

CITY OF SANTA BARBARA

# Street Tree Infrastructure Conditions Project

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2014



## Introduction

There are many challenges to maintaining a healthy urban forest surrounded by built underground and overhead infrastructure. Conflicts between trees and infrastructure can result when a built environment confines an established tree, or when tree planting occurs in spaces that are unsuitable for a variety of reasons. Actions that aim at alleviating the conflict often occur to the tree and range from canopy pruning to root pruning and tree removal. Less often are actions that remove or redevelop hardscape infrastructure to accommodate tree health and growing conditions.

Street trees are under the jurisdiction of the City and routinely pruned by the City's Forestry staff for tree health and public safety. Trees located under Southern California Edison (SCE) high voltage utility lines are maintained by SCE for fire safety. SCE, in conjunction with California Forestry and Fire (Cal Fire) and the California Public Utilities Commission (CPUC), developed Fire Threat Maps which take into account high voltage line locations in relation to infrastructure/population density, wind events and general wildland fire threat.<sup>1</sup> The CPUC developed the following high voltage line safety clearance requirements:

- At least 4 feet for trees located in SCE “very high” or “extreme” high fire zones, while some trees are trimmed beyond 4 feet to account for future growth.
- At least 18 inches for all other zones, while some trees are trimmed beyond 18 inches to account for future growth.

The pruning methods employed by SCE to address line safety can adversely impact the appearance and function of the tree (Figure 1). Trees located under low voltage lines do not pose any fire threat and are not routinely pruned for safety by SCE but are captured in the survey due to the potential for tree-infrastructure conflicts.

In June 2013, the City Parks and Recreation Department (Department) initiated the Street Tree Infrastructure Conditions Project (Project) to better understand, characterize and document the conditions of trees located under high voltage utility lines, the proximity of tree canopy to the lines, characterize the parkway conditions and tree growspace. Information was also gathered on vacant sites located under utility lines, including parkway and growspace characteristics. To capitalize on information gathering while out in the field, the Project also took into account vacant sites not under utility lines that were nearby (across the street). The purpose of this Project is to provide information on the condition of City street trees located beneath overhead utility lines and the potential actions that can alleviate conflicts and improve the trees growing

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<sup>1</sup> These maps differ from the City's Fire Department wildland fire hazard classification maps which were determined by three variables; vegetation (fuel), topography, and weather.

environment. In addition, this information will inform decisions on potential replanting of vacant sites.

Figure 1



Topped



Side Notch



V- Notch



Side Trim

## Methodology

### *Arbor Access Database Query and Mapping*

Maps of individual neighborhoods were created using City's centerline and neighborhood data using ArcGIS Desktop. GIS shapefiles of All Valid Vacant Sites and Trees with Overhead Utilities were derived from Arbor Access data and overlaid onto neighborhood maps to create a series of maps for field use. The query found 5,944 trees city-wide are located under utility lines (non-specific as to high or low voltage) and approximately 3,500 vacant sites city-wide. Seven neighborhoods (30% of residential land) containing the majority of utility lines were surveyed. Neighborhoods are based on the General Plan residential zoning designation and include: West Downtown Westside, Laguna, Oak Park, Eastside, Upper East, and Lower East. Information on each tree was printed from Arbor Access to use as guide in the field to verify conditions and provide updated information for the tree inventory database.

Twenty-five (25) neighborhoods with approximately 1,490 street trees under utility lines were not surveyed as part of this Project and include:

Waterfront	Foothill
West Beach	Eucalyptus Hill
Lower State	East San Roque
West Mesa	East Mesa
San Roque	East Beach
Samarkand	Downtown
Riviera	Coast Village
Upper State	Cielito
Milpas	Campanil
Lower West	Bel Air
Lower Riviera	Alta Mesa
Hope Hitchcock	Hidden Valley

These neighborhoods have very few streets with overhead utility lines and therefore utility line and tree conflicts were considered lower priority than the surveyed neighborhoods.

### *Data Gathering*

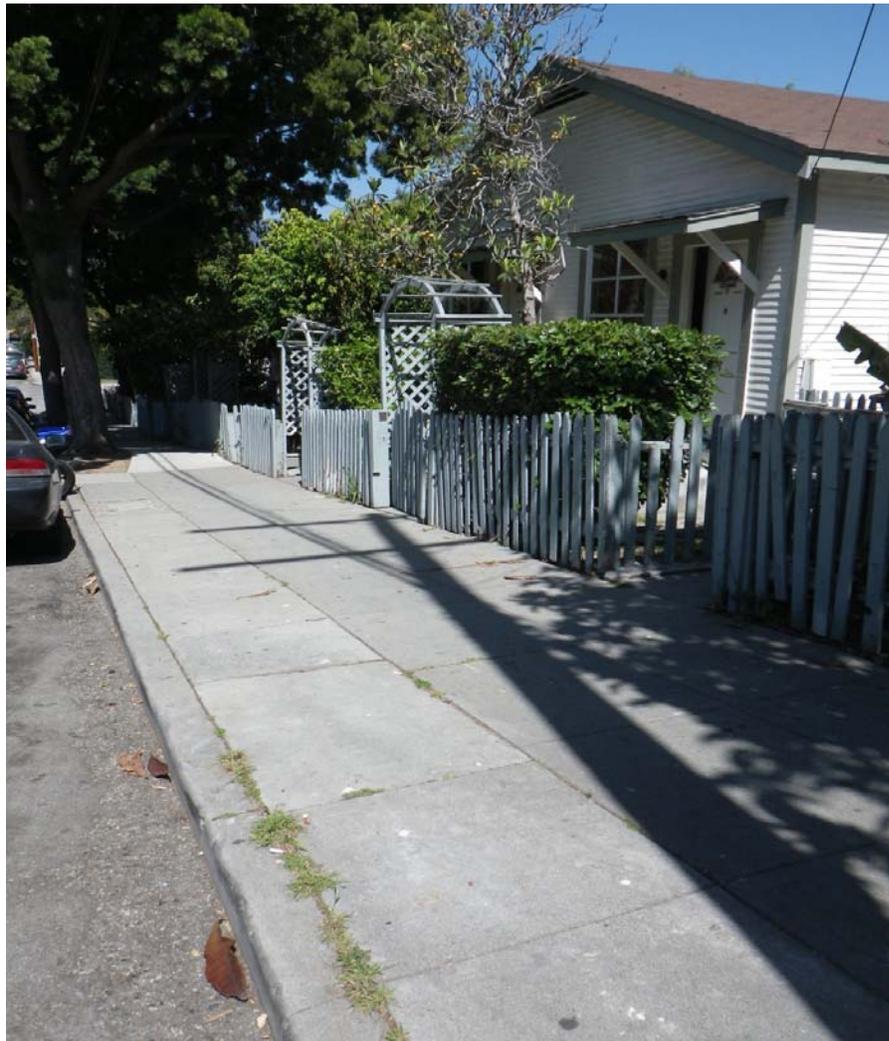
Field data was gathered with a Portable Handheld Device (PDA) that was preformatted to Pathfinder compatible data file. After field collection, data was transferred from PDA to spatial software for further data analysis. The Pathfinder program provides the flexibility to capture GPS coordinates of sites and to create a unique survey that allows

an exact assessment of the presence of street trees, their aesthetic condition, and possible planting opportunities. Field survey data includes:

1. **Tree Identification** – A unique number assigned to each tree
2. **Site Status and Suitability for Planting** – A value of Tree or Vacant indicates the current status of the site. A value of Yes or No indicates if a site is a suitable site for a tree. Criteria are based on Public Works traffic and street sign visibility and include:
  - Is within 6 feet from an underground utility
  - Is within 10 feet of a driveway apron
  - Is within 20 feet from a street light
  - Is within 50 feet from an intersection
3. **Presence of Utility Lines** – A value Yes or No indicates whether a site has utility lines overhead.
4. **Voltage Line Type** - Identifies the type of voltage line above site. Values include:
  - High Voltage
  - High and Low Voltage
  - Low Voltage/Other
5. **Voltage Line Location** – Identifies the distance between the top of tree canopy and voltage line. Values include:
  - 0-5 feet above canopy
  - 5-10 feet above canopy
  - 10-20 feet above canopy
  - 20+ feet above canopy
6. **Pruning Type** – Identifies the style of pruning used to prune tree (Figure 1, pg 4). Values include:
  - None – No visible pruning conducted to the tree
  - Topped- the entire top of tree is reduce to a uniform height
  - Side Notch - a portion of the tree is reduce by a heading cut creating an asymmetric appearance to the tree profile
  - Side Trim – branch removal of one side of the tree creating an uneven appearance of weight distribution of the tree
  - V-notch - branch removal down the center of the tree creating a deep V shape depression
7. **Parkway Type** - Identifies the type of site substrate, classified by substrate that covers 50% or more of the parkway. Values include:
  - Grass
  - Cement/Hardscape
  - Bare Soil

- Landscaping
  - Rock/Gravel
8. **Parkway Size** – A numeric measurement in feet of length and width of parkway strip.
  9. **Growspace Size** – A numeric measurement in feet of length and width or diameter of available planting space within parkway strip.
    - a. If current site is in a suitable planting location, but grow space is obstructed by parkway substrate, measurement of 0x0 was recorded as growspace size. Figure 2 shows a suitable site for planting but there is no growspace available due to cemented parkway.

Figure 2: 522 East Canon Perdido St



## Result Summary

Survey results of all neighborhoods are available in Table 1; Detailed survey results of each neighborhood can be found in individual neighborhood reports.

A total of 5,157 sites were surveyed in seven neighborhoods. Figure 3 illustrates the distribution of each site surveyed. The correlating orange and blue color on the map represent whether or not a site is located under utility lines. Size of neighborhoods range from 178 acres in West Downtown to 529 acres in the Westside. Neighborhood design also ranges from suburban neighborhoods, such as Eastside and Westside, characterized by low to medium density single family housing located near outskirts of

the city, to general urban neighborhoods, such as Laguna and West Downtown, characterized by medium to high density multifamily housing located along busier mixed-use arterials. SCE Fire Threat Maps of the surveyed neighborhoods range from little/no danger threat to people in areas such as Oak Park and Upper East, to very high threat to people in areas such as West Downtown.

Of the 5,157 sites surveyed, 3,843 (75%) have trees and 1,314 (25%) are vacant (Figure 4). Of the 3,843 trees, 3,688 (96%) are located under high voltage lines (or a combination of high and low voltage), 9 (<1%) are located under low voltage only lines and 146 (4%) do not have overhead utilities. A total of 612 (16.5%) trees located under high voltage lines are visually hard pruned by one of the techniques described on page 6. There are 586 trees with a canopy that is within 5 feet of high voltage lines and another 1,237 trees have canopy 5-10 feet from high voltage lines that are currently not pruned by SCE, but could be subject to SCE hard pruning techniques unless otherwise pruned by City staff.

Survey results show distribution of suitable and not suitable valid vacant sites and illustrated in Figure 5. The correlating green and purple on the map represent whether or not the vacant site is a suitable planting space. Of the vacant sites inventoried, 1,066 are identified as suitable for replanting. Half are located under high voltage lines and half have no overhead utilities. Sites identified as not suitable for replanting, 248, will need confirmation by the City Arborist or Street Tree Inspector. Site suitability is based on Public Works Department, Traffic Division vehicle line-of-sight criteria and does not include other factors that may affect a sites ability/suitability for tree re-establishment. For example, a tree of an appropriate size and stature may in fact be suitable even if one or more of the line-of-sight criteria are not met.

Parkway conditions were noted for each site inventoried. Sites located in grass parkways include 1,979 (38%) of the total sites inventoried, bare soil sites include 1,375 (27%) of total sites, cement/hardscape include 887 (17%), landscaped parkways account for 716 (14%), and rock parkways account for 200 (4%) of total sites surveyed. Cement and hardscape parkways are of particular interest due their restriction of oxygen and water supply to tree roots and hardscape conflicts. Sites located in cement parkways provide opportunities to enhance the parkways and increase tree health through hardscape removal.

**Table 1  
Street Tree Infrastructure Project Summary**

	Eastside	Laguna	Lower East	Oak Park	Upper East	West Downtown	West side	Grand Total
<b>Area (acres)</b>	<b>429</b>	<b>324</b>	<b>180</b>	<b>416</b>	<b>377</b>	<b>178</b>	<b>529</b>	<b>2433</b>
<b>Total tree and vacant sites</b>	<b>879</b>	<b>650</b>	<b>405</b>	<b>1001</b>	<b>830</b>	<b>508</b>	<b>884</b>	<b>5157</b>
<b>Total tree sites</b>	<b>710</b>	<b>527</b>	<b>311</b>	<b>725</b>	<b>585</b>	<b>358</b>	<b>627</b>	<b>3843</b>
Tree sites under high voltage utility lines	678	502	300	693	558	344	613	3688
Tree sites under low voltage lines	2	0	0	5	1	0	1	9
Tree sites not under utility lines	30	25	11	27	26	14	13	146
<b>Trees pruned</b>	<b>67</b>	<b>107</b>	<b>46</b>	<b>164</b>	<b>65</b>	<b>63</b>	<b>100</b>	<b>612</b>
<b>Trees with canopy location of 0-5 feet from High Voltage line</b>	<b>70</b>	<b>94</b>	<b>22</b>	<b>180</b>	<b>88</b>	<b>83</b>	<b>49</b>	<b>586</b>
<b>Trees with canopy location of 5-10 feet from High Voltage line</b>	<b>129</b>	<b>164</b>	<b>92</b>	<b>271</b>	<b>187</b>	<b>145</b>	<b>249</b>	<b>1237</b>
<b>Trees with canopy location of 10+ feet from High Voltage line</b>	<b>479</b>	<b>244</b>	<b>186</b>	<b>242</b>	<b>283</b>	<b>116</b>	<b>315</b>	<b>1865</b>
<b>Total vacant sites</b>	<b>169</b>	<b>123</b>	<b>94</b>	<b>276</b>	<b>245</b>	<b>150</b>	<b>257</b>	<b>1314</b>
Vacant sites under utility lines	85	57	39	172	117	86	105	661
Suitable	64	39	29	157	104	70	79	542
Not suitable	21	18	10	15	13	16	26	119
Vacant sites not under utility lines	84	66	55	104	128	64	152	653
Suitable	67	54	32	93	111	59	108	524
Not suitable	17	12	23	11	17	5	44	129
<b>Sites in grass parkway</b>	<b>372</b>	<b>184</b>	<b>110</b>	<b>343</b>	<b>328</b>	<b>209</b>	<b>433</b>	<b>1979</b>
<b>Sites in bare soil parkway</b>	<b>284</b>	<b>200</b>	<b>104</b>	<b>260</b>	<b>146</b>	<b>154</b>	<b>227</b>	<b>1375</b>
<b>Sites in cement/hardscape parkway</b>	<b>92</b>	<b>163</b>	<b>150</b>	<b>178</b>	<b>145</b>	<b>63</b>	<b>96</b>	<b>887</b>
<b>Sites in landscaped parkway</b>	<b>108</b>	<b>94</b>	<b>27</b>	<b>157</b>	<b>153</b>	<b>55</b>	<b>122</b>	<b>716</b>
<b>Sites in rock parkway</b>	<b>23</b>	<b>9</b>	<b>14</b>	<b>63</b>	<b>58</b>	<b>27</b>	<b>6</b>	<b>200</b>
<b>Average parkway (ft)</b>	<b>80x5.5</b>	<b>164x9</b>	<b>120.5x5</b>	<b>103x6.5</b>	<b>141x6.5</b>	<b>98.5x6.5</b>	<b>68x8</b>	
<b>Average growspace (ft)</b>	<b>7x5</b>	<b>9.25x5</b>	<b>7.5x5</b>	<b>7x5</b>	<b>8.25x5.5</b>	<b>22.5x6</b>	<b>6x5</b>	
<b>SCE fire threat</b>	<b>Mode-rate</b>	<b>Little/No Danger</b>	<b>Very High</b>	<b>Little/No Danger</b>	<b>Little/No Danger</b>	<b>Very High</b>	<b>Mode-rate</b>	

Figure 3

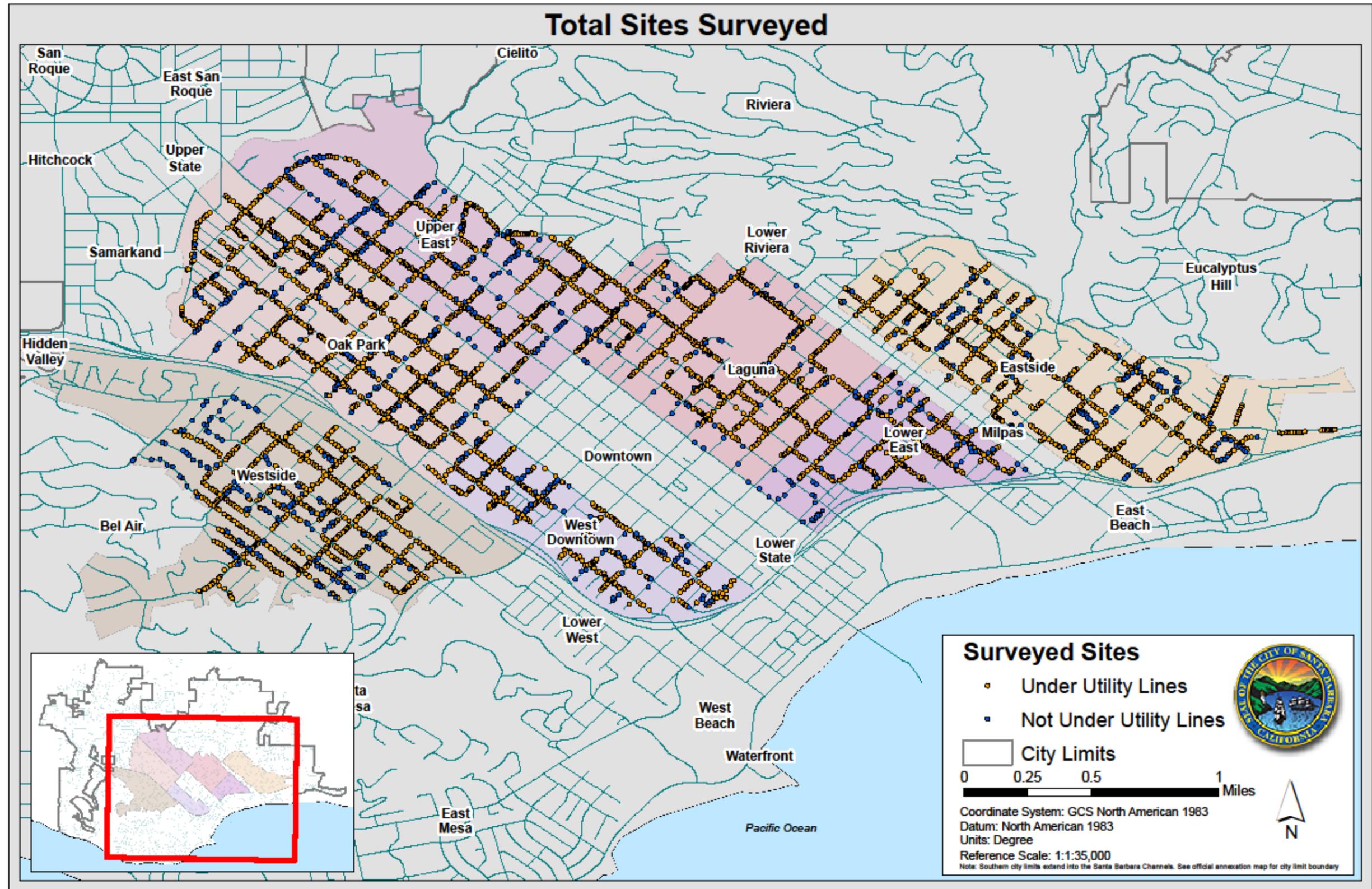


Figure 4

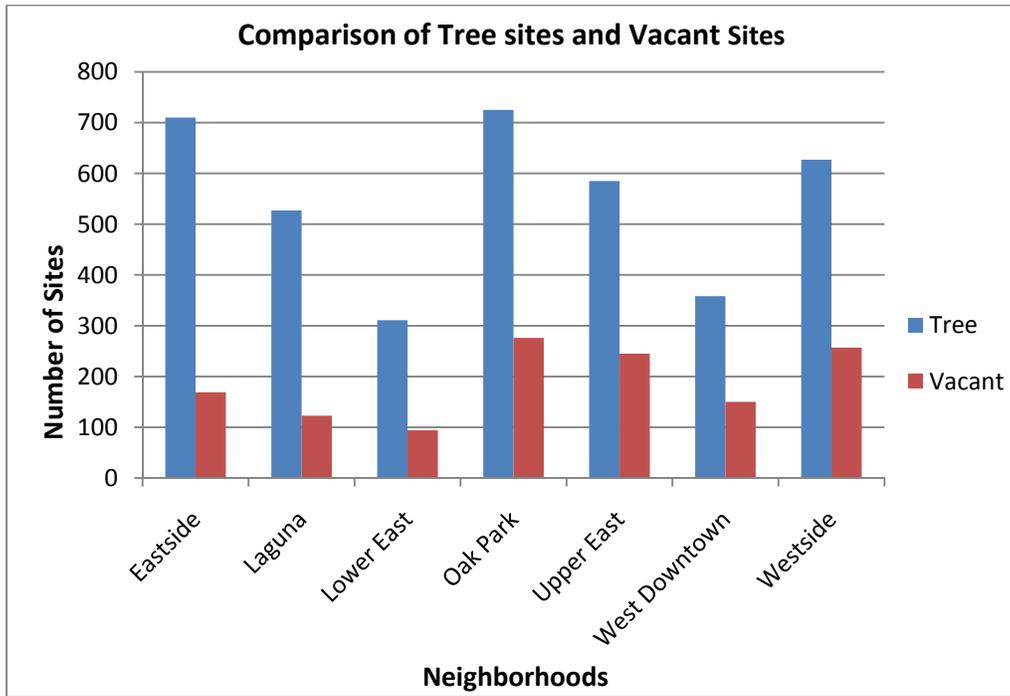
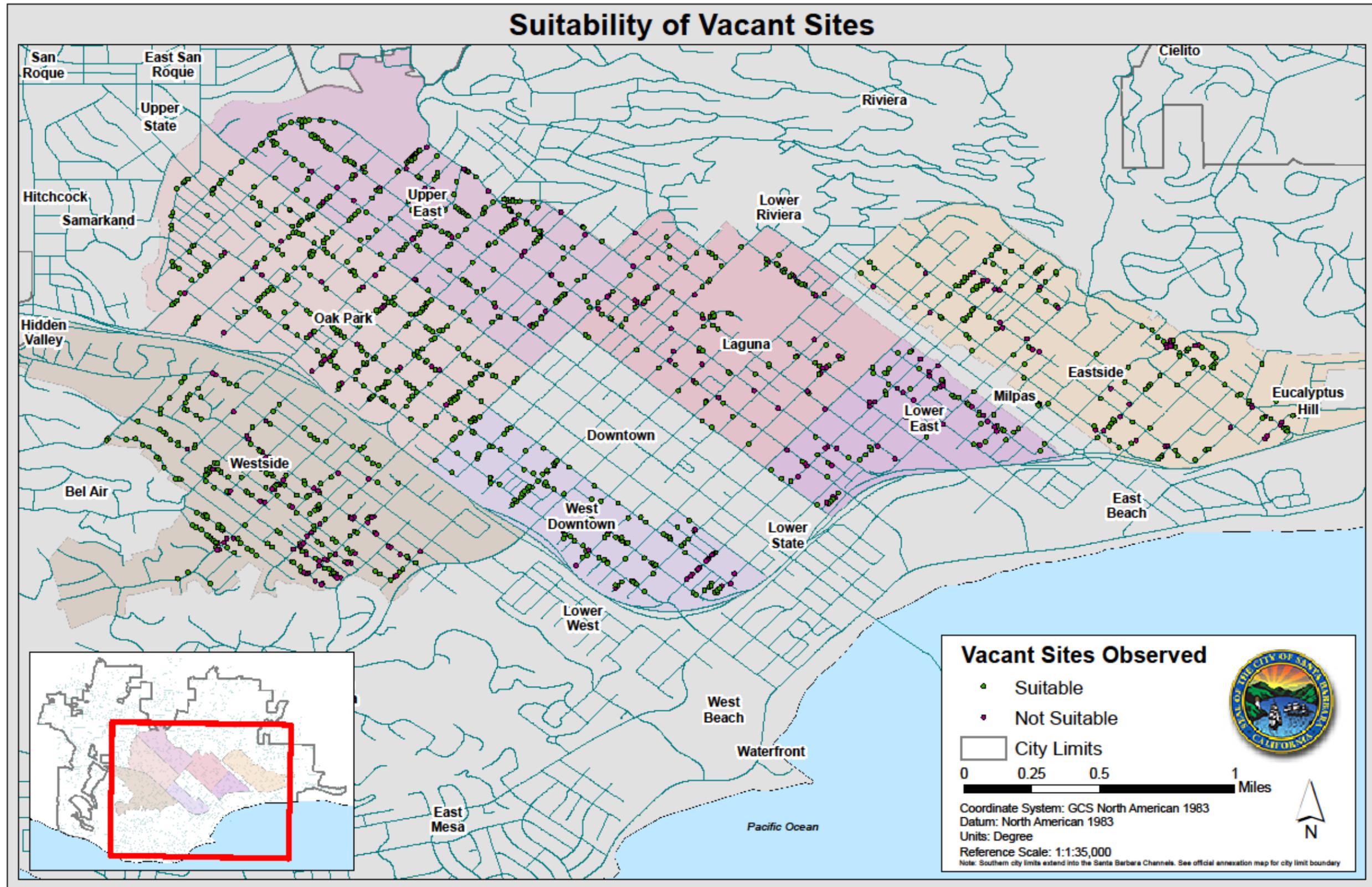


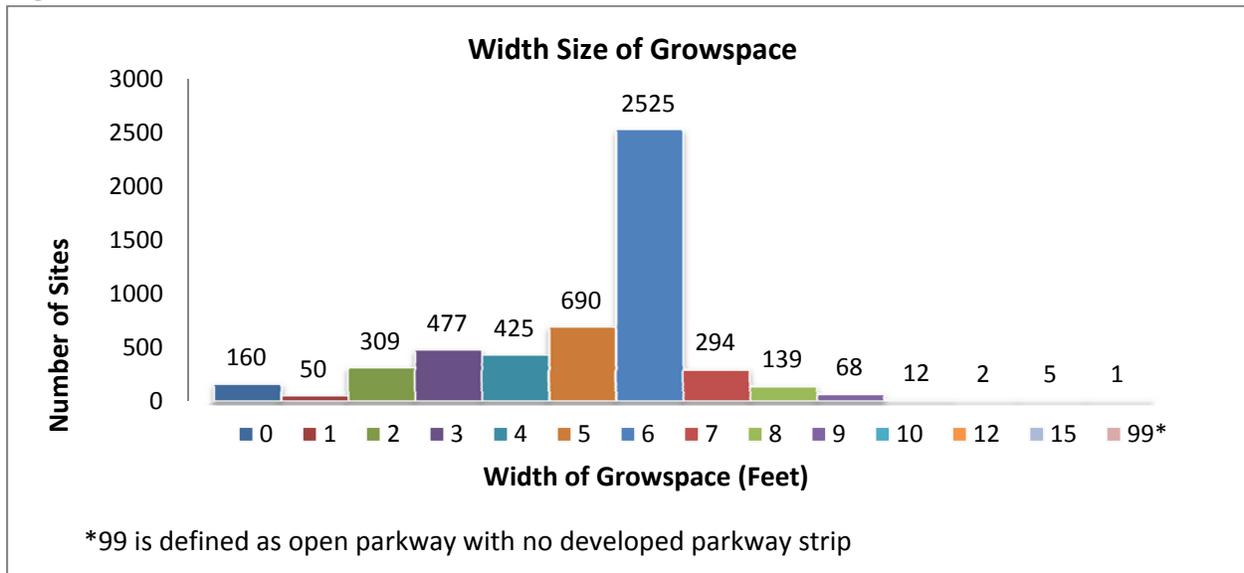
Figure 5



Parkway and growspace sizes vary greatly from street to street within the 7 neighborhoods. Average parkway and grow space is presented for each neighborhood in Table 1 and illustrated in Figure 6. Parkway size of the surveyed neighborhoods range from 80 ft by 5.5 ft in Eastside to 164 ft by 9 ft in Laguna. Growspace size ranges from 0 ft by 0 ft to 22.5 ft by 6 ft. A growspace identified as 0x0 ft<sup>2</sup> includes fully landscaped areas requiring shrub removal to cement parkways with no available planting space. Should redevelopment remove the hardscape or landscaping, then the site is otherwise a suitable place for tree planting.

A key element in the success of tree establishment and long-term health is the trees ability to spread its roots and receive adequate oxygen, water and minerals. The larger the growing space, the better the trees ability to spread its roots. Figure 6 shows the distribution of growspace width in surveyed areas. A number of sites, 160, are identified as having a growspace size of 0x0; whereas, the average growspace is six feet width.

Figure 6



## Discussion

The purpose of the Project was to confirm the number of trees existing under both high and low voltage lines, the type and severity of pruning, if any, and the approximate distance of tree canopy below high voltage lines. This information will be used to prioritize tree care and maintenance to existing trees in potential conflict with overhead utilities

Information gathered on vacant sites and parkway conditions will inform decisions on tree planting, such as the size and type of tree that will be suitable for the space, given the parkway conditions, available growing space and surrounding infrastructure. The number of vacant sites available for planting is under investigation for a number of reasons:

1. Trees may have been planted without updates to the City's tree inventory (Arbor Access) database; and
2. Some vacant sites may not actually be suitable for replanting due to the surrounding infrastructure or proximity to driveways and street corners.

A goal of this project is to begin to address these vacant sites and confirm suitability for replanting. Site suitability is based on a number of factors, including: parkway and growspace size, location in relation to driveway intersections, and presence of overhead or underground utilities. Enhancements of parkways could include cement/pavement removal that exposes new planting sites, and provides proper drainage and oxygen supply to surrounding tree roots.

## **Management Options**

Several options have been developed to address existing trees located under high voltage lines, enhance parkway growing conditions and replant trees in vacant sites.

### **1. Tree Maintenance/Pruning**

Options to address trees through tree pruning can be looked at from two perspectives: First, to address the trees that are currently being heavily pruned and determine if intervention can prolong the health as well as improve the aesthetics; or second, address trees NOT being heavily pruned by SCE to provide practices now that may decrease the chances of dramatic pruning later. The following information may help to determine the best course of action.

- Heavily pruned trees within 20 feet of high voltage lines:
  - A total of 602 trees were surveyed that are within 20 feet of the high voltage line and are heavily pruned by SCE for line safety clearance. 364 of those have a tree canopy 0-5 feet from lines, while 206 trees have a canopy of 5-10 feet from lines. An additional 32 trees are currently being pruned by SCE that have a canopy 10-20 feet below lines. With further analysis from the City Arborist and/or SCE, these trees may be available for directional pruning which may help not only the aesthetics but the health of the tree and prolong the trees life.
- Tree canopy located within 10 feet of high voltage lines and NOT currently pruned by SCE:

- Trees located within 10 feet of the lines but NOT currently pruned by SCE account for 1,253 trees. These trees may also require further investigation to determine if actions taken now can decrease the risk of dramatic pruning techniques.
- Tree canopy located 10-20 feet from lines and NOT currently pruned by SCE:
  - 1,155 trees exist within this category and may benefit from proactive pruning techniques to help direct branches away from high voltage lines.
- Tree canopy 20+ feet from lines and NOT currently pruned by SCE:
  - The remaining 667 trees with a canopy 20 feet or greater from high voltage lines and not currently pruned by SCE are likely the best group to benefit from directional pruning now to decrease dramatic pruning later. A young tree training program to help form the structure and growth of the tree for its mature form could possibly be instituted to these trees. The identification of such a program was developed as part of the City's Urban Forest Management Plan.

## 2. Tree Removal/Replacement

With additional inspection by staff, it may be determined that some trees require removal and replacement. The information provided here presents an initial look at areas where removal may be warranted.

- Trees heavily pruned by SCE, in small growspace and in a cement parkway:
  - 15 trees located under high voltage lines and currently heavily pruned exist in the Eastside (4), Lower East (1) Westside (6) and Laguna (4) neighborhoods. These trees are in a growspace that is small (characterized as anything with 2 feet or less growing area including: 2x3, 2x2, 2x1, 1x1 feet) and are further confined within a cement/hardscape parkway which reduces the trees access to air, water and nutrients. The trees located here range in DBH size from 7-18 inches. Larger trees in these confined spaces may be prioritized for inspection and possible removal and replacement.
- All trees with a pruning type of side trim or side notch:
  - Trees that have a pruning type characterized as a side notch or side trim may result in a lopsided or side heavy tree and a potential risk to the public due to limb failure, and include 77 trees: Eastside (16), Laguna (4), Lower East (5), Oak Park (16), Upper East (14), Westside (19) and West Downtown (3).
- All palms located under high voltage lines:
  - A total of 356 palms located under utility lines: Eastside (30), Laguna (35), Lower East (34), Oak Park (117), Upper East (100), Westside (6) and

West Downtown (34). Palm trees are characterized by their vertical growth and cannot be directionally pruned to avoid high voltage lines. Pruning often results in shortened palm fronds (noted as topped in the survey).

- Trees located in areas determined not suitable for replanting and currently being heavily trimmed by SCE:
  - A total of 163 heavily trimmed trees exist in areas determined not suitable planting sites based on distances from various types of infrastructure, as well as pedestrian and traffic visibility.

### 3. Tree Planting in Vacant Sites

Vacant sites located under or near high voltage lines were surveyed to determine the viability to replant. While it has been noted, the criteria used to determine a sites suitability for tree planting is based on line-of-sight information for pedestrian and car traffic visibility, it may be determined through further inspection by the Street Tree Supervisor and/or Arborist, that certain trees can be placed in a location this survey deemed as an inappropriate planting space. The following options exist for replanting vacant suitable sites.

- Vacant sites surveyed NOT under utility lines:
  - A total of 524 sites were surveyed that do not have overhead utilities and are determined to be a suitable planting site. Of these, 456 are in parkways characterized as bare soil, grass, landscaping or rock and 46 are found in cement/hardscape parkways and with available growspace. A neighborhood by neighborhood approach could be used to replant the above noted vacant sites: Eastside (64), Laguna (49), Lower East (31), Oak Park (88), Upper East (105), West Downtown (57), Westside (108). \*\*22 sites were deemed suitable for replanting however the space is not available. These are areas where opportunities exist to open up cement/hardscape parkways (see third bullet down).
- Vacant sites surveyed with overhead utility lines:
  - A total of 542 sites located under utility lines were determined to be suitable for replanting. Of these 471 exist in parkways characterized as bare soil, grass, landscaping or rock and may provide a better growing environment than cement parkways. 71 sites exist in parkways characterized as cement/hardscape, however of those, 31 are in a growspace that has at least a 5 foot parkway width. These areas will provide a better growing environment than areas with a very confined growspace.
- Vacant sites with no overhead utility, cement parkway and little to no growspace:

- In some cases a long stretch of parkway has been cemented over, but if removed, would provide ample growing space for a tree to live. The survey identified 22 vacant sites throughout the city that have a cement parkway and no growspace. In addition, there are two vacant tree sites found in the Eastside neighborhood with a parkway of cement and a growspace of 2x2 feet. This small growspace also provides an opportunity for enhanced growing conditions if opened up.

## **Next Steps**

This report provides information and options for the Department to address the conflict between overhead high voltage utility lines and to improve parkway growing conditions. Next steps will include evaluating costs and resource needs then prioritizing and implementing actions within the neighborhoods surveyed for this Project. Given the current drought, it may be that the Department's priority is to remove hardscape, beginning with sites where trees currently exist, and then moving on to vacant sites in order to prepare the site for a future planting. Options provided in this report are consistent with the objectives of the City's newly adopted Urban Forest Management Plan.