops draining from the soil). The amount is expressed as the height of a column of water on the soil surface. Soils with low soil water holding capacity hold less than 4 inches of water at field capacity. Soils with high soil water holding capacity hold more than 9 inches of water at field capacity.

³Salinity refers to soluble salts, either neutral or alkaline in reaction, that occur in soils in sufficient quantities to have a toxic or retarding effect on the growth of cultivated plants. The term "alkali" is used in the 1958 Soil Survey.

References

Gardner, R.A.; Harradine, F.F.; Hargreaves, H.J; Retzer, J.L.; Bartholomew, O.F.; Glassey, T. W. June 1958. Soil survey, Santa Clara Area, California. Series 1941, No. 17. U.S.D.A. and California Agricultural Experiment Station.

6.2. Canopy cover assessment

Phytosphere Research used a random dot grid and 2007 aerial photography in Google Earth to estimate tree canopy cover in the land area of Sunnyvale.

We generated 2,500 random coordinates that were distributed across a rectangular area that included the City's land area. The random coordinates were created using a random uniform distribution function in JMP® 7.0.1 (SAS Institute) software. These random coordinates were imported into an ESRI ArcMap® layer file. The city boundary GIS layer (provided by the City of Sunnyvale) was used to select only those points within the city limits. The points were overlaid on an aerial image of the city. Points that were located in ponds near the bay were removed from the random sample set. The resulting sample included 2210 random points distributed over approximately 19.25 square miles.

We used the zoning GIS layers supplied by the city to assign a land use designation to each point. Points were grouped into the following classes:

- residential (including single and multiple-unit zonings),
- commercial/industrial,
- city parks,
- schools,
- other city-owned properties.

The sample provided a sufficient number of points to provide good canopy cover estimates citywide and in major land uses, but the number of points falling in uncommon land uses was low. To provide a more accurate estimate of canopy cover in city parks, we created a denser set of random coordinates and selected those fell within city parks. This provided a sample of 472 random dots that we used to estimate canopy cover in parks.

We created separate files for the points in each land use category and exported the points to Google Earth kml files. Layers for the city limits and polygons for parks, schools, and city properties were also exported to Google Earth kml files. To assess canopy cover, we used the most recent available (October 2007) Google Earth imagery (Figure 3-5). We recorded whether each dot was on tree canopy. We also noted within each land use whether points were within the paved portions (curb to curb) of public streets or if they fell on trees growing within the apparent street right of way (ROW). Sidewalk placement and width were used to help estimate the width of the ROW at a given sample point.

We also used the random dots to select a sample for estimating average tree canopy area, which was needed to estimate tree numbers from canopy cover data (number of trees= total canopy area/ average tree canopy area). For the tree nearest to each random sample point, we measured the canopy diameter to the nearest 0.1 m using the Google Earth distance measuring tool. Areas were calculated from diameters assuming a circular canopy shape. We used an initial sample of 100 random coordinates each from residential and commercial land uses. To increase the number of street trees represented in the sample, we added an additional 100 random points that were located on streets.

6.3. Tree inventory tabulation

Species listed in the City Street Tree inventory as of December 2010.

| Species | Number | Percent |
|---|--------|---------|
| <i>Acacia baileyana</i> | 2 | 0.01% |
| <i>Acacia melanoxylon</i> | 39 | 0.09% |
| <i>Acacia spp.</i> | 1 | 0.00% |
| <i>Acer japonicum</i> | 1 | 0.00% |
| <i>Acer macrophyllum</i> | 1 | 0.00% |
| <i>Acer negundo</i> | 5 | 0.01% |
| <i>Acer palmatum</i> | 39 | 0.09% |
| <i>Acer platanoides</i> | 6 | 0.02% |
| <i>Acer pseudoplatanus</i> 'Atropurpureum' | 6 | 0.02% |
| <i>Acer rubrum</i> | 267 | 0.65% |
| <i>Acer saccharinum</i> | 49 | 0.12% |
| <i>Acer spp.</i> | 2 | 0.01% |
| <i>Acer x freemanii</i> | 2 | 0.01% |
| <i>Aesculus carnea</i> | 8 | 0.02% |
| <i>Aesculus hippocastanum</i> | 3 | 0.01% |
| <i>Ailanthus altissima</i> | 2 | 0.01% |
| <i>Albizia julibrissin</i> | 32 | 0.08% |
| <i>Alnus cordata</i> | 22 | 0.05% |
| <i>Alnus oregona</i> | 4 | 0.01% |
| <i>Alnus rhombifolia</i> | 61 | 0.15% |
| <i>Araucaria araucana</i> | 1 | 0.00% |
| <i>Araucaria spp.</i> | 2 | 0.01% |
| <i>Arbutus unedo</i> | 2 | 0.01% |
| <i>Arecastrum romanzoffianum</i> | 12 | 0.03% |
| <i>Betula nigra</i> | 102 | 0.25% |
| <i>Betula pendula</i> | 230 | 0.56% |
| <i>Betula platyphylла japonica</i> | 3 | 0.01% |
| <i>Butia capitata</i> | 1 | 0.00% |
| <i>Callistemon citrinus</i> | 162 | 0.39% |
| <i>Callistemon viminalis</i> | 32 | 0.08% |
| <i>Calocedrus decurrens</i> | 15 | 0.04% |
| <i>Carpinus betulus fastigiata</i> | 184 | 0.45% |
| <i>Casimiroa edulis</i> | 1 | 0.00% |
| <i>Castanea sativa</i> | 2 | 0.01% |
| <i>Casuarina cunninghamiana</i> | 112 | 0.27% |
| <i>Casuarina equisetifolia</i> | 124 | 0.30% |
| <i>Casuarina stricta</i> | 4 | 0.01% |
| <i>Catalpa speciosa</i> | 2 | 0.01% |
| <i>Cedrus atlantica</i> | 15 | 0.04% |
| <i>Cedrus deodara</i> | 230 | 0.56% |
| <i>Celtis australis</i> | 408 | 0.99% |

| Species | Number | Percent |
|--------------------------------------|--------|---------|
| <i>Celtis sinensis</i> | 617 | 1.49% |
| <i>Celtis spp.</i> | 1 | 0.00% |
| <i>Ceratonia siliqua</i> | 744 | 1.80% |
| <i>Cercis occidentalis</i> | 16 | 0.04% |
| <i>Chamaerops humilis</i> | 11 | 0.03% |
| <i>Chitalpa X tashkentensis</i> | 35 | 0.09% |
| <i>Chorisia speciosa</i> | 3 | 0.01% |
| <i>Cinnamomum camphora</i> | 744 | 1.80% |
| <i>Citrus limon</i> | 11 | 0.03% |
| <i>Citrus sinensis</i> | 7 | 0.02% |
| <i>Citrus X paradisi</i> | 1 | 0.00% |
| <i>Cordyline australis</i> | 35 | 0.09% |
| <i>Cornus spp.</i> | 1 | 0.00% |
| <i>Crataegus laevigata</i> | 39 | 0.09% |
| <i>Cupaniopsis anacardioides</i> | 2 | 0.01% |
| <i>Cupressocyparis leylandii</i> | 2 | 0.01% |
| <i>Cupressus macrocarpa</i> | 20 | 0.05% |
| <i>Cupressus sempervirens</i> | 431 | 1.04% |
| <i>Diospyros kaki</i> | 3 | 0.01% |
| <i>Dodonaea viscosa</i> | 4 | 0.01% |
| <i>Eriobotrya deflexa</i> | 31 | 0.08% |
| <i>Eriobotrya japonica</i> | 24 | 0.06% |
| <i>Erythrina armata</i> | 2 | 0.01% |
| <i>Erythrina caffra</i> | 3 | 0.01% |
| <i>Eucalyptus cinerea</i> | 4 | 0.01% |
| <i>Eucalyptus cladocalyx</i> | 17 | 0.04% |
| <i>Eucalyptus ficifolia</i> | 2 | 0.01% |
| <i>Eucalyptus globulus</i> | 407 | 0.98% |
| <i>Eucalyptus lansdowneana</i> | 18 | 0.04% |
| <i>Eucalyptus leucoxylon</i> | 1 | 0.00% |
| <i>Eucalyptus nicholii</i> | 5 | 0.01% |
| <i>Eucalyptus parvifolia</i> | 64 | 0.16% |
| <i>Eucalyptus polyanthemos</i> | 55 | 0.13% |
| <i>Eucalyptus robusta</i> | 1 | 0.00% |
| <i>Eucalyptus sideroxylon</i> | 52 | 0.13% |
| <i>Eucalyptus spp.</i> | 6 | 0.02% |
| <i>Eucalyptus viminalis</i> | 11 | 0.03% |
| <i>Eugenia paniculata</i> | 3 | 0.01% |
| <i>Fagus sylvatica "Atropunicea"</i> | 13 | 0.03% |
| <i>Feijoa sellowiana</i> | 1 | 0.00% |
| <i>Ficus carica</i> | 4 | 0.01% |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| Species | Number | Percent |
|-------------------------------------|---------------|----------------|
| <i>Fortunella margarita</i> | 1 | 0.00% |
| <i>Fraxinus american</i> | 139 | 0.34% |
| <i>Fraxinus oxyacarpa</i> | 497 | 1.20% |
| <i>Fraxinus pennsylvanica</i> | 49 | 0.12% |
| <i>Fraxinus uhdei</i> | 518 | 1.25% |
| <i>Fraxinus v. 'Rio Grande'</i> | 525 | 1.27% |
| <i>Fraxinus velutina</i> | 300 | 0.73% |
| <i>Geijera parviflora</i> | 515 | 1.25% |
| <i>Ginkgo biloba</i> | 1478 | 3.57% |
| <i>Gleditsia triacanthos</i> | 36 | 0.09% |
| <i>Grevillea robusta</i> | 11 | 0.03% |
| <i>Heteromeles arbutifolia</i> | 6 | 0.02% |
| <i>Hibiscus rosa-sinensis</i> | 2 | 0.01% |
| <i>Ilex altaclarensis Wilsonii</i> | 7 | 0.02% |
| <i>Jacaranda mimosifolia</i> | 13 | 0.03% |
| <i>Juglans hindsii</i> | 17 | 0.04% |
| <i>Juglans regia</i> | 18 | 0.04% |
| <i>Juglans spp.</i> | 1 | 0.00% |
| <i>Juniperus californica</i> | 9 | 0.02% |
| <i>Juniperus chinensis</i> | 2 | 0.01% |
| <i>Juniperus chinensis</i> | 76 | 0.18% |
| <i>Torulosa</i> | | |
| <i>Juniperus scopulorum</i> | 1 | 0.00% |
| <i>Juniperus spp.</i> | 1 | 0.00% |
| <i>Koelreuteria bipinnata</i> | 2 | 0.01% |
| <i>Koelreuteria paniculata</i> | 3 | 0.01% |
| <i>Lagerstroemia indica</i> | 120 | 0.29% |
| <i>Lagerstroemia x fauria</i> | 614 | 1.49% |
| <i>Lagerstromia x fauria(lavend</i> | 123 | 0.30% |
| <i>Lagerstromia x fauria(red)</i> | 572 | 1.38% |
| <i>Lagunaria patersonii</i> | 2 | 0.01% |
| <i>Laurus nobilis</i> | 227 | 0.55% |
| <i>Leptospermum spp.</i> | 2 | 0.01% |
| <i>Ligustrum lucidum</i> | 401 | 0.97% |
| <i>Liquidambar</i> | 4 | 0.01% |
| <i>'ROTUNDILOBA'</i> | | |
| <i>Liquidambar styraciflua</i> | 3525 | 8.52% |
| <i>Liriodendron tulipifera</i> | 800 | 1.93% |
| <i>Lyonothamnus floribundus asp</i> | 2 | 0.01% |
| <i>Magnolia grandiflora</i> | 4633 | 11.20% |
| <i>Magnolia x. soulangiana</i> | 12 | 0.03% |
| <i>Malus spp.</i> | 5 | 0.01% |
| <i>Malus syvestris</i> | 19 | 0.05% |
| <i>Maytenus boaria</i> | 119 | 0.29% |
| <i>Melaleuca linariifolia</i> | 195 | 0.47% |
| <i>Melaleuca nesophila</i> | 10 | 0.02% |
| <i>Melaleuca quinquenervia</i> | 2 | 0.01% |

| Species | Number | Percent |
|-------------------------------------|---------------|----------------|
| <i>Metasequoia glyptostroboides</i> | 1 | 0.00% |
| <i>Morus alba</i> | 15 | 0.04% |
| <i>Myoporum laetum</i> | 8 | 0.02% |
| <i>Nerium oleander</i> | 67 | 0.16% |
| <i>Olea europaea</i> | 154 | 0.37% |
| <i>Other</i> | 15 | 0.04% |
| <i>Paulownia tomentosa</i> | 4 | 0.01% |
| <i>Persea americana</i> | 16 | 0.04% |
| <i>Phoenix canariensis</i> | 25 | 0.06% |
| <i>Photinia fraseri</i> | 522 | 1.26% |
| <i>Picea engelmannii</i> | 2 | 0.01% |
| <i>Picea pungens</i> | 8 | 0.02% |
| <i>Pinus canariensis</i> | 550 | 1.33% |
| <i>Pinus coulteri</i> | 1 | 0.00% |
| <i>Pinus edulis</i> | 5 | 0.01% |
| <i>Pinus halepensis</i> | 50 | 0.12% |
| <i>Pinus pinea</i> | 76 | 0.18% |
| <i>Pinus radiata</i> | 195 | 0.47% |
| <i>Pinus spp.</i> | 1 | 0.00% |
| <i>Pinus thunbergiana</i> | 83 | 0.20% |
| <i>Pistacia chinensis</i> | 2868 | 6.94% |
| <i>Pittosporum crassifolium</i> | 1 | 0.00% |
| <i>Pittosporum eugenoides</i> | 17 | 0.04% |
| <i>Pittosporum undulatum</i> | 7 | 0.02% |
| <i>Platanus acerifolia</i> | 1124 | 2.72% |
| <i>Platanus racemosa</i> | 3 | 0.01% |
| <i>Podocarpus gracilior</i> | 726 | 1.76% |
| <i>Podocarpus macrophyllus</i> | 8 | 0.02% |
| <i>Populus canadensis</i> | 3 | 0.01% |
| <i>Populus nigra 'Italica'</i> | 17 | 0.04% |
| <i>Prunus amygdalus</i> | 41 | 0.10% |
| <i>Prunus armeniaca</i> | 25 | 0.06% |
| <i>Prunus blireiana</i> | 130 | 0.31% |
| <i>Prunus caroliniana</i> | 16 | 0.04% |
| <i>Prunus cerasifera</i> | 717 | 1.73% |
| <i>Prunus domestica</i> | 36 | 0.09% |
| <i>Prunus lyonii</i> | 21 | 0.05% |
| <i>Prunus persica</i> | 43 | 0.10% |
| <i>Prunus serrulata</i> | 106 | 0.26% |
| <i>Pseudotsuga menziesii</i> | 5 | 0.01% |
| <i>Punica granatum</i> | 1 | 0.00% |
| <i>Pyrus calleryana</i> | 701 | 1.70% |
| <i>Pyrus kawakamii</i> | 142 | 0.34% |
| <i>Quercus agrifolia</i> | 236 | 0.57% |
| <i>Quercus coccinea</i> | 210 | 0.51% |
| <i>Quercus franetto</i> | 8 | 0.02% |
| <i>Quercus ilex</i> | 1363 | 3.30% |
| <i>Quercus kelloggii</i> | 17 | 0.04% |

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

| Species | Number | Percent |
|---------------------------------|---------------|----------------|
| <i>Quercus lobata</i> | 142 | 0.34% |
| <i>Quercus palustris</i> | 4 | 0.01% |
| <i>Quercus shumardi</i> | 483 | 1.17% |
| <i>Quercus spp.</i> | 7 | 0.02% |
| <i>Quercus suber</i> | 539 | 1.30% |
| <i>Quercus virginiana</i> | 380 | 0.92% |
| <i>Quercus wislizeni</i> | 54 | 0.13% |
| <i>Quillaja saponaria</i> | 3 | 0.01% |
| <i>Rhamnus alaternus</i> | 4 | 0.01% |
| <i>Rhus lancea</i> | 347 | 0.84% |
| <i>Robinia pseudoacacia</i> | 134 | 0.32% |
| <i>Sapium sebiferum</i> | 185 | 0.45% |
| <i>Schinus molle</i> | 75 | 0.18% |
| <i>Schinus terebinthifolius</i> | 29 | 0.07% |
| <i>Sequoia sempervirens</i> | 1024 | 2.48% |
| <i>Sequoiadendron giganteum</i> | 5 | 0.01% |
| <i>Solanum rantonnetii</i> | 5 | 0.01% |
| <i>Sophora japonica</i> | 2 | 0.01% |
| <i>Stump</i> | 141 | 0.34% |
| <i>Thuja occidentalis</i> | 19 | 0.05% |
| <i>Tilia cordata</i> | 19 | 0.05% |
| <i>Tipuana tipu</i> | 2 | 0.01% |
| <i>Trachycarpus fortunei</i> | 25 | 0.06% |
| <i>Tristania conferta</i> | 14 | 0.03% |
| <i>Tristania laurina</i> | 899 | 2.17% |
| <i>Ulmus americana</i> | 1 | 0.00% |
| <i>Ulmus campestris</i> | 1 | 0.00% |
| <i>Ulmus parvifolia</i> | 296 | 0.72% |
| <i>Ulmus pumila</i> | 10 | 0.02% |
| Vacant site (Large) | 441 | 1.07% |
| Vacant site (Medium) | 2775 | 6.71% |
| Vacant site (Small) | 1091 | 2.64% |
| <i>Viburnum japonicum</i> | 4 | 0.01% |
| <i>Washingtonia filifera</i> | 14 | 0.03% |
| <i>Washingtonia robusta</i> | 56 | 0.14% |
| <i>Xylosma congestum</i> | 5 | 0.01% |
| <i>Yucca gloriosa</i> | 71 | 0.17% |
| <i>Zelkova serrata</i> | 400 | 0.97% |

6.4. List of trees whose numbers are being increased

Street Tree Services was planting the following species in increasing numbers in certain planting situations along streets as of December 2010. These species have been targeted for increased planting because local experience suggests that they will perform well in specific situations (see discussion in section 3.3.2).

Species

Acer rubrum
Betula nigra
Carpinus betulus fastigiata
Cedrus atlantica
Cedrus deodara
Chitalpa X tashkentensis
Cinnamomum camphora
Eucalyptus sideroxylon
Fraxinus american
Fraxinus v. 'Rio Grande'
Ginkgo biloba
Lagerstroemia x fauria
Lagerstromia x fauria(lavend
Lagerstromia x fauria(red)
Laurus nobilis
Persea americana
Photinia fraseri
Pinus canariensis
Platanus acerifolia
Podocarpus gracilior
Podocarpus macrophyllus
Prunus cerasifera
Pyrus calleryana
Quercus franetto
Quercus ilex
Quercus lobata
Quercus shumardi
Quercus suber
Quercus virginiana
Sapium sebiferum
Tristania laurina

6.5. List of trees whose numbers are being decreased

Street Tree Services was decreasing the use of the following species along streets or in certain planting situations as of December 2010. These species have been targeted for reduced planting or have been discontinued because of problems that have developed in specific situations (see discussion in section 3.3.2).

| | | |
|----------------------------------|-------------------------------------|---------------------------------|
| <i>Acacia baileyana</i> | <i>Juniperus scopulorum</i> | <i>Quercus ilex</i> |
| <i>Acacia melanoxylon</i> | <i>Lagerstroemia indica</i> | <i>Quercus virginiana</i> |
| <i>Acer macrophyllum</i> | <i>Laurus nobilis</i> | <i>Quercus wislizenii</i> |
| <i>Acer negundo</i> | <i>Ligustrum lucidum</i> | <i>Rhus lancea</i> |
| <i>Acer palmatum</i> | <i>Liquidambar styraciflua</i> | <i>Sapium sebiferum</i> |
| <i>Callistemon citrinus</i> | <i>Liriodendron tulipifera</i> | <i>Schinus molle</i> |
| <i>Casuarina cunninghamiana</i> | <i>Lyonothamnus floribundus</i> asp | <i>Schinus terebinthifolius</i> |
| <i>Casuarina stricta</i> | <i>Magnolia grandiflora</i> | <i>Sequoia sempervirens</i> |
| <i>Cedrus deodara</i> | <i>Malus spp.</i> | <i>Thuja occidentalis</i> |
| <i>Celtis australis</i> | <i>Malus syvestris</i> | <i>Tristania conferta</i> |
| <i>Celtis sinensis</i> | <i>Melaleuca linariifolia</i> | <i>Ulmus campestris</i> |
| <i>Ceratonia siliqua</i> | <i>Melaleuca quinquenervia</i> | <i>Ulmus parvifolia</i> |
| <i>Cinnamomum camphora</i> | <i>Metasequoia glyptostroboides</i> | <i>Washingtonia filifera</i> |
| <i>Cordyline australis</i> | <i>Olea europaea</i> | <i>Washingtonia robusta</i> |
| <i>Cornus spp.</i> | <i>Persea americana</i> | <i>Zelkova serrata</i> |
| <i>Cupaniopsis anacardioides</i> | <i>Phoenix canariensis</i> | |
| <i>Eriobotrya deflexa</i> | <i>Picea engelmannii</i> | |
| <i>Eriobotrya japonica</i> | <i>Picea pungens</i> | |
| <i>Erythrina caffra</i> | <i>Pinus canariensis</i> | |
| <i>Eucalyptus globulus</i> | <i>Pinus coulteri</i> | |
| <i>Eucalyptus lansdowneana</i> | <i>Pinus halepensis</i> | |
| <i>Eucalyptus polyanthemos</i> | <i>Pinus pinea</i> | |
| <i>Eucalyptus spp.</i> | <i>Pinus thunbergiana</i> | |
| <i>Eugenia paniculata</i> | <i>Pistacia chinensis</i> | |
| <i>Ficus carica</i> | <i>Podocarpus gracilior</i> | |
| <i>Fraxinus american</i> | <i>Populus canadensis</i> | |
| <i>Fraxinus oxycarpa</i> | <i>Prunus amygdalus</i> | |
| <i>Fraxinus pennsylvanica</i> | <i>Prunus armeniaca</i> | |
| <i>Fraxinus uhdei</i> | <i>Prunus caroliniana</i> | |
| <i>Fraxinus velutina</i> | <i>Prunus cerasifera</i> | |
| <i>Geijera parviflora</i> | <i>Prunus lyoni</i> | |
| <i>Ginkgo biloba</i> | <i>Prunus serrulata</i> | |
| <i>Jacaranda mimosifolia</i> | <i>Pseudotsuga menziesii</i> | |
| <i>Juglans hindsii</i> | <i>Pyrus calleryana</i> | |
| <i>Juglans regia</i> | <i>Pyrus kawakamii</i> | |
| <i>Juniperus californica</i> | <i>Quercus coccinea</i> | |

6.6. Street tree species composition by block face

As an adjunct to this report, Phytosphere Research used a copy of the street tree inventory database (downloaded 1/17/10) to develop a new database related to tree species distribution for street trees by block face. A block face is defined here as a length of street between two successive intersections that includes trees on both sides of the street. Designation of block faces was based on the "on street", "from street" and "to street" fields in the tree inventory. We used JMP® 9.0.0 (SAS Institute) software to cross tabulate the data and summarize tree occurrence on each block face. In addition to totaling the three most common trees on each block face, a formula was used to determine whether one to three trees were dominant on the block, based on their occurrence relative to the total number of species present. The data were converted to a Microsoft Excel worksheet with the fields listed below. The worksheet contains 3,688 block face records. The spreadsheet was provided to the Urban Landscape Manager in electronic format. (Filename "Copy of Sunnyvale block face trees 3-9-10.xls" transmitted via e-mail 3/9/10).

| Field | Description |
|--------------------------------------|--|
| Address number | Address of one tree on block face |
| Street | Street of Address number field |
| Address-Street | Address Number field concatenated to Street field |
| OnStr | Street the trees located on- this is the block face |
| block-on/from/to of block face trees | Block face plus cross streets that delimit the block face |
| Total sites | Number of inventoried planting sites on block face |
| Num live trees | Number of live inventoried trees on block face |
| Num(SPP) | Number of species on block face |
| SPP1 | Most common tree on block face |
| N of spp1 | Number of trees of species 1 |
| Percent for spp1 | Percent of trees on block face represented by species 1 |
| SPP2 | Second most common tree on block face |
| N of spp2 | Number of trees of species 2 |
| Percent for spp2 | Percent of trees on block face represented by species 2 |
| SPP3 | Third most common species on block face |
| N of spp3 | Number of trees of species 3 |
| Percent for spp3 | Percent of trees on block face represented by species 3 |
| Top 2 trees % of all trees | Percent of all trees on block made up by the top 2 most common trees |
| Top 3 trees % of all trees | Percent of all trees on block made up by the top 3 most common trees |
| Main species1 | Primary dominant species on block based on the following formula: SPP1 if (Percent for spp1 > 60%) or (Top 2 trees % of all trees) > 66% or (Top 3 trees % of all trees) > 75%. Otherwise listed as "none" |
| Main species2 | Secondary dominant species on block based on following formula: SPP2 if (Top 2 trees % of all trees) > 66% and (Percent for spp1) ≤ 60% and (Percent for spp2) > 33%. Otherwise listed as "none". |
| Main species3 | Tertiary dominant species on block based on following formula: SPP3 if (Main species2) is not "none" and (Top 3 trees % of all trees) > 75% and (Percent for spp3) ≥ 25%. Otherwise listed as "none". |

7. Planning documents, policies, and city code related to trees

City of Sunnyvale Consolidated General Plan (2011)

General plan goals pertaining to the urban forest:

Chapter 2 Community Vision

City-wide Vision Goals

II. Attractive Community: To maintain and enhance the appearance of Sunnyvale, and to distinguish it from surrounding communities, through the promotion of high quality architecture, the preservation of historic districts and structures, the maintenance of a healthy urban forest, and the provision of abundant and attractive open space.

III. Environmental Sustainability: To promote environmental sustainability and remediation in the planning and development of the City, in the design and operation of public and private buildings, in the transportation system, in the use of potable water and in the recycling of water.

Goal LT-2 An Attractive Community

Preserve and enhance an attractive community, with a positive image and a sense of place that consists of distinctive neighborhoods, pockets of interest and human-scale development.

Policy LT-8.4

Maintain existing park and open space tree inventory through the replacement of trees with an equal or greater number of trees when trees are removed due to disease, park development or other reasons.

Policy LT-8.5

Maintain Parks and open space tree inventory on a system wide basis rather than a site-by-site basis with an understanding that there is no single optimum number of trees for a particular site.

Policy LT-8.6

Maintain a working fruit orchard throughout the largest portion of Orchard Heritage Park for as long as practical.

Policy CC-2.1

Maintain and provide attractive landscaping in the public right-of-way to identify the different types of roadways and districts, make motorists more comfortable and improve the enjoyment of residential neighborhoods.

Policy CC-5.4

Seek out, catalog and evaluate heritage resources which may be significant.

Sunnyvale Municipal Code

Chapter 13.16. City Trees

13.16.010. Intent.

The intent of this chapter is to:

- (a) Ensure the preservation of the city's urban forest;
- (b) Regulate the maintenance, removal and planting of trees, shrubbery and plantings within the public rights-of-way.
- (c) Regulate the installation and maintenance of any structure, fencing, trees, shrubbery, planting or growth interfering with the safety and welfare of persons utilizing the public rights-of-way.
- (d) Encourage the protection of trees to provide shade, beauty, wind protection, air filtration, mitigation of noise, soil protection, habitat for birds and small animals, screening between buildings, camouflage of blighted areas and enhancement of property values.
- (e) Encourage and maintain the healthy growth of trees to make the city more attractive to visitors and potential new residents. (Ord. 2374-91 § 2 (part)).

13.16.020. New city trees.

Whenever new development occurs, a minimum of one tree per lot shall be installed. In existing developments, if it is determined to be feasible, city trees shall be installed. The number of trees and types of trees to be installed, their location and the method of installation shall be in accordance with standards approved by the city council. (Ord. 2374-91 § 2 (part)).

13.16.030. Definitions.

- (1) “City tree” means any woody plant which is growing within the public right-of-way along a city street and has a trunk four inches or more in diameter at four and one-half feet above normal ground level.
- (2) “Official city tree” means a species of tree designated by the superintendent and on the official tree list.
- (3) “Official tree list” means a list of species of trees designated as official city trees by the superintendent.
- (4) “Owner of the property” means the record owner or contract purchaser of any parcel of land fronting on any city street.
- (5) “Parkway strip” means the public area between the curbing and the sidewalk.
- (6) “Superintendent” means the superintendent of trees and landscaping, or any person designated by the superintendent to perform the duties set forth in this chapter.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(7) “Tree easement” means the public area either between the curb and sidewalk (parkway strip), or between a monolithically constructed sidewalk and the property line along a city street right-of-way.

(8) “Unofficial city tree” means a tree planted or growing within the public right-of-way which is not on the official tree list, or has not been approved by the superintendent. (Ord. 2374-91 § 2 (part)).

13.16.040. Official tree list.

(a) The superintendent shall maintain and periodically review the official tree list, and may add to, delete from or otherwise modify the list. The official tree list shall be on file for public inspection at the office of the department of public works.

(b) No tree shall be planted in the public right-of-way or overhang any city street unless the tree is on the official tree list, unless a written permit from the superintendent has been obtained to plant a tree not on the list. (Ord. 2374-91 § 2 (part)).

13.16.050. Enforcing authority.

The superintendent or designated representative shall have the authority to regulate the maintenance, planting and removal of trees on streets and property within the public rights-of-way, and on other property under the ownership and control of the city (with the exception of parks and golf courses), to ensure safety or preserve aesthetics. (Ord. 2374-91 § 2 (part)).

13.16.060. Permits required.

(a) Planting. It is unlawful for any person to plant or set out any tree within the public right-of-way without first procuring a permit from the superintendent.

(b) Maintenance and Removal. It is unlawful for any person to trim, prune, spray, fertilize, remove, cut above ground, or otherwise disturb any city tree without first procuring a permit from the superintendent. The permit shall be issued when the superintendent determines that the required work is necessary and that the proposed method is in accordance with generally accepted arboricultural specifications and standards of practice.

(c) Construction. It is unlawful for any person to make any excavation, place any fill, compact the soil, or construct any structure, walkway, driveway, pavement or public utility within fifteen feet of any city tree without first obtaining a permit for such work from the superintendent and conducting such work in accordance with such permit. As a condition of issuing such permit, the superintendent shall require that the work be done in accordance with such generally accepted arboricultural specifications and standards of practice necessary to protect the vitality of the tree.

(d) Permits.

(1) Applications for permits must be made at least forty-eight hours in advance of the time the work is to be started.

(2) The application shall contain, but shall not be limited to, the following:

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (A) The number of trees to be planted or set out, the location, grade, size, quality, species, cultivar or variety of each tree, the method of planting, and such other information as the superintendent may require;
- (B) The number and kinds of trees to be sprayed, fertilized, trimmed/pruned, removed, relocated or otherwise preserved, the kind of treatment to be administered, the composition of the spray or fertilizer material to be applied, and such other information as the superintendent may require;
- (C) The written agreement of each applicant for a permit that the applicant will comply with the requirements, regulations and standards of this chapter;
- (D) The time schedule for the proposed work; and
- (E) Such other information as the superintendent deems necessary. (Ord. 2374-91 § 2 (part)).

13.16.070. Unofficial city trees.

- (a) Planting. It is unlawful for any person to plant an unofficial city tree within the public right-of-way along a city street.
- (b) Maintenance or Removal Permit. Unofficial city trees may be maintained or removed by property owners at their expense only upon obtaining a permit. (Ord. 2374-91 § 2 (part)).

13.16.080. Removal of damaged trees.

- (a) Official or unofficial city trees shall be removed immediately by the city in the event such a tree is damaged or destroyed from any cause which in the opinion of the superintendent results in such a tree becoming an immediate threat to the safety of life or property.
- (b) City trees shall be ordered removed when the superintendent finds such action necessary to prevent a hazard to public safety or to prevent the spread of disease or insects to public trees and places.
 - (1) The property owner who is notified of such order shall have the right within five days from the service of the order to file a written appeal with the director of public works.
 - (2) The director may revoke or modify the order if the director finds that the removal of the tree is not necessary to prevent a hazard to public safety or to prevent the spread of disease or insects to public trees and places.
 - (3) The total cost of the removal of city trees shall be borne by the city. An official city tree shall be planted, when practical, as a replacement in a location approved by the superintendent. The cost of the official city tree replacement shall be borne by the city.
- (c) Unofficial city trees ordered removed shall be allowed to remain if each of the following conditions is complied with:
 - (1) The property owner obtains a permit to prune the tree above and below ground; the property owner provides the city a signed written statement satisfactory to the city indemnifying and holding harmless the city from any liability or loss from the continued maintenance of the tree.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(2) The total cost of removing the unofficial city trees, when it becomes necessary in the future, shall be paid by the property owner or successor in title, which obligation shall be evidenced by a written document satisfactory to the city and recorded in the office of the county recorder.

(d) The superintendent shall initiate a tree replacement program in those areas of the city in which city trees are required to be removed. (Ord. 2374-91 § 2 (part)).

13.16.090. Abuse or mutilation.

Unless specifically authorized by the superintendent, it is unlawful for any person to:

(a) Intentionally damage, break, cut, carve, mutilate, kill, injure or destroy any city tree;

(b) Transplant or remove any city tree;

(c) Attach any rope, wire, nails, advertising posters, sign or other contrivance to any city tree;

(d) Allow to come in contact with the roots, leaves, bark or any part of any city tree any gaseous liquid or solid substance harmful to such tree; or

(e) Cause or permit any wire charged with electricity to come in contact with any city tree. (Ord. 2374-91 § 2 (part)).

13.16.100. Public nuisance.

The following are hereby declared public nuisances:

(a) Any diseased, infested, dead or dying tree, shrub or other plant on private property so near to any city tree as to constitute a danger to such tree, or to any street or portion thereof.

(b) Any tree, shrub or groundcover on any private property or within the tree easement of a type of species apt to destroy, impair or otherwise interfere with any approved city tree, street improvement, sidewalk, curb, gutter, sewer or other public improvement, including any main or service;

(c) Any vines, climbing plants, trees or shrubs growing into or over any city trees or any public hydrant, pole or electrolier;

(d) The existence of any tree on private property within the city limits that is infested, infected or in danger of becoming infested or infected with objectionable insects, scales, fungus or growth injurious to trees;

(e) The existence of any branches or foliage on private property which interferes with the visibility on, or free use of, or access to, any portion of any street improved for vehicular, bicycle or pedestrian travel;

(f) Any hedges or thorny plants of any kind on any tree easement or part thereof;

(g) Any shrubs or plants more than twenty-four inches in height in the tree easement, or portion thereof, measured above top of curb grade;

(h) Any tree, shrub or other plant on private property which dangerously obstructs the view in the triangular area described in Chapter 19.44, commonly known as the “visibility triangle.”

- (i) The construction or maintenance of any type of wall or fence around or within any tree easement or portion thereof;
- (j) The placing or maintenance within any tree easement, or portion thereof, of any solid landscaping, decorative materials or plants, including but not limited to large rocks, driftwood or planters made of tile or concrete pipe sections, which protrude more than twenty-four inches above the level of curb and sidewalk and which are continuous with the length of the tree easement, or otherwise tend to block the free movement of pedestrians across the width of the parkway strip;
- (k) The placing or maintenance of any type of ground cover or plant materials within three feet of the base of any tree planted in a tree easement;
- (l) Any concrete, asphalt, tar paper or plastic membranes or other types of impervious materials placed in the tree easement in such close proximity to a city tree as to impede the movement of soil, air and water which are necessary to sustain tree growth and development. (Ord. 2721-03 § 7, 2003; Ord. 2374-91 § 2 (part)).

13.16.110. Abatement of public nuisance.

When any public nuisance as defined herein exists, it shall be subject to abatement as provided for in Chapter 9.26. (Ord. 2374-91 § 2 (part)).

13.16.120. Abatements costs debt to city.

The amount of the cost of abatement of a public nuisance, and any of the charges required to be paid by a property owner or any other person in this chapter, shall be deemed a debt due and owing to the city. The debt shall be collectible in the same manner as any other civil debt owing to the city. Such civil action shall not be a bar to any criminal action provided for by law. (Ord. 2374-91 § 2 (part)).

Chapter 19.37 Landscaping, irrigation, and usable open space.

19.37.010. Purpose.

The purpose of this chapter is to ensure that adequate landscaped areas and useable open space are provided where applicable for all zoning districts; to promote the conservation and efficient use of water and to prevent the waste of this valuable resource; and to promote water conservation as one component of sustainable building practices. This chapter shall be construed to assure consistency with the requirements of the Water Conservation in Landscaping Act of the California Government Code, or any successor statute, and any applicable implementing regulations, as they exist at the time of enactment or as later amended. In addition to compliance with the provisions in this chapter, projects shall comply with stormwater management requirements set forth in Chapter 12.60. (Ord. 2918-10 § 3).

19.37.020. Applicability.

All provisions of this chapter shall apply to the following landscaping projects:

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (a) Individual Single-Family or Duplex Residential Projects. New landscaping installations equal to or greater than one thousand square feet in connection with construction of a new dwelling unit.
- (b) All Other Projects. New landscaping installations or landscaping rehabilitation projects equal to or greater than one thousand square feet.
- (c) Exemptions. Landscaping and irrigation requirements shall not apply to:
 - (1) Projects that fall below the square footage thresholds stated in subsections (a) and (b);
 - (2) Individual single-family or duplex residential projects that are not in connection with construction of a new dwelling unit;
 - (3) Registered local, state or federal historical sites where landscaping establishes a historical landscaping style, as determined by the Heritage Preservation Commission, planning commission, or by any applicable public board or commission responsible for architectural review or historic preservation;
 - (4) Ecological restoration or mined-land reclamation projects that do not require a permanent irrigation system; or
 - (5) Community gardens, plant collections (as part of botanical gardens and arborets open to the public), non-irrigated areas designated for non-development (e.g., open spaces and existing native vegetation), agricultural uses, commercial nurseries and sod farms. (Ord. 2918-10 § 3).

19.37.030. Definitions.

The following terms and definitions pertain to the water efficiency sections of this chapter:

- (a) “Applied water” means the portion of water supplied by the irrigation system to the landscaped area.
- (b) “Automatic irrigation controller” means an automatic timing device used to remotely control valves that operate an irrigation system. Automatic irrigation controllers schedule irrigation events using either evapotranspiration (weather-based) or soil moisture data.
- (c) “Certified professional” means a licensed landscape architect, a licensed landscape contractor, a licensed professional engineer, certified irrigation designer, or any other person authorized by the state to design a landscape or irrigation system, or a certified landscape irrigation auditor.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (d) “Conversion factor (0.62)” means the number that converts acre-inches per acre per year to gallons per square foot per year.
- (e) “Drip irrigation” means any non-spray low volume irrigation system utilizing emission devices with a flow rate measured in gallons per hour. Low volume irrigation systems are specifically designed to apply small volumes of water slowly at or near the root zone of plants.
- (f) “Estimated total water use” (ETWU) means the total water used for the landscaped area as described in Section 19.37.050.
- (g) “ET adjustment factor” (ETAF) means a factor of 0.7, that, when applied to reference evapotranspiration, adjusts for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscaped area. ETAF for a special landscaped area shall not exceed 1.0.
- (h) “Evapotranspiration rate” means the quantity of water evaporated from adjacent soil and other surfaces and transpired by plants during a specified time.
- (i) “Hardscape” means any durable material (pervious and non-pervious) in a landscaped area, such as decks, patios or pedestrian walkways, and other non-irrigated elements which may include art work, benches, and bicycle parking.
- (j) “Hydrozone” means a portion of the landscaped area having plants with similar water needs. A hydrozone may be irrigated or non-irrigated.
- (k) “Irrigation audit” means an in depth evaluation of the performance of an irrigation system. An irrigation audit includes, but is not limited to: inspection, system tune up, system test with distribution uniformity or emission uniformity, correction of any overspray or runoff that causes overland flow, and preparation of an irrigation schedule.
- (l) “Irrigation efficiency” (IE) means the measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. Required irrigation efficiency is described in Section 19.37.110.
- (m) “Low water use plant” means a plant species whose water needs are compatible with local climate and soil conditions. Species classified as “very low water use” and “low water use” by WUCOLS, having a regionally adjusted plant factor of 0.0 through 0.3, shall be considered low water use plants.
- (n) “Maximum applied water allowance” (MAWA) means the upper limit of annual applied water for the established landscaped area as specified in Section 19.37.050.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (o) “Mulch” means any organic material such as leaves, bark, straw, compost, or inorganic mineral materials such as rocks, gravel, and decomposed granite left loose and applied to the soil surface for the beneficial purposes of reducing evaporation, suppressing weeds, moderating soil temperature, and preventing soil erosion.
- (p) “Native plant” means a plant indigenous to a specific area of consideration. For the purposes of these guidelines, the term shall refer to plants indigenous to the coastal ranges of central and northern California, and more specifically to such plants that are suited to the ecology of the present or historic natural community(ies) of the project’s vicinity.
- (q) “No water using plant” means a plant species with water needs that are compatible with local climate and soil conditions such that regular supplemental irrigation is not required to sustain the plant after it has become established.
- (r) “Plant factor” or “plant water use factor” is a factor, when multiplied by ET₀ (reference evapotranspiration), estimates the amount of water needed by plants. For purpose of calculation of the ETWU, use values from WUCOLS, or equivalent reference subject to approval by the director of community development.
- (s) “Precipitation rate” means the rate of application of water measured in inches per hour.
- (t) “Recreational area” means areas dedicated to active play such as parks, sports fields, and golf courses where turf provides a playing surface.
- (u) “Reference evapotranspiration” or “ET₀” means a standard measurement of environmental parameters which affect the water use of plants. For purposes of calculation of the MAWA and ETWU, as described in Section 19.37.050, use current reference evapotranspiration data, such as from the California Irrigation Management Information System (CIMIS), or other equivalent data, or soil moisture sensor data.
- (v) “Runoff” means water which is not absorbed by the soil or landscaping to which it is applied and flows from the landscaped area.
- (w) “Soil moisture sensing device” or “soil moisture sensor” means a device that measures the amount of water in the soil. The device may also suspend or initiate an irrigation event.
- (x) “Special landscaped area” (SLA) means an area of the landscaping dedicated solely to edible plants, areas irrigated with recycled water, water features using recycled water, and areas dedicated to active play such as parks, sports fields, golf courses, and where turf provides a playing surface.
- (y) “Turf” means a ground cover surface of mowed grass.

(z) “Water feature” means a design element where open water performs an aesthetic or recreational function. Water features include ponds, lakes, waterfalls, fountains, artificial streams, spas, and swimming pools (where water is artificially supplied).

(aa) “WUCOLS” means the Water Use Classification of Landscape Species published by the University of California Cooperative Extension, the Department of Water Resources and the Bureau of Reclamation, 2000. (Ord. 2918-10 § 3).

19.37.040. Minimum landscaped area and useable open space.

(a) Minimum Landscaped Area. Table 19.37.040 describes the minimum landscaped area and useable open space required by zoning district. In addition to the minimum landscaped area, areas not used for buildings, parking lot areas, driveways or pedestrian walkways shall be landscaped unless the review authority determines that landscaping is not necessary to achieve the purposes of this chapter. For requirements specific to single family uses, see subsection (f).

(b) Landscaped Buffer Required. A landscaped buffer is required for any property with a nonresidential use in a residential zoning district that abuts a residential use. It is also required for properties of any use in a nonresidential zoning district which abuts a residential zoning district. See Section 19.37.080 for buffer landscaping design requirements.

(c) Landscaped Frontage Strip Required. A fifteen-foot wide landscaped frontage strip is required for all properties except those noted below in subsection (f). The frontage strip is measured from the inside edge of the public sidewalk, or if no sidewalk exists, from the curb. See Section 19.37.090 for frontage strip landscaping design requirements.

(d) Useable Open Space Required. Useable open space is required for all duplex and multifamily residential properties as described in Table 19.37.040. Useable open space areas that meet the definition of landscaping may contribute towards the minimum landscaped area of the site. See Section 19.37.100 for useable open space design requirements.

(e) Specific Plan, Precise Plan and Other Specialized Plan Areas. Minimum landscaped area and useable open space for properties within a specialized plan’s prescribed area are described in their individual plans.

(f) Allowances and Limitations for Single-Family Uses and Single-Family Zoning Districts.

(1) Allowances for Single-Family Zoning Districts. Yards are not required to be landscaped in single-family zoning districts; however other provisions in Title 19 may apply.

(2) Limitation on Paved Areas in the R-0 and R-1 Zoning Districts. Not more than fifty percent of the required front yard of any lot within an R-0 or R-1 zoning district shall be paved with asphalt, concrete cement, or any other impervious surface, except as may be required to meet off-street parking and access requirements of Chapter 19.46.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(3) Landscaped Frontage Strip for Single-Family Uses. A landscaped frontage strip is not required in any zoning district for single-family residential uses which have a frontage on a public street.

Table 19.37.040**Minimum Landscaped Area and Useable Open Space by Zoning District**

| Zoning District | Useable Open Space | Other Landscaped Area | Parking Lot Landscaped Area | Total Landscaped Area |
|-----------------|-------------------------------|-----------------------|-----------------------------|--|
| R-0 | N/A | N/A | N/A | N/A |
| R-1 | N/A | N/A | N/A | N/A |
| R-1.5 | N/A | N/A | N/A | N/A |
| R-1.7/PD | N/A | N/A | N/A | N/A |
| R-2 | 500 sq. ft./unit ¹ | 850 sq. ft./ unit | 20% of the parking lot area | Total minimum landscaped area is the combination of the minimum parking lot landscaped area and other landscaped area. In no case shall this total be less than 20% of the lot area. |
| R-3 | 400 sq. ft./unit | 425 sq. ft./unit | | |
| R-4 | 380 sq. ft./unit | 375 sq. ft./unit | | |
| R-5 | 380 sq. ft./unit | 375 sq. ft./ unit | | |
| C-1 | N/A | 12.5% of floor area | | |
| C-2 | N/A | 12.5% of floor area | | |
| C-3 | N/A | 12.5% of floor area | | |
| C-4 | N/A | 12.5% of floor area | | |
| O | N/A | 10% of lot area | | |
| P-F | N/A | 10% of lot area | | |
| M-S | N/A | 10% of floor area | | |
| M-3 | N/A | 10% of floor area | | |

¹ One thousand square feet of useable open space is required for a property with an accessory living unit.

(Ord. 2918-10 § 3).

19.37.050. Water efficiency design requirements.

Water Efficiency in Design. Landscaped areas shall be designed to achieve water efficiency. Landscaping design and plant selection may be based on one of two options. Regardless of which option is selected, all other criteria described in this chapter shall apply. The options include:

- (a) Option 1—Turf Limitation and Minimum Area with Water Conserving Plants. Turf area shall not be more than twenty-five percent of the landscaped area, and native, low water use or no water use plants shall be installed in at least eighty percent of all non-turf landscaped areas.
- (b) Option 2—Water Budget Calculations. If the turf limitation option is not selected, a water budget calculation shall be prepared and shall adhere to the following requirements:

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(1) The plant factor shall be obtained from WUCOLS or an equivalent reference subject to approval by the director of community development. For areas that mix plants with different water uses, the plant factor calculation is based on the proportion of the respective plant factors, or based on the plant factor of the higher water using plant. The plant factor ranges from 0.0 to 0.3 for low water use plants, from 0.4 to 0.6 for moderate water use plants, and from 0.7 to 1.0 for high water use plants.

(2) All water features shall be included in the high water use hydrozone.

(3) All special landscaped areas (SLA) shall be identified and their water use included in the water budget calculations.

(4) The reference evapotranspiration adjustment factor (ETAF) for SLAs shall not exceed 1.0. The ETAF for all other landscaped areas shall not exceed 0.7.

(5) Maximum applied water allowance (MAWA) shall be calculated using the following equation:

$$\text{MAWA} = (\text{ETo}) (0.62) [(0.7 \times \text{LA}) + (0.3 \times \text{SLA})]$$

Where:

MAWA = Maximum applied water allowance (gallons per year)

ETo = Reference evapotranspiration (inches per year)

0.62 = Conversion factor (to gallons)

0.7 = Reference evapotranspiration adjustment factor (ETAF)

LA = Planted landscaped area including SLA and not including hardscapes (square feet)

0.3 = Additional water allowance for SLA

SLA = Special landscaped area (square feet)

(6) Estimated total water use (ETWU) will be calculated using the equation below. The sum of the ETWU calculated for all hydrozones shall not exceed the MAWA.

$$\text{ETWU} = (\text{ETo})(0.62) \left(\frac{\text{PP} \times \text{HA}}{\text{IE}} + \text{SLA} \right)$$

Where:

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

ETWU = Estimated total water use per year (gallons)

ETo = Reference evapotranspiration (inches)

PF = Plant factor from WUCOLS

HA = Hydrozone area [high, medium, and low water use areas] (square feet)

SLA = Special landscaped area (square feet)

0.62 = Conversion factor

IE = Irrigation efficiency (minimum 0.70)

(Ord. 2918-10 § 3).

19.37.060. General planting, soil management and water feature design requirements.

(a) **Plant Material.** In addition to the requirements below, plant selection and installation shall be done in accordance with accepted horticultural industry practices.

(1) **Variety.** Landscaping shall include trees, shrubs, vines, flowers, ground covers or a combination thereof.

(2) **Size at Time of Planting.** Plant materials shall be sized and spaced to achieve immediate effect, in accordance with horticultural industry practices and at the discretion of the director of community development. Trees shall be of minimum fifteen gallon size. Twenty-four or thirty-six inch box trees may be required at the discretion of the director of community development.

(3) **Number of Trees.** There shall be one tree per one thousand square feet of required landscaped area in addition to required street trees and parking lot trees.

(4) **Turf.** All turf areas shall be planted with tall fescue or similar turf requiring less water. Turf shall not be planted on slopes greater than ten percent where the toe of the slope is adjacent to an impermeable hardscape.

(b) **Grouping of Plants.** Plants with similar water needs shall be grouped (also described as a hydrozone). Areas that mix plants with different water uses may be allowed if a water budget is performed.

(c) **Soil Management.**

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (1) Mulch. A minimum two-inch layer of mulch shall be applied on all non-turf soil areas.
- (2) Soil Amendments. Soil amendments, such as compost, shall be incorporated according to the soil conditions at the project site and based on what is appropriate for selected plans.
- (3) Grading. If the project includes grading, the grading shall be designed to minimize soil erosion, runoff and water waste. The grading shall avoid soil compaction in planted landscaped areas.
- (d) Water Features. Recirculating water systems shall be used for water features. Where available, recycled water shall be used for water features. (Ord. 2918-10 § 3).

19.37.070. Parking lot landscaping design requirements.

- (a) Parking Lot Shading. Trees shall be planted and maintained throughout the lot to ensure that at least fifty percent of the parking area will be shaded within fifteen years after the establishment of the lot.
 - (1) Solar Energy Systems as Shading. Up to twenty-five percent of the fifty percent parking lot shading requirement (twelve and one-half percent of the total parking lot area) may be met with installation of solar energy systems rather than trees.
 - (2) Calculation of Shading. Shading shall be calculated by using the diameter of the tree crown at fifteen years or the dimensions of any roofed area supporting the solar energy system within the parking lot area.
 - (3) Surfaces Subject to Shading Calculation. All surfacing on which a vehicle can drive is subject to shade calculation, including all parking stalls, vehicular drives within the property regardless of length, drive-through lanes, and all maneuvering areas regardless of depth. The following surface areas are exempt from shading requirements: truck loading areas in front of overhead doors, truck maneuvering and parking areas unconnected to and exclusive of any vehicle parking, surfaced areas not to be used for vehicle parking, driving or maneuvering, provided they are made inaccessible to vehicles by a barrier such as bollards or fencing, display, sales, service, or vehicular storage areas for automobile dealerships (required parking for auto dealerships is still subject to shading requirements), or surfaced areas existing prior to January 1, 2002.
- (b) Ground Cover and Shrubs on Parking Islands. Parking islands shall contain living ground cover or shrubs with the trees, unless it can be shown that ground cover is incompatible with the tree. Where living ground cover is unsuitable, the director of community development may allow porous, nonliving ground cover such as pebbles or tanbark.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(c) Drainage Design. Landscaping islands and parking islands shall be designed to integrate parking lot and site drainage in order to reduce storm water runoff velocities and minimize non-point source pollution. When six-inch concrete curbs are installed, they shall have drainage “weep holes.”

(d) Wheel Stops. Concrete wheel stops shall be installed when landscaped areas are not adequately protected. (Ord. 2918-10 § 3).

19.37.080. Buffer landscaping design requirements.

The following is a list of design requirements for buffer landscaping.

(a) Width. The buffer shall maintain a width of at least ten feet.

(b) Landscaping. The buffer shall include a planted screen of approved trees and shrubs which shall be placed along the length of the buffer at intervals not to exceed twenty feet, provided, however, that the director of community development may grant exceptions through a miscellaneous plan permit when warranted by conditions on the property.

(c) Wall Design. The buffer shall include a decorative masonry wall six feet in height measured from the highest adjoining grade. When the adjacent nonresidential building is two stories or more in height, the decorative masonry wall shall be eight feet measured from the highest adjoining grade. Where a residential use is permitted in a nonresidential zoning district, the wall shall be required on the residential property, unless a wall already exists.

(d) Specific Plan, Precise Plan and other specialized plan areas. Properties within a specialized plan’s prescribed area may be subject to additional buffer landscaping design requirements, as described in their individual plans. (Ord. 2918-10 § 3).

19.37.090. Frontage strip landscaping design requirements.

(a) Width. The frontage strip shall be fifteen feet wide along the entire street frontage measured from the inside edge of the public sidewalk, or if no sidewalk exists, from the curb.

(b) Landscaping Allowances. Frontage strip landscaping may be crossed by walkways and access drives.

(c) Specific Plan, Precise Plan and Other Specialized Plan Areas. Properties within a specialized plan’s prescribed area may vary from these frontage strip design requirements, as described in their individual plans. (Ord. 2918-10 § 3).

19.37.100. Useable open space design requirements.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (a) Function. Useable open space must be designed to be accessible to, and useable for outdoor living, recreation or utility use.
- (b) Location. Useable open space may not be located in any required front yard area.
- (c) Minimum Useable Open Space Dimensions and Area. Each useable open space area shall have at least a twelve foot dimension in any direction and a minimum area of two hundred square feet except for:
 - (1) Private balconies must have a minimum of seven feet in any direction and a minimum area of eighty square feet.
 - (2) Roofs, decks or porches must have a minimum of ten feet in any direction and a total of one hundred twenty square feet.
- (d) Private Useable Open Space Required. In the R-4 and R-5 zoning districts, a minimum of eighty square feet per unit shall be designed as private useable open space.
- (e) Specific Plan, Precise Plan and Other Specialized Plan Areas. Properties within a specialized plan's prescribed area may vary from these useable open space design requirements, as described in their individual plans. (Ord. 2918-10 § 3).

19.37.110. Irrigation system design requirements.

- (a) Irrigation System Required. All landscaped areas shall have a permanent irrigation system, except for single-family detached and duplex dwellings.
- (b) Irrigation Efficiency. Irrigation systems shall be designed and maintained to meet or exceed an average landscaping irrigation efficiency of seventy percent.
- (c) Water Waste Prohibited. Water waste resulting from an inefficient irrigation system leading to runoff, low head drainage, overspray, or other similar conditions where water flows onto adjacent property, non-irrigated areas such as walkways, roadways or structures is prohibited.
- (d) Hydrozone Irrigation. Systems shall be designed to meet the individual needs of each plant group. Valves and control circuits shall be separated based on the required rate and quantity of water used.
 - (1) Valves. Each valve shall irrigate a hydrozone with similar site, slope, sun exposure, soil conditions and plant materials with similar water use. Where feasible, trees shall be placed on separate valves from shrubs, groundcovers, and turf.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(2) Sprinkler Heads. Sprinkler heads and other emission devices shall be selected based on what is appropriate for the plant type within that hydrozone. Sprinkler heads must have matched precipitation rates within each circuit.

(e) Low Volume Irrigation. Bubbler or drip-type irrigation, or other low-flow, non-spray technology shall be provided for:

(1) Trees and shrubs.

(2) Mulched areas.

(3) Areas with slope greater than ten percent, unless it can be demonstrated that no runoff or erosion will occur if other types of irrigation is used.

(4) Areas that are less than eight feet wide in any direction.

(f) Overhead Sprinkler Irrigation. Overhead irrigation systems may be used for clustered shrub plantings. Areas within two feet of a non-permeable surface may not be irrigated using overhead sprinkler irrigation unless it can be demonstrated that no runoff would occur, or the adjacent non-permeable surface is designed and constructed to drain entirely to landscaping.

(g) Irrigation Controllers and Sensors. All irrigation controllers must utilize either evapotranspiration or soil moisture sensor data and be capable of dual or multiple programming. Irrigation systems shall also incorporate sensors (rain, freeze, wind, etc.) that suspend or alter irrigation operation during unfavorable weather conditions.

(h) Screening of Devices. Irrigation controllers and backflow devices shall be screened from public view.

(i) Scheduling. Irrigation must be scheduled between eight p.m. and ten a.m. (Ord. 2918-10 § 3).

19.37.120. Landscaping and irrigation approval.

(a) Permit Required. Except as otherwise provided in this chapter, no person shall install or modify any landscaped area described in Section 19.37.020 without first obtaining a miscellaneous plan permit for each such action, in accordance with the procedure described in Chapter 19.82.

(b) Landscaping and Irrigation Plans Required. Landscaping and irrigation plans shall be required for any modification or installation of new landscaping that falls within the thresholds stated in this chapter. The plans shall meet the information requirements determined by the director of community development to comply with the provisions of this chapter.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(1) Preparation by Certified Professional. Landscaping and irrigation plans shall be prepared by, and bear the signature of, a certified professional, except for new landscaping installations or landscaping rehabilitation projects with less than two thousand five hundred square feet of landscaped area. (Ord. 2918-10 § 3).

19.37.130. Landscaping irrigation audit and maintenance.

(a) Irrigation Audit Required. Prior to approval of occupancy by a building official, a landscaping irrigation audit shall be conducted and an irrigation audit report shall be submitted for projects with landscaping and irrigation plans approved after June 10, 2010.

(1) Audit by Certified Professional. The landscaping irrigation audit shall be conducted and the report shall be prepared by a certified professional, except for new landscaping installations or landscaping rehabilitation projects with less than two thousand five hundred square feet of landscaped area.

(2) Audit Report Content. The irrigation audit report shall include, but not be limited to: inspection, system tune-up, system test with distribution uniformity, correction of any overspray or runoff that causes overland flow, and preparation of an irrigation schedule.

(b) Submittal of Landscaping Maintenance Schedule. Prior to the final inspection by the building official, a regular maintenance schedule shall be submitted to the director of community development for review and approval. The maintenance schedule shall include, but not be limited to, routine inspection; adjustment and repair of the irrigation system and its components; aerating and dethatching turf areas; replenishing mulch; fertilizing; pruning; weeding in all landscaped areas; and removing obstructions to irrigation spray heads or other emission devices. Landscaping shall be maintained in accordance with the approved maintenance schedule.

(c) General Maintenance. Landscaping shall be maintained in compliance with the approved landscaping plan, and shall be maintained in a neat, clean and healthful condition. Removed landscaping shall be replaced with specimen plants to match the approved landscaping plan. (Ord. 2918-10 § 3).

Chapter 19.94. TREE PRESERVATION

19.94.010. Findings.

The city council finds that:

(a) The city of Sunnyvale has a great diversity of trees that are of economic value to the city and make it a desirable place for residents, business owners and visitors;

(b) The appearance of Sunnyvale contributes to the economic prosperity of the city;

(c) Trees contribute to the scenic beauty of Sunnyvale;

(d) Trees help to naturally control flooding and erosion, moderate noise pollution, climate, dust and other airborne pollutants, remove carbon dioxide from the atmosphere and produce oxygen, and shelter and feed birds and other wildlife;

(e) The development and redevelopment of the city often necessitates the removal of trees, thereby contributing to their depletion; and

(f) It is necessary to protect and manage these valuable assets and their habitat to protect the health, safety and welfare of the citizens of Sunnyvale. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.010).

19.94.020. Purpose.

The purpose of this chapter is to regulate the protection, installation, removal and long term management of significantly sized trees on private property within the city and city owned golf courses and parks; encourage the proper protection and maintenance of significantly sized trees which are located on such property; establish a review and permit procedure to assure the correct planting, maintenance, protection and removal of significant trees on such property; and establish penalties for violation of its provisions. This chapter is not intended to regulate trees on public rights-of-way, which are regulated pursuant to Chapter 13.16. The provisions of this chapter identify and prescribe specific procedures and requirements for the filing, processing and consideration of the removal and preservation of trees. These provisions shall be used in conjunction with the general requirements and procedures identified in Chapter 19.98 including requirements and procedures for applications, fees, notification, appeals, conditions of approval, modifications, expiration, extensions, revocation and infractions, as applicable. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.020).

19.94.030. Definitions.

For the purpose of this chapter the following definitions apply:

(1) “Damage” means any intentional action or gross negligence which causes injury, death or disfigurement of a tree. Actions include, but are not limited to, cutting, girdling, poisoning, overwatering, unauthorized relocation or transportation of a tree or trenching, excavating, altering the grade or paving within the dripline of a tree.

(2) “Dripline” means the outermost line of the tree’s canopy projected straight down to the ground surface. As depicted in a plan view, the dripline appears as an irregularly shaped circle.

(3) “Protected tree” means a tree of significant size.

(4) “Significant size” means a tree thirty-eight inches or greater in circumference measured four and one-half feet above ground for single-trunk trees. For multi-trunk trees “significant size” means a tree which has at least one trunk with a circumference thirty-eight inches or greater measured four and one-half feet above ground level, or in which the measurements of the circumferences of each of the multi-trunks, when measured four and one-half feet above the ground level, added together equal an overall circumference one hundred thirteen inches or greater.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(5) “Tree” means any woody plant which has a trunk thirteen inches or more in circumference at four and one-half feet above ground level.

(6) “Tree removal” means the physical removal of a tree or causing the death of a tree through damaging, poisoning, or other direct or indirect action, including excessive trimming, pruning, or mutilation that sacrifices the health, destroys, or diminishes the aesthetic quality, or diminishes the life expectancy of the tree. (Ord. 2808-06 § 2: Ord. 2623-99 § 1 (part): prior zoning code § 19.81.030 (part)).

* Editor’s Note: The definitions in Section 19.94.030 also appear in Ch. 19.12.

19.94.040. Actions prohibited.

(a) It is unlawful to damage or kill any protected tree.

(b) It is unlawful to remove any protected tree from private property in any zoning district or from any city owned golf course or park, without a protected tree removal permit. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.040).

19.94.050. Permits required.

(a) In order to remove any protected tree from private property in any zoning district, or from any city owned golf course or park, it is necessary to obtain a protected tree removal permit from the department of community development. Any tree which has been designated as a heritage landmark, pursuant to the provisions of Chapter 19.96, shall not be removed without obtaining a tree removal permit in addition to a landmark alteration permit in accord with Chapter 19.96.

(b) Tree removal permits shall be filed at least ten working days prior to the proposed date of tree removal.

(c) Removal of orchard trees as part of farming operations or upon order of the county agricultural inspector are exempt from the provisions of this chapter. (Ord. 2808-06 § 3: Ord. 2623-99 § 1 (part): prior zoning code §§ 19.81.050, 19.81.080 (a)).

19.94.060. Standards and criteria.

One or more of the following standards must be met before a protected tree removal permit may be approved:

(a) The tree is diseased or damaged;

(b) The tree represents a potential hazard to people, structures or other trees;

(c) The tree is in basically sound condition, but restricts the owner’s ability to enjoy the reasonable use or economic potential of the property, or unreasonably restricts an adjoining property owner’s use or economic potential of the adjoining property. In the event this is the sole basis for the application, the following criteria shall be used to evaluate the application under this subsection:

(1) The necessity of the requested removal to allow construction of improvements such as additions to existing buildings or incidental site amenities or to otherwise allow economic or reasonable enjoyment of property;

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (2) The topography of the land and the effect of the requested action on water retention and diversion or increased flow of surface water;
- (3) The approximate age of the tree relative to its average life span;
- (4) The potential effect of removal on soil erosion and stability where the tree is located;
- (5) Current and future visual screening potential;
- (6) The property has become over landscaped with trees so that they are too numerous, crowded, and unreasonably restricts the property owner's ability to use their land. In this event, selective removal can be approved in conjunction with acceptable arborist's practices;
- (7) The tree has outgrown its useful landscape value due to its inappropriate species, size and location, relative to the existing structures on the property;
- (8) Any other information the director of community development finds pertinent to the application. (Ord. 2808-06 § 4: Ord. 2623-99 § 1 (part): prior zoning code § 19.81.060).

19.94.070. Display of permit.

All permits issued for tree removal shall be so displayed as to be clearly visible from a public right-of-way. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.070).

19.94.080. Replacement trees.

(a) At the discretion of the director of community development, replacement trees may be required as a condition of issuance of a protected tree removal permit, or as a condition of any discretionary permit for development or redevelopment. The need for replacement trees shall be evaluated based on the following criteria:

- (1) The number, species, size and location of existing trees on the site; and
- (2) Good forestry practices such as, but not limited to, the number of healthy trees a given parcel of land will support.

(b) At the discretion of the director of community development, other mitigation measures may be required, where either it is not feasible to plant any replacement trees on the site, or where the replacement trees to be planted are deemed inadequate by the director to sufficiently mitigate the effects of the removal of the tree(s). Mitigation measures could include, but would not be limited to, paying for the planting of additional trees in parks or other public areas of the city. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.090).

19.94.090. Requirements for replanting programs.

The following items shall be included in replanting programs when protected trees must be removed:

- (a) Minimum distances between trees and between trees and buildings shall be provided such that the health of the replacement trees shall be ensured;
- (b) Replanting shall occur within a specified time period;

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

- (c) Mixed species shall be used in large replantings whenever possible to reduce the likelihood of disease and infestations;
- (d) Tree care procedures shall be included in all replanting plans and shall include, but not be limited to, the following items: mulching; straightening; new staking or restaking; fertilizing; and any other procedures deemed necessary by the city;
- (e) Minimum size for the replacement of a protected tree shall be a California Association of Nurserymen's standard twenty-four inch box size tree. The director of community development shall have the authority to require larger or smaller replacement trees upon review of specific cases. Smaller trees may be approved if the applicant can document the long term advantages of using the smaller tree size. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.100).

19.94.100. Relocation of trees.

At the discretion of the director of community development, the tree(s) to be removed may be required to be relocated on or off the subject site. The need for relocation shall be evaluated based on the criteria found in Section 19.94.080 plus the ease with which the removed tree can be replanted. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.110).

19.94.110. Requirements concerning protected trees during site development or modification.

When site development or modification is occurring and a discretionary permit and a public hearing are required, the developer or owner shall meet the following requirements:

- (a) Tree Survey. A tree survey conducted by an arborist who has been certified by the International Society of Arboriculture shall be submitted as part of the required application materials for all use, design or special development permits on developing or redeveloping property. The survey shall show the location, size, and species (both common and Latin names required) of all trees (protected and unprotected) on the site, and shall include a calculation of the value of each tree. A written letter shall be included when a protected tree(s) is proposed to be removed explaining why the tree(s) cannot be relocated or the design of the structures altered to maintain the trees.
- (b) Plan Modifications.
 - (1) The approving body shall have the ability to require the reasonable alteration of a proposed building in order to retain protected trees.
 - (2) The approving body shall have the ability to require relocation (on or off site) of protected trees which the applicant proposes to remove.
- (c) Replanting Plans. When protected trees must be removed, replanting plans shall be submitted as part of the landscaping plan for the proposed project. The replanting plan shall be subject to the requirements of Section 19.94.090, but actual number and sizes of replacement trees shall be reviewed on a case by case basis.
- (d) Tree Protection Plan. The developer shall submit a tree protection plan which shall demonstrate how tree protection shall be provided during and after construction and shall include, where appropriate, a description of any of the protective measures set forth in Section 19.94.120.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(e) Tree Bonds. The approving body shall have the authority to require a developer to post a bond with the City for the value of any tree required to remain as a condition of permit approval during development activities on a site.

(1) The bond may be for a maximum period of five years.

(2) The value of the tree shall be determined by the director of community development.

(3) The bond will be released back to the developer if the tree remains in good health through the end of the bond period.

(4) In the event the tree dies or begins to decline in poor health, the bond will be used by the City to replace the aesthetic value of the tree that was lost.

(f) Soil Mitigation. The approving body shall have the authority to require underground soil or planting measures, such as structural soils, in any location deemed appropriate for future or existing tree growth. (Ord. 2808-06 § 5; Ord. 2623-99 § 1 (part): prior zoning code § 19.81.120).

19.94.120. Tree protection during construction.

Protected trees designated for preservation shall be protected during construction of a project by use of the following methods:

(a) Protective fencing shall be installed no closer to the trunk than the dripline, and far enough from the trunk to protect the integrity of the tree. The fence shall be a minimum of four feet in height and shall be set securely in place. The fence shall be of a sturdy but open material (i.e., chain link) to allow visibility to the trunk for inspections and safety.

(b) The existing grade level around a tree shall normally be maintained out to the dripline of the tree. Alternate grade levels, as described in the tree protection plan, may be approved by the director of community development.

(c) Drain wells shall be installed whenever impervious surfaces will be placed over the root system of a tree (the root system generally extends to the outermost edges of the branches).

(d) Pruning that is necessary to accommodate a project feature, such as a building, road or walkway shall be reviewed and approved by the department of community development and the department of public works.

(e) New landscaping installed within the dripline of an existing tree shall be designed to reproduce a similar environment to that which existed prior to construction. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.130).

19.94.130. Project review committee.

All tree surveys, replanting plans and tree protection plans submitted with discretionary permit applications made pursuant to Title 19, shall be reviewed at a project review committee meeting at which the applicant shall be present. Discretionary permits shall not be issued until such time as the tree survey, replanting plan and tree protection plans are deemed complete and have been approved by the director of community development. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.140).

19.94.140. On-site inspections.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Appropriate city staff shall be authorized to conduct on-site inspections during construction to ensure that tree preservation procedures are being followed and replanting plans implemented. Failure to abide by an approved plan or permit may result in a stop work order to be issued by the director of community development. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.150).

19.94.150. Emergency waivers and exemptions.

The provisions of this chapter are waived if compliance would hamper the rescue of life or property from immediate danger or the repair of utilities in the event of emergencies such as wind storms, ice storms or other natural disasters. (Ord. 2623-99 § 1 (part): prior zoning code § 19.81.160).

19.94.160. Penalties for violation.

(a) Any person, property owner, firm or corporation who intentionally or negligently violates any of the provisions of this chapter or any permit issued pursuant to it, or who fails to comply with any condition of any discretionary permit which relates to protected tree preservation, shall be liable for a civil penalty assessed and recovered in a civil action brought by the city attorney.

(1) In the event that the violation results in any substantial injury or damage to a protected tree, the civil penalty shall be not less than five thousand dollars nor more than twenty-five thousand dollars. In the event that the violation results in the destruction or improper removal of a protected tree, the civil penalty shall be not less than ten thousand dollars nor more than fifty thousand dollars. The appropriate penalty shall apply separately to each tree affected by the improper action.

(2) In any civil action brought to seek such civil penalties, and/or to obtain injunctive relief for violation of any provision of this chapter, in which the city prevails, the court shall determine and impose reasonable expenses, including attorneys' fees incurred by the city in the investigation and prosecution of the action.

(b) The director of community development or his designee shall have the authority to require an administrative hearing for any violations of the provisions of this chapter, including but not limited to, illegal tree removal.

(1) The administrative hearing shall be set for a date that is not less than fifteen calendar days and not more than thirty calendar days from the date the "Notice of Violation" is served in accordance with Section 1.08.100.

(2) The hearing officer may impose such fines, reasonable expenses and landscaping deemed necessary to replace the aesthetic value of the tree based on generally accepted arborist's practices.

(3) The hearing officer may consider any relevant evidence and the decision must be supported by the weight of the evidence. Strict rules of evidence shall not apply.

(4) The hearing officer shall issue a written decision within fifteen days of the hearing date. The hearing officer may continue the hearing and request additional information from city staff or the recipient of the "Notice of Violation" before issuing a written decision.

(5) If the hearing officer imposes a fine for a violation of this chapter and the fine has not been satisfied within ninety days or has not been appealed, then the obligation shall become a lien against the real property on which the obligation occurred.

(6) The failure of any recipient of a “Notice of Violation” to appear at the administrative hearing shall constitute a waiver of any objections to the imposition of a fine or other appropriate remedy imposed by the hearing officer and constitutes a failure to exhaust administrative remedies.

(7) The decision of the hearing officer may be appealed to the planning commission within fifteen days of the date of service of the written decision. The decision of the planning commission shall be final.

(c) The remedies provided for in this section are in addition to and do not supersede or limit any and all other remedies, civil or criminal. (Ord. 2808-06 § 6: Ord. 2623-99 § 1 (part): prior zoning code § 19.81.190).

Chapter 19.96. Heritage Preservation

19.96.010. Findings and purpose.

(a) The city council finds that the character and history of the city are reflected in its cultural, historical, and architectural heritage, that these historical and cultural foundations should be preserved as living parts of community life and development to build an understanding of the city’s past so that future generations may have a genuine opportunity to appreciate, enjoy, and understand the rich heritage of the city, that with ever increasing pressures of modernization and urbanization, city landmarks, neighborhoods, and other areas of historical and cultural interest are threatened with demolition, and that pursuant to the provisions of the National Historic Preservation Act of 1966, as amended, the city of Sunnyvale joins with private concerns, the state of California, and the United States Congress to develop preservation programs and activities to give maximum encouragement to agencies and individuals undertaking preservation of the city’s unique architectural, historical, aesthetic, and cultural heritage. The provisions of this chapter identify and prescribe specific procedures and requirements for the filing, processing and consideration by the heritage preservation commission. These provisions shall be used in conjunction with the general requirements and procedures identified in Chapter 19.98 including requirements and procedures for applications, fees, notification, appeals, conditions of approval, modifications, expiration, extensions, revocation and infractions.

(b) The purpose of this chapter is to promote the public health, safety, and general welfare, and

(1) To safeguard the city’s unique cultural heritage as embodied and reflected in the city’s architectural history and patterns of cultural development;

(2) To encourage and facilitate public knowledge, understanding, and appreciation of the city’s historic past and unique sense of place and to encourage public participation in identifying heritage resources;

(3) To promote the enjoyment, celebration, and use of heritage resources appropriate for the educational, cultural, recreational as well as material needs of people;

(4) To preserve diverse architectural styles, patterns of development, and design preferences reflecting phases of the city's history and to encourage complementary contemporary design and construction and inspire a more livable urban environment;

(5) To enhance property values and to increase economic and financial benefits to the city and its inhabitants through incentives for preservation;

(6) To protect and enhance the city's attraction to tourists and visitors thereby stimulating business and industry;

(7) To identify as early as possible and resolve conflicts between the preservation of heritage resources and alternative land uses by integrating the preservation of heritage resources into the comprehensive planning, management and development processes for both public and private property;

(8) To conserve valuable material and energy resources by ongoing use and maintenance of the existing built environment;

(9) To stabilize neighborhoods through the preservation of heritage resources and establishment of heritage resource districts; and

(10) To develop and maintain appropriate settings and environments for heritage resources. (Ord. 2623-99 § 1 (part): prior zoning code § 19.80.005).

19.96.040. Definitions.

For the purpose of this chapter, the following definitions apply:

(a) “Alteration” means any exterior change or modification to an improvement or site which affects the exterior architectural features of property.

(b) “Designated heritage resource” means a heritage resource which has specific elements which are expressly found to meet one or more of the Criteria of the National Register of Historic Places as established by the Secretary of the Interior and incorporated by reference into this code and which has been designated and determined to be appropriate for preservation by the city council, and has been recognized by the state or the nation to be historically significant.

(c) “Designated heritage resource district” means a heritage resources district which has specific elements which are expressly found to meet one or more of the Criteria of the National Register of Historic Places as established by the Secretary of the Interior and incorporated by reference into this code and which has been designated and determined to be appropriate for preservation by the city council, and has been recognized by the state or the nation to be historically significant.

(d) “Exterior architectural feature” means the architectural elements embodying style, design, general arrangement and components of all of the outer surfaces of an improvement. This includes such visual characteristics as paint, color, surface texture, grading, surface paving, materials, accessory structures, trees and other natural features, and exterior objects such as signs, plaques, light fixtures, street furniture, walls, fences, steps, plantings and landscape accessories.

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

(e) “Heritage housing combining district” means a heritage resource district consisting of residential properties which has been zoned as a heritage housing combining district for the purposes of preserving, protecting, enhancing and perpetuating the appearance of the district which contributes to the cultural or aesthetic heritage of the city.

(f) “Heritage resource” means improvements, buildings, portions of buildings, structures, signs, features, sites, scenic areas, views and vistas, places, areas, landscapes, trees, or other natural objects or objects of scientific, aesthetic, educational, political, social, cultural, architectural, or historical significance to the citizens of the city, the Santa Clara Valley region, the state, or the nation, which are designated and determined to be appropriate for preservation by the city council.

(g) “Heritage resource district” means any geographically definable area containing a concentration or continuity of heritage resources which are thematically related, or which contribute to each other and are unified by a special character, historical interest, aesthetic value, or which represents one or more architectural periods or styles typical to the city, and that has been designated and determined to be appropriate for preservation by the city council, pursuant to provisions of this chapter.

(h) “Improvement” means any building, structure, place, parking facility, fence, gate, wall, work of art, or other object constituting a physical betterment of real property, or any part of such betterment.

(i) “Local landmark” means a heritage resource which is significant in that the resource materially benefits the historical character of a neighborhood or area, or the resource in its location represents an established and familiar visual feature of the community or city, and has been designated and determined to be appropriate for preservation by the city council.

(j) “Local landmark district” means a heritage resources district which demonstrates a higher collective integrity of location, design, setting, materials, workmanship, feeling, and association which is essential to the sustained value of the separate individual resources and which has been designated and determined to be appropriate for preservation by the city council. A local landmark district possesses a significant concentration or continuity of heritage resources unified by past events, or aesthetically by plan or physical development; or the collective value of the local landmark district as a whole may be greater than the value of each individual heritage resource within it.

(k) “Local register of heritage resources” means a list of heritage resources officially designated or recognized by the city.

(l) “Preservation” means the identification, protection, conservation, enhancement, perpetuation or rehabilitation of any heritage resource that prevents the deterioration, alteration, destruction or removal of such resource. (Ord. 2780-05 § 1 (part); Ord. 2623-99 § 1 (part); prior zoning code § 19.80.050 (part)).

19.96.050. Criteria for evaluation and nomination of heritage resources.

Any improvement, building, portion of buildings, structures, signs, features, sites, scenic areas, views, vistas, places, areas, landscapes, trees, or other natural objects or objects of scientific,

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

aesthetic, educational, political, social, cultural, architectural, or historical significance can be designated a heritage resource by the city council and any area within the city may be designated a heritage resource district by the city council pursuant to provisions of this chapter if it meets the Criteria of the National Register of Historic Places, or one or more of the following:

- (a) It exemplifies or reflects special elements of the city's cultural, social, economic, political, aesthetic engineering, architectural, or natural history;
- (b) It is identified with persons or events significant in local, state, or national history;
- (c) It embodies distinctive characteristics of a style, type, period, or method of construction, or is a valuable example of the use of indigenous materials or craftsmanship;
- (d) It is representative of the work of a notable builder, designer, or architect;
- (e) It contributes to the significance of an historic area, being a geographically definable area possessing a concentration of historic or scenic properties or thematically related grouping of properties which contribute to each other and are unified aesthetically or by plan or physical development;
- (f) It has a unique location or singular physical characteristic or is a view or vista representing an established and familiar visual feature of a neighborhood, community, or the city of Sunnyvale;
- (g) It embodies elements of architectural design, detail, materials, or craftsmanship that represents a significant structural or architectural achievement or innovation;
- (h) It is similar to other distinctive properties, sites, areas, or objects based on a historic, cultural, or architectural motif;
- (i) It reflects significant geographical patterns, including those associated with different eras of settlement and growth, particular transportation modes, or distinctive examples of park or community planning;
- (j) It is one of the few remaining examples in the city, region, state, or nation possessing distinguishing characteristics of an architectural or historic type or specimen;
- (k) With respect to a local landmark, it is significant in that the resource materially benefits the historical character of a neighborhood or area, or the resource in its location represents an established and familiar visual feature of the community or city.
- (l) With respect to a local landmark district, a collective high integrity of the district is essential to the sustained value of the separate individual resources;
- (m) With respect to a designated landmark and designated landmark district, the heritage resource shall meet Criteria of the National Register of Historical Places, which are incorporated by reference into this chapter. (Ord. 2623-99 §1 (part): prior zoning code §19.80.060).

Recent code changes related to trees

On April 4, 2006, the City Council adopted new regulations related to tree preservation. The changes affect three Title 19 sections including, Tree Preservation, Solar Access, and General

Sunnyvale Urban Forest Management Plan 2014– Sunnyvale CA

Procedures. The bullet below summarizes the change that has been made to the City's Zoning Code. These changes took effect on May 9, 2006

- Two New Required Findings:
 1. A property has sufficient landscaping or is over landscaped;
 2. Allow removal of overgrown, but healthy, trees.
- New Penalty Process for Illegal Tree Removals:
 1. New administrative procedure that creates an administrative penalty process rather than the existing civil process.
- Tree Removal Permit (TRP) Appeals:
 1. Clarifies that only applicants can appeal a TRP decision.
- New Conditions of Approval for Development of Property:
 1. Can require a bond for protecting trees during construction;
 2. Can require underground mitigation measures for new trees.
- Solar Access Clarification:
 1. Solar access rights clarified for protection of significant sized trees.
- Additional Ordinance Clarification Issues:
 1. Adds the definition of “tree removal” to code;
 2. Increases tree measurement location to 4½ feet above ground;
 3. TRP permit now valid for only one year;
 4. Requires Latin names to be used in tree surveys;
 5. Changes TRP timeline to at least 10 days.