

2012 Oak Tree Restoration Planting Project Five Year Progress Report

City of Atascadero
San Luis Obispo County, California



Prepared for

City of Atascadero

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Cover Page: Valley oak growing out of a tree tube at Halcon Road restoration site. March 23, 2017.

Executive Summary

- Oak tree restoration occurred at four sites between 2012 and 2015: Alondra Road, Calle Milano, Halcon Road, and the Wastewater Treatment Plant (WWTP). In March 2015, native trees and shrubs were also planted at the WWTP expansion site.
- Overall oak survival after five years was highest at Calle Milano, next highest at Alondra Road and Halcon Road, and lowest at WWTP.
- Oak growth and survival differed depending on type of browse protection, irrigation, amount of shade, and whether the oak was planted as an acorn or container stock. These results can be used to guide future restoration efforts and maximize oak survival.
- Oaks and other species planted at ten other sites throughout Atascadero are no longer irrigated or protected and range from 7 to over 20 years old. Survival of these trees indicates irrigation and tree protection could be removed from the Alondra Road, Calle Milano, Halcon Road, and WWTP sites in the relatively near future.
- The most important challenges at restoration sites in Atascadero are providing sufficient irrigation to plantings within the first few years and preventing damage from gophers.
- Continued annual maintenance and monitoring of restoration sites is necessary to ensure oak survival.

1.0 Introduction

Oak tree restoration within the City of Atascadero began in 1996 with the planting of the Heilmann Grove in 1996. Between 1996 and 2011, ten oak tree restoration sites were established. In 2012, three new oak tree restoration sites within open spaces around the Las Lomas development were planted: Halcon Road, Calle Milano, and Alondra Road. A fourth restoration site was planted on open space near the De Anza Trail at the Wastewater Treatment Plant (WWTP). These four sites were established because the Las Lomas development project within the City of Atascadero required the removal of over 1300 native oak trees. Tree removal fees were placed in the City Tree Planting Fund to facilitate replacement plantings within city limits, with an emphasis on replacing trees as close to the removal site as possible. Althouse and Meade, Inc. oversaw all plantings and subsequent maintenance and monitoring at these four restoration sites. See Exhibit 1 for site locations. Initial plantings occurred in November and December 2012 and January 2013. Further plantings occurred in January 2014 and March 2015. Annual reports were produced for the City in 2013, 2014, and 2015. This report summarizes all work undertaken from 2012-2017, as well as tree survival, challenges, and corrective actions taken. We also provide information on tree survival at the other ten oak tree restoration sites established in Atascadero prior to 2012. See Exhibit 2 for locations of all 14 oak restoration sites.

2.0 Summary of Work and Planting Activities

2.1 Planting Totals

A total of 1,589 oaks (843 container stock and 746 acorns) were planted between 2012 and 2015 at Halcon Road, Calle Milano, Alondra Road, and WWTP. During the initial round of planting in Year 1, in November and December 2012 and January 2013, a total of 916 valley oak (*Quercus lobata*) and blue oak (*Quercus douglasii*) from container stock and acorns were planted at the four sites. Of the 916 oaks, 673 were container stock and 243 were acorns. In Year 2, in January 2014, a total of 317 oaks were planted at the four sites. Of these, 170 were container stock and 147 were acorns. In Year 3, in March 2015, 81 native trees and shrubs were planted in an expansion planting project at WWTP southwest of the original oak restoration site, and 356 acorns were planted at Alondra Road and WWTP. The acorns planted in March 2015 were planted after the rainy season in a very low water year, and most did not survive. They are excluded from further analysis. No further oaks were planted in 2016 or 2017. See Table 1 for a summary of oak planting effort during the project. See Table 2 for a summary of plantings at the WWTP expansion site.

TABLE 1. OAK TREE PLANTING EFFORT.

Site	Species	Year 1 (2012-13)		Year 2 (2014)		Year 3 (2015)		Total
		Container	Acorns	Container	Acorns	Container	Acorns	
Alondra	Blue oak	363	101	156	59	0	276	955
Calle Milano	Valley oak	25	0	2	0	0	0	27
Halcon	Valley oak	55	45	12	8	0	0	120
WWTP	Valley oak	230	97	0	80	0	80	487
Total		673	243	170	147	0	356	1,589

TABLE 2. WWTP EXPANSION PLANTINGS IN MARCH 2015.

Common Name	Scientific Name	Total
Black Cottonwood	<i>Populus trichocarpa</i>	10
Black Walnut	<i>Juglans californica</i>	11
Blue Elderberry	<i>Sambucus nigra ssp. caerulea</i>	10
California Buckwheat	<i>Eriogonum fasciculatum</i>	10
California Rose	<i>Rosa californica</i>	10
Coffeeberry	<i>Frangula californica</i>	10
Snowberry	<i>Symphoricarpos albus</i>	5
Valley Oak	<i>Quercus lobata</i>	15
Total		81

2.2 Planting Treatments

During Year 1, oak seedlings and acorns were assigned to one of six different treatments to compare acorn vs. container stock success, to test the effectiveness of different types of browse protection (tree tube vs. wire browse cage), and to determine whether planting without irrigation is a viable option for sites with difficult access to irrigation water. When additional oaks were planted in Year 2 and Year 3, they were planted in treatments that were irrigated. See Table 3 for a summary of the treatments.

TABLE 3. OAK TREE PLANTING TREATMENTS.

Planting Type	Browse Protection	Irrigation/ Gopher Basket	Years Planted
Tree Pot	Tree tube	Yes	Year 1
Tree Pot	Wire browse cage	Yes	Year 1, Year 2
Acorn	Tree tube	Yes	Year 1, Year 2, Year 3
Acorn	Tree tube	No	Year 1
Acorn	Wire browse cage	Yes	Year 1, Year 2
Acorn	Wire browse cage	No	Year 1

2.3 Work Summary

In November and December 2012 and January 2013, irrigation, tree tubes, and browse protection were installed and 916 oaks (acorns and container stock) were planted at Halcon Road, Calle Milano, Alondra Road, and WWTP. The sites were monitored approximately every four to six weeks. Drought conditions and problems with the irrigation systems at Alondra Road and WWTP caused extensive oak mortality in 2013 (see Section 4.0). In the fall, multiple irrigation leaks were repaired. In January 2014, 317 oaks (acorns and container stock) were replanted in irrigated locations where trees had died. Beginning in March 2014, these four restoration sites were monitored every other week to inspect and repair the irrigation system more frequently. In May 2014, a pressure tank and electrical pump were installed at WWTP to correct irrigation problems at that site. In March 2015, 81 native trees and shrubs were planted in six irrigated plots for the WWTP expansion planting project and 356 acorns were planted at Alondra Road and WWTP in irrigated planting locations where trees had died in previous years. Beginning in mid-2016 and continuing through 2017, new 5-foot-tall welded wire cages were installed around trees that had outgrown the older wire browse protection and tree tubes.

At all four sites, all live plantings were mulched as needed. Weed whipping and hand pulling of weeds within browse protection occurred at least annually, sometimes biannually depending on annual rainfall. Browse protection and tree tubes were repaired and maintained as needed. Excess browse protection, pin flags, and rebar were removed from dead trees. Tree survival was assessed annually. At WWTP, irrigation tubing was capped or removed in areas where plantings had died. Spraying for noxious weeds, particularly yellow starthistle (*Centaurea solstitialis*), occurred at that site as needed. Monitoring of irrigation and browse protection also occurred at the other 10 older restoration sites approximately monthly.

3.0 Results of Planting Activities

3.1 Survival at Las Lomas and WWTP Plantings

3.1.1 Overall and Annual Survival Rates

Oak survival varied widely among sites. Table 4 shows the overall survival rate of the four restoration sites calculated by comparing the initial number of plantings in Year 1 with surviving plantings in Year 5. Calle Milano had the highest survival rate (76%) while WWTP had the lowest

(9%). Alondra Road and Halcon Road had roughly the same survival rate (52% and 51% respectively).

TABLE 4. INITIAL AND FINAL NUMBERS OF SURVIVING OAK TREE PLANTINGS.

Site	Initial Number Planted	Number Surviving After Year 5	Overall Survival
Alondra Road	464	239	52%
Calle Milano	25	19	76%
Halcon Road	100	51	51%
WWTP	320	30	9%

Figure 1 shows the number of plants alive at the end of each year at each of the four restoration sites. Four sites were planted in late 2012. Numbers declined sharply at Alondra and WWTP in Year 1 because of irrigation problems. Early in Year 2, new oaks were planted at those sites, so the number of surviving plants increased by the end of Year 2. The number of surviving plants declined slowly or not at all after Year 2 at Alondra Road, Callie Milano, and Halcon Road, but continued to decline sharply at WWTP due to gopher predation.

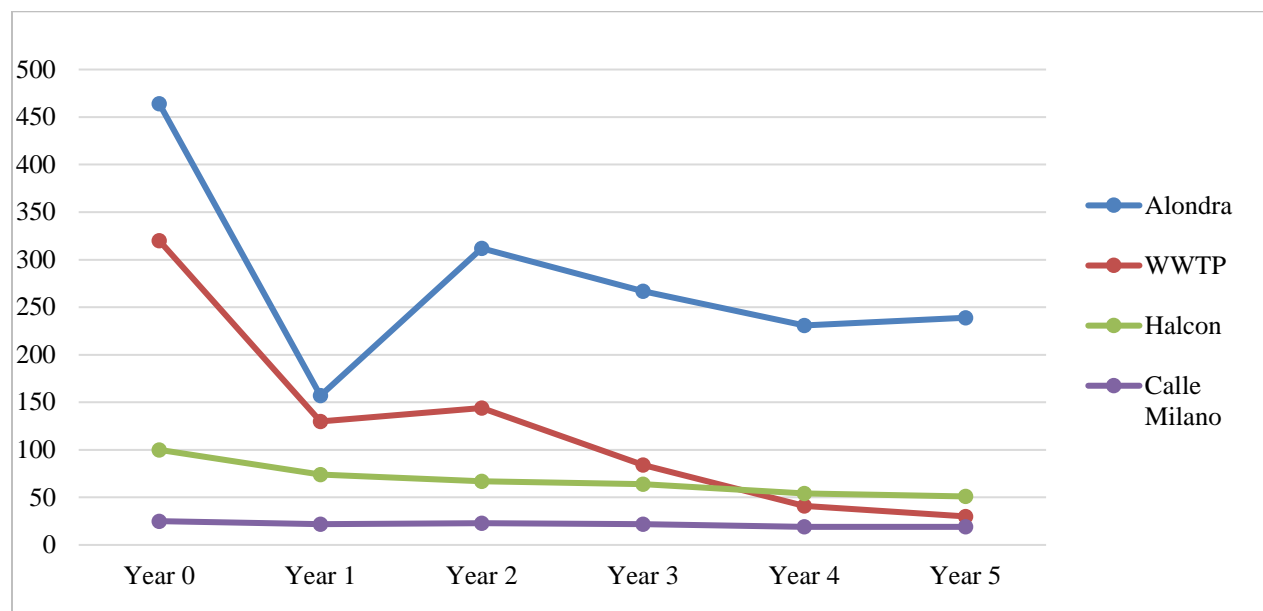


FIGURE 1. ANNUAL NUMBER OF SURVIVING OAK TREES.

Table 5 shows annual survival rates for each site, calculated by dividing the number of plants present at the end of that year with those present at the start of the year. Annual survival varied widely among sites. Alondra and WWTP had the lowest survival in Year 1 due to problems with irrigation. From Year 2 through Year 5, Alondra Road, Calle Milano, and Halcon Road all had annual survival of over 70%. Only WWTP had continually low survival through Year 4, due to predation by gophers. In Year 5, annual survival at all restoration sites exceeded survival 70%, with Alondra Road achieving a survival rate of 103% due to acorns resprouting. This is likely due

to normal rainfall levels during the 2016-17 winter, which preceded Year 5. Blue oak and valley oak acorns were documented resprouting at Alondra, Halcon, and WWTP in different years when there was sufficient water.

TABLE 5. ANNUAL SURVIVAL RATE OF OAK TREES.

Site	Year 1	Year 2	Year 3	Year 4	Year 5
Alondra Road	34%	84%	86%	87%	103%
Calle Milano	88%	96%	96%	86%	100%
Halcon Road	74%	71%	96%	84%	94%
WWTP	41%	69%	58%	49%	73%

3.1.2 Comparison of Treatments

Survival of trees assigned to different treatment groups was tracked through Year 4. By Year 5, only overall survival was assessed. Trees were planted in treatment groups at Alondra Road, Halcon Road, and WWTP. Tree survival at WWTP was very low due to irrigation issues and gopher predation and is excluded from further analysis.

Valley oak trees appear to grow best from container stock planted in tree tubes. At Halcon Road, valley oaks were planted with the six treatments listed in Table 2. The treatment groups with the highest survival rate by Year 4 were container stock planted in tree tubes (88%) and container stock planted in wire browse protection (57%). Acorns planted at this site had only a 9% survival rate across treatments.

Blue oaks fared best when planted as acorns in tree tubes. At Alondra Road, blue oaks were planted with the six treatments listed in Table 2. By Year 4, the treatment group with the highest survival rate was acorns planted in tree tubes (55%), higher than container stock planted in tree tubes (34%) or wire browse protection (28%) and acorns planted in wire browse protection (14%).

Blue oak acorns planted in tree tubes fared equally well with or without irrigation. This suggests that planting blue oak acorns in tree tubes would be effective at sites where irrigation would be difficult or unfeasible.

3.1.3 Tree Growth Rates

Blue oaks at Alondra grew rapidly once the irrigation problems were corrected. The oldest trees are now over five years old, and the tallest saplings are approximately five feet tall. Almost every tree at the site is over two feet tall. The surviving valley oaks at WWTP are four and five years old and between three and five feet tall. However, valley oaks at Halcon Road and Calle Milano exhibited much slower growth. Most trees at those sites are four or five years old, but very few exceed two feet in height. Most are between 12 and 24 inches tall.

Valley oaks at Halcon Road and Calle Milano were planted in the shade under a canopy of mature oaks. Oaks at Alondra Road and WWTP were planted in full sun. This appears to have dramatically impacted growth rates. Oaks at the shaded sites may require irrigation longer, as it will take them longer to grow to sufficient size.

3.2 Survival at WWTP Expansion Planting Sites

Eighty-one native trees and shrubs were planted in six plots at the WWTP expansion site, southwest of the original WWTP oak restoration site (See Table 1 for species list). All plants were planted in gopher baskets and irrigated. The expansion planting project was undertaken in March 2015, at the beginning of Year 3 of the oak restoration project at WWTP. At the time of the initial plantings, all irrigation issues had been resolved at WWTP. However, there were many gophers in the area and plant survivorship was low due to gopher damage in the first two years after planting (58 percent and 32 percent, respectively). During the most recent assessment, only 13 plants of four species remained (black cottonwood, California rose, snowberry, and coffeeberry) from the original 81 plantings of eight species, an overall survival rate of 16%. Table 6 shows number and annual survival rate of plantings at the WWTP expansion site. Annual survival was highest in 2017, perhaps because the average rainfall year in 2016-17 allowed gophers to disperse into other areas of the surrounding open space instead of concentrating in irrigated areas.

TABLE 6. NUMBER OF PLANTINGS AND ANNUAL SURVIVAL RATE AT WWTP EXPANSION SITE.

	Initial Planting (early 2015)	End of 2015	End of 2016	End of 2017
Number of live plantings	81	47	15	13
Annual survival rate	--	58%	32%	87%

3.3 Survival at Other Atascadero Oak Restoration Sites

There are 10 other oak tree restoration sites within the City of Atascadero: Paloma Horse Arena, Portola Road East, Portola Road West, Carmelita, Stadium Park, Atascadero Lake Park, Adobe Springs, Chico, Las Lomas First Phase, and Heilmann Grove (see Exhibit 2). The oldest, Heilmann Grove, was established in 1996 and the most recent, Chico, was planted in 2011. The Adobe Springs, Stadium Park, and Heilmann Grove sites are maintained periodically mainly by volunteers from the Atascadero Land Preservation Society (ALPS) and the Atascadero Native Tree Society (ANTA). In 2016, ANTA joined ALPS and is now part of that organization. ALPS volunteers still maintain oaks planted at many of these sites. As of February 2018, a total of 274 oak trees (valley, blue, and coast live oaks), 32 other native trees (willow, bay laurel, sycamore, box elder, madrone, and buckeye), and 40 native shrubs are present at the other 10 sites. See Table 7 for a list of sites and number of surviving plants.

The oldest restoration site in Atascadero is Heilmann Grove. The oldest trees at this site are over 20 years old, and the youngest trees are 11 years old. All oaks have grown to such a size that irrigation is no longer needed and all irrigation tubing and materials have been removed from the site. Based on the success of this site, we expect irrigation materials may soon be removed from other sites.

TABLE 7. SURVIVING PLANTINGS AT OTHER RESTORATION SITES AS OF FEBRUARY 2018.

Site Name	Year Established	Area (ac)	Oaks	Other Native Trees	Shrubs	Total Plantings
Heilmann Grove	1996	5.0	79	6	3	88
Stadium Park	2007	0.65	21	0	0	21
Carmelita	2008	2.1	7	0	2	9
Portola Road East	2008	1.7	4	1	1	6
Portola Road West	2008	2.1	4	3	3	10
Atascadero Lake Park	2008	0.7	9	5	0	14
Paloma Horse Arena (and Triangle)	2009	2.9	63	12	13	88
Adobe Springs	2009	1.5	30	5	13	48
Las Lomas - First Phase	2010	1.4	37	0	0	37
Chico	2011	1.0	20	0	5	25
Total			274	32	40	346

4.0 Challenges Encountered

During the first year of the project, the primary challenges encountered involved lack of water due to drought and malfunctions in the irrigation systems at Alondra Road and WWTP. At Alondra Road in 2013, irrigation to one section of the planting area was turned off three times. This was due to neighbors reporting irrigation leaks and water being turned off. Monitoring frequency was insufficient to detect leaks before neighbors reported them. As a result, most trees were lost in the sections where irrigation was shut off. At WWTP in 2013, the gravity feed system from the water storage tank did not provide enough pressure to water the entire site, and the planting areas farthest from the tank suffered high mortality. The irrigation system at WWTP was also plagued by gophers that repeatedly chewed into irrigation lines. After irrigation problems at Alondra and WWTP were corrected in 2014 (see Section 5.0 below), oak mortality due to lack of water was greatly reduced.

From 2014 onward, the main challenge at WWTP was plant mortality due to gopher damage. It appears that the irrigation of the WWTP site either attracted or concentrated gophers within the planting areas. Even gopher cages were not sufficient to protect the roots of oak trees and other native plants. Gophers were the chief cause of the plant mortality at WWTP and the WWTP expansion site in 2014, 2015, and 2016. In 2017, much less gopher damage occurred. This may be due to the increased rainfall in 2016-17 allowing gophers to disperse into other areas, or perhaps the few surviving plants at WWTP have grown sufficiently to resist gopher predation.

Soil type at each site may also affect gopher predation and plant survival. For example, being adjacent to the Salinas River, the surface soil at the WWTP site features coarse-textured sand and gravel with relatively little clay. This soil layer is approximately 4 to 5 feet deep and its loose

structure allows gophers and other rodents to easily burrow in or tunnel through the soil. Gopher burrows are common at the WWTP site (Photo 7).

Conversely, soil types at the other sites are less conducive to gophers. For example, at Alondra Road, Calle Milano, and Halcon Road soil is typically dry and very hard to depths of 5 feet. Weathered shale and limestone is common at these sites. The denser soil particles, combined with areas of shale or sandstone, make burrowing or tunneling through these soil types more difficult; thus, these soils are less hospitable to gophers and other tunneling rodents. Gopher burrows are relatively uncommon at the Alondra, Calle Milano, and Halcon sites.

Beginning in 2015, oak trees at Alondra Road and WWTP were large enough to grow out of the tree tubes and browse protection. Browse damage from deer became a problem for the oldest oak seedlings at these sites.

5.0 Corrective Actions Taken

After the numerous irrigation failures at Alondra Rd and WWTP in Year 1, several corrective actions were taken in Year 2. Beginning in March 2014, Alondra Road, Calle Milano, Halcon Road, and WWTP were monitored every other week. This increased monitoring allowed early detection of irrigation leaks at Alondra Road. In addition, the site monitor contacted local residents and provided them with his phone number to call if they saw a leak. As a result, the irrigation at Alondra was turned off only once, and the shut-off was detected the next week.

In May 2014, a pressure tank and electrical pump were installed at WWTP to correct the irrigation problems with the gravity feed system. Rodents were chewing holes in irrigation tubing at that site, necessitating near constant repairs. Instead of resorting to professional rodent control, the low-cost solution of adding a drip tray underneath one of the drip emitters provided rodents with a watering station. This reduced damage to irrigation tubing by at least 75 percent.

Beginning in mid-2016 and continuing through 2017, new 5-foot-tall welded wire cages were installed around trees that had outgrown the older wire browse protection and tree tubes. These larger, stronger cages protect larger oaks from deer.

6.0 Recommendations and Mitigations

Recommendations for future work at the oak tree restoration sites are presented below.

6.1 Maintenance and Monitoring

Ongoing maintenance and monitoring should occur a minimum of twice per month at Alondra Road, Calle Milano, Halcon Road, and WWTP, and as needed (at least a few times annually) at the other 10 sites. Maintenance and monitoring consists of adjusting the watering schedule, checking the irrigation tubing for breaks and leaks and capping flow to areas that no longer require irrigation; repairing or removing the old wire browse protection as necessary; replacing old browse protection with new 5-foot browse protection cages as warranted; and cleaning up and removing old flags, rebar, and tree tubes in areas where plants have died; monitoring weed growth at all sites and conduct weed removal via weed whipping and hand pulling within browse protection at least

once annually; mulching all plantings as needed; and monitoring yellow starthistle growth at WWTP and Heilmann Grove and treating with herbicides if necessary.

6.2 Survival Assessment

Annual survival assessment of plantings at Alondra Road, Calle Milano, Halcon Road, and WWTP should be conducted annually to evaluate site conditions and plan future maintenance actions. Surviving plantings should also be counted at the other 10 restoration sites in Atascadero at least every other year.

7.0 Photos



Photo 1. Alondra Road restoration site after initial planting in December 2012. View north.



Photo 2. Alondra Road restoration site on January 12, 2018. Note that there are fewer plantings remaining, but the tree tubes and browse protection cages contain oaks that are now from 3 to 5 feet tall. View north.



Photo 3. Five-year-old blue oak sapling at Alondra Road. This tree is over 5 feet tall. January 12, 2018.



Photo 4. Five-year-old blue oak at Alondra Road; tree is nearly 4 feet tall but has been damaged by browsing. The tree tube will be removed and replaced with a welded wire browse cage. January 12, 2018.



Photo 5. This four-year-old valley oak at Calle Milano is approximately 18” tall. March 23, 2017.



Photo 6. Four-year-old valley oak at Halcon Road. This tree is just over 2 feet tall. March 23, 2017.



Photo 7. Arborist Cory Meyer at WWTP holding a valley oak killed by gophers. This tree was three years old and over 3 feet tall. November 3, 2015.



Photo 8. Gopher burrows are common throughout the WWTP site due to loose sandy soils. View east. December 11, 2012.



Photo 9. This four-year-old valley oak at WWTP outgrew the tree tube it was planted in. Deer continuously browsed the top until the tree tube was replaced with a larger welded wire cage. March 23, 2017.



Photo 10. These sycamores (foreground) and oaks (background) at Paloma Horse Arena were 6 years old at the time of this photo. This site was planted in 2009. July 12, 2015.



Photo 11. Oak trees at Heilmann Grove. The trees in this photo are nearly 20 years old. This was the first oak restoration site, planted in 1996, and all irrigation has since been removed. Trees are self-sufficient. July 12, 2015.

Exhibit 1. Oak Tree Restoration Sites Planted in 2012

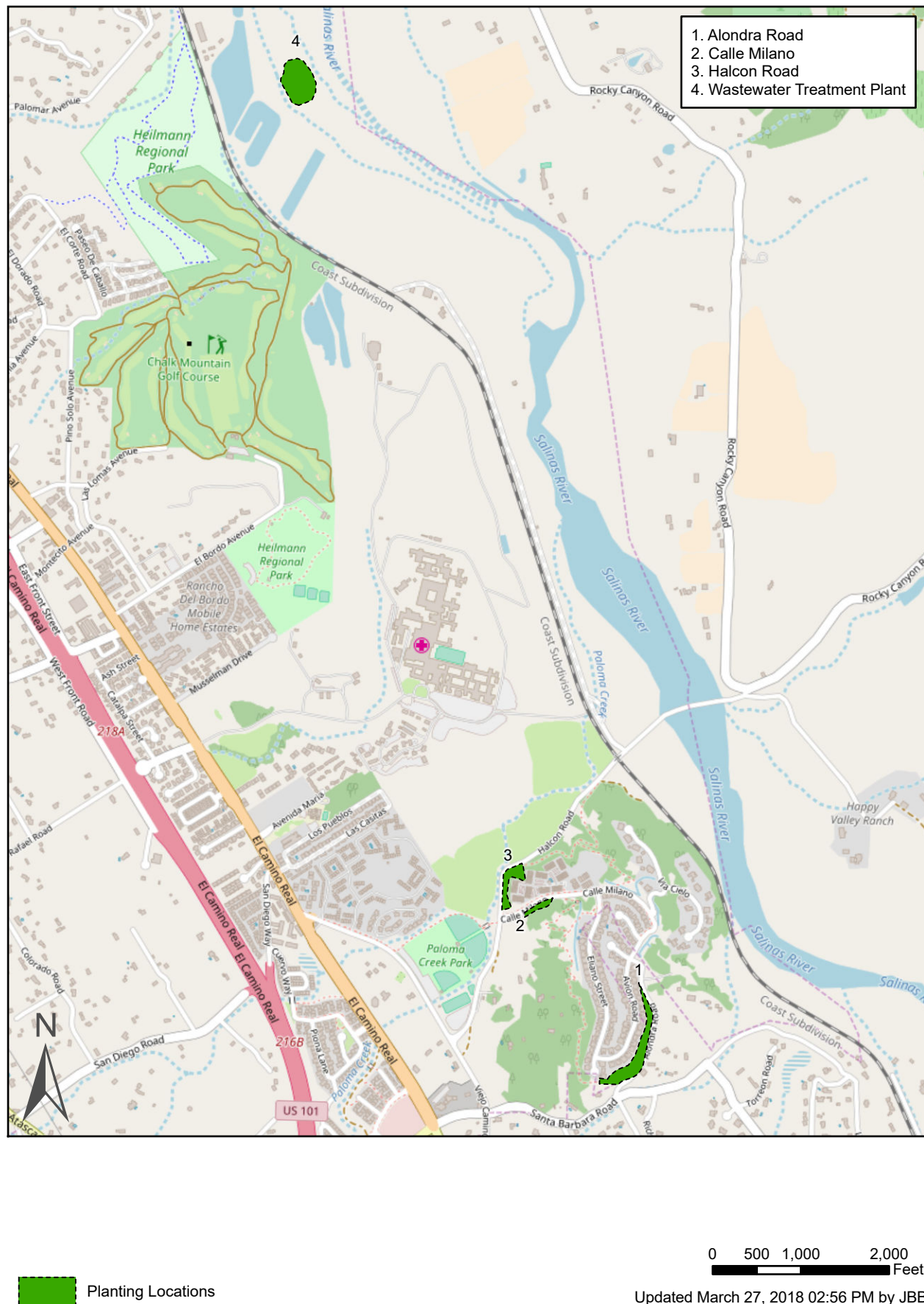
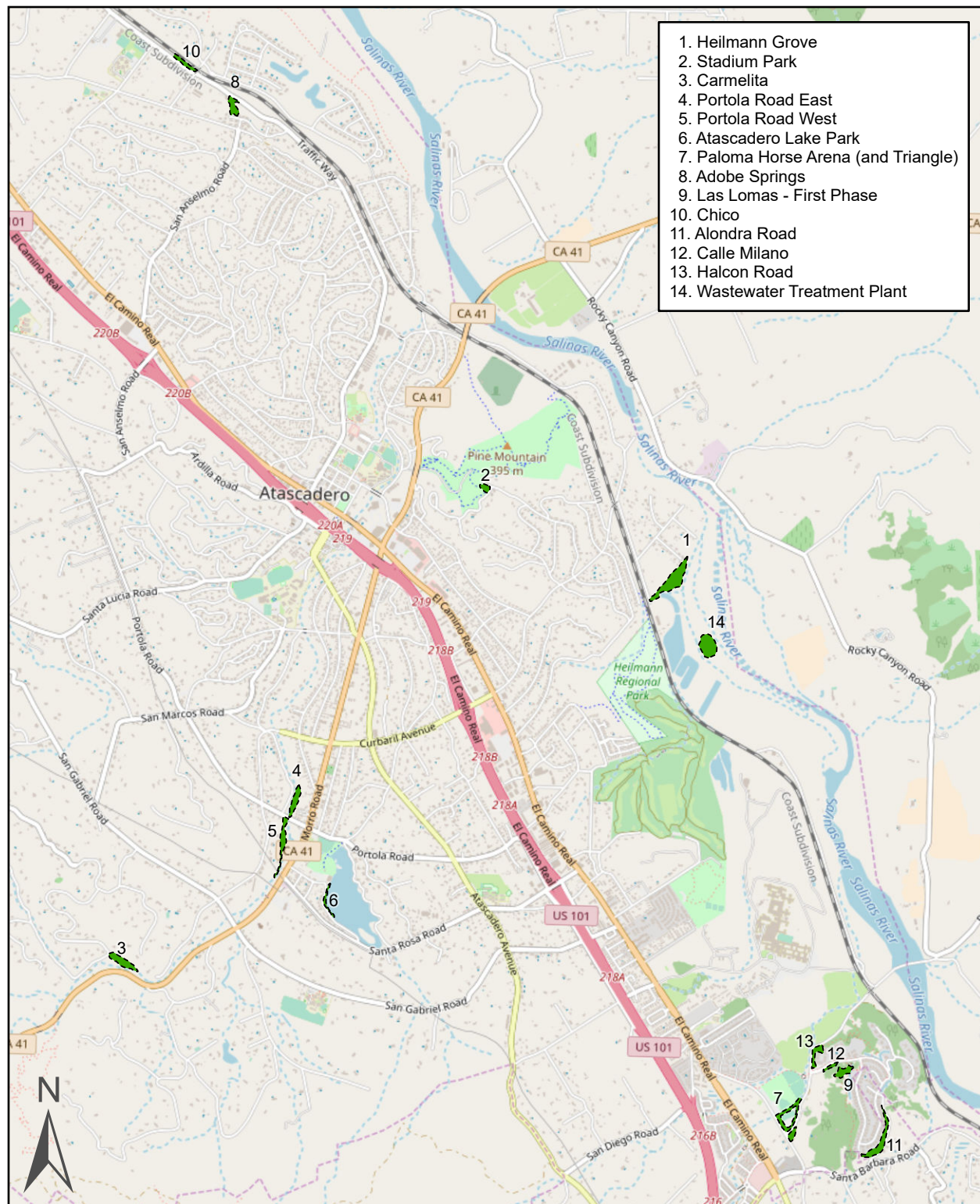


Exhibit 2. All Oak Tree Restoration Sites



 Planting Locations

0 0.25 0.5 1
Mile

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