YEAR 4 (2019) ANNUAL MONITORING REPORT

PALLID MANZANITA HABITAT ENHANCEMENT AND CONSERVATION PLAN FOR THE CHABOT SPACE AND SCIENCE CENTER

Prepared for

Chabot Space and Science Center
10000 Skyline Blvd.
Oakland, CA 94619

Prepared by

Friends of Sausal Creek
P.O. Box 2737
Oakland, CA 94602

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Section 1. INTRODUCTION

1.1 SUMMARY

The purpose of this report is to present the results of the 2019 annual monitoring (Year 4) of the Pallid Manzanita Habitat Enhancement and Conservation Plan (HECP). All monitoring activities were carried out as specified in the HECP, with minor modifications. Per the HECP (Chabot Space & Science Center 2015), the site will be monitored for five years, ending December 31st of 2020. Year 4 extends from January 2019 to December 2019. This report addresses activities completed through December 31, 2019.

This annual monitoring report includes a summary of implemented actions, performance criteria, monitoring methods, locations sampled, representative photographs, monitoring results, trends, and recommendations.

In summary, the site continues to show great promise. Beginning in 2015, mature tree removals combined with monthly volunteer workdays to clear competing vegetation and litter has promoted robust natural recruitment in the occupied pallid manzanita site at Chabot Space and Science Center (CSSC). The observed seedlings are presumably germinated from the existing soil seed bank. Due to the presence of dead manzanitas in this area, it is assumed that an abundant and viable soil seed bank exists, and additional pallid manzanitas will continue to germinate. Furthermore, it seems that more germination will be supported if another round of tree removals occurs.

In Year 1, over 100 seedlings presumed to be pallid manzanita were surveyed. Seedling surveys conducted in April of 2019 revealed that 102 living seedlings were present on the site. While some seedlings recorded in the past 3 years have since senesced, other seedlings appear to be first or second year recruits. Additionally, some seeding clusters are doing so well that finding individuals within the clusters is becoming more challenging, thus altering recruitment monitoring results.

As mentioned in past reports, it was determined that having a dedicated crew of volunteers trained in skills relating to pallid manzanita restoration would ensure a higher level of efficiency and care when working with this sensitive species. In Year 4, recruitment efforts targeted volunteers interested in being on a dedicated Pallid Crew. Volunteers were asked again to commit to six workdays a year and were given a training on Pallid manzanitas and monitoring methods. Unfortunately, the cohesion of the 2017 crew did not materialize in 2019; most volunteers attended only once or twice during the workday season. This being said, much was accomplished at the CSSC site in 2019.

Annual monitoring of seedling height, canopy, and vigor is critical to understanding the population dynamics of the species in the context of an actively managed restoration site. In Year 4, volunteers and FOSC staff conducted seedling monitoring again; both re-documenting tagged seedlings from the previous year as well as tagging newly discovered seedlings.

In 2019 our non-native cover class in the 1-2 meter range was 24%, slightly above the performance standard targets of less than 20% non-native cover. This is in large part due to non-native grasses that are prevalent at the site as they account for about 42% of the non-native vegetation in this cover class and are challenging to manage. Despite this slight increase, FOSC staff believe the performance standard will continue to be met in the future, especially as new pallid seedlings and other native species outcompete the non-native forbs and grasses.

Given that this site is at risk for conversion to woodland and/or scrubland, the highest priority management actions in 2020 will include continued native and non-native shrub and tree removal. Furthermore, any additional vegetation and duff removal activity in 2020 will be concentrated in areas that are most likely to support pallid manzanita germination. This includes locations where seedlings are already growing, but also areas with known seed banks, namely where the 21 pallid manzanita plants surveyed in 1995 once grew.

A brief summary of the performance criteria and the site status is included in Table 1 below.

TABLE 1. SUMMARY OF PERFORMANCE CRITERIA AND SITE STATUS

PERFORMANCE CRITERIA	IS SITE ON TRACK TO MEET PERFORMANCE CRITERIA?	COMMENTS
A minimum of 21 pallid manzanita plants will be established at the CSSC site within five years from the date of completion of the first phase of invasive tree removals and Fire Abatement Requirements (December 30, 2014) and will be maintained in perpetuity.	Yes	Between April and November 2019, 102 live pallid manzanita seedlings were observed on site. Of these plants, 84% were in healthy (vigor class 3) condition.
The CSSC site will contain less than 20% cover of invasive [non-native] plant species within five years and shall be maintained annually.	Yes, though not met in 2019	Based on the 2019 monitoring data, non-native species in the > 2 meter, 1-2 meter and < 1 meter ranges were an average of 0%, 0%, and 24% cover respectively. (See Table 5 for a detailed breakdown) In 2019 the 1-2 meter range was barely above the performance criteria (by 4%). FOSC believes the percentage will be brought back down to below 20% in 2020.
Areas around existing pallid manzanita individuals at the CSSC site will be clear of competing vegetation.	Yes	Volunteer work days in 2019 cleared competing vegetation in pallid manzanita habitat. Work days in 2020 will continue to remove competing vegetation.
Monitoring of the existing CSSC pallid manzanita population will occur on an annual basis provided that the soil is dry enough. Annual monitoring will be conducted for five years if performance standards are met, or longer until performance standards are met.	Yes	Monitoring occurred in 2019 and is planned for 2020.

1.2 PROJECT BACKGROUND

The pallid manzanita (*Arctostaphylos pallida*) population at the Chabot Space and Science Center (CSSC) showed dramatic decline between 1995 and 2015. The 1995 Environmental Impact Report[1] identified 21 individuals. When active management at CSSC began in 2015 with finalization of the Habitat Enhancement and Conservation Plan (HECP)[2], only three mature pallid manzanitas were present at the site. Of these three plants, only one was a survivor from the original 21. Of further concern, prior to 2015 and the start of active management, there was minimal regeneration on-site, demonstrating the population was trending toward extirpation. As cited in the HECP, some of the possible reasons for the population decline include: lack of vegetation management causing pallid manzanitas to be shaded out; fire suppression; and potential *Phytophthora cinnamomi* infection. Although *P. cinnamomi* testing of soil at the CSSC site in 2016 was negative, these results do not ensure that the pathogen is not present.

The HECP specifies two overarching management goals for maintaining pallid manzanitas on site. First, create viable habitat for the pallid manzanita by reducing overstory competition and removing trees and non-native shrubs. Second, increase the pallid manzanita population to at least 21 individual plants. Monitoring the health of living pallid manzanitas and pallid manzanita recruitment will also play a key role in determining restoration success efforts and informing future management decisions. The HECP requires that germination experiments will be conducted to test various methods for pallid manzanita recruitment. The HECP also specifies monitoring will occur annually to document the health of individual pallid manzanitas and habitat conditions.

The goal of annual monitoring is to assess any changes in the status of pallid manzanitas on site, assess results of the germination experiment and future out-plantings (if instigated), and assess success of weed abatement. During the five-year monitoring period, the frequency of weed eradication needed and the status of the pallid manzanita population will be evaluated. If performance standard thresholds are not met at the end of the monitoring period, weed management and annual monitoring will continue until standards are met. If at the end of the five-year monitoring period the performance standards are met, monitoring will then occur once every three years to ensure that conditions are maintained. Weed abatement in the area will likely be ongoing for an indefinite amount of time.

Overall site conditions have improved considerably during the last four years as a result of tree removals that have opened up the canopy, and vegetation management activities including recurring volunteer workdays. Davey Tree completed Phase 2 of tree removals as outlined in the HECP in December 2016. Friends of Sausal Creek (FOSC), in partnership with CSSC, the East Bay chapter of the California Native Plant Society (EBCNPS), and the City of Oakland, has organized habitat improvement volunteer workdays at CSSC since February 2015. During these workdays, volunteers remove non-native plants and heavy wood litter from the sunny knoll above the parking lot and on the south side of the West Ridge Trail. As of 2019, most of the

[1] Environmental Science Associates. 1996. Chabot Observatory and Science Center Environmental Assessment. March 22.

[2] Chabot Space and Science Center. 2015. Pallid Manzanita Habitat Enhancement and Conservation Plan. October 2015.

litter is gone, and managing the site includes removal of non-native as well as encroaching native shrubs, and annual invasive plants that are re-establishing at the site.

Improving habitat conditions through active management has resulted in a significant amount of natural recruitment at the CSSC pallid manzanita site since 2015. Seedling monitoring was established in Year 2 in an effort to determine what factors may be contributing to seedling mortality. In future years, this information may be used to direct effective management decisions at this site. Furthermore, knowledge gained through observations at CSSC may eventually be applied to restoration of other pallid manzanita populations within the species' limited range.

After completion of the Year 1 monitoring report, Nomad Ecology, LLC chose not to continue providing oversight and guidance for HECP implementation. FOSC and partners have regularly approached CSSC for funding assistance, including a small annual project support budget for monitoring and reporting activities in 2019, but the requests were not granted. CSSC agreed to in kind tree removal in 2019 and have offered to assist FOSC efforts to explore future funding. In 2019 FOSC contributed staff time and materials to continue HECP implementation with only partial funding obtained from a grant through Alameda County Fish and Game Commission (ACFGC). Lech Naumovich of Golden Hour Restoration Institute also offered pro-bono assistance as a professional biologist to oversee the HECP implementation in 2018, and his organization's time was partially funded by ACFGC in 2019. Naumovich is the author of the 2017 *East Bay Regional Park District Pallid Manzanita Management Plan* and is actively working with EBRPD on their management of this species.

Section 2. GOALS, PERFORMANCE STANDARDS, AND MONITORING METHODS

2.1 GOALS AND PERFORMANCE STANDARDS

As detailed in the HECP, there were no original mitigation requirements in the 1996 Environmental Assessment concerning the size of habitat to be set aside for the pallid manzanita. When the Environmental Assessment was submitted in 1996, there were 21 individual pallid manzanita plants. When the HECP was drafted in 2006, there were 11 individual plants. When the HECP was revised in October 2015 there were 3 living plants remaining at the site, only one of which was from the original 1996 population. As of December 2019, only one of the original plants remain.

Based on the HECP, goals for the pallid manzanita are as follows:

- Restore the CSSC population to the original size prior to construction, at a minimum that would be 21 plants.
- Maintain CSSC occupied areas free of woody invasive plants by removal and continued maintenance of species that compete with the pallid manzanita for light and nutrients (this includes native and non-native species).
- Monitor and manage the CSSC pallid manzanita site population over the long term to ensure pallid manzanita individuals persist and thrive.

Performance Standards for the CSSC site are as follows:

- A minimum of 21 pallid manzanita plants will be established at the CSSC site within five years from the date of completion of the first phase of invasive tree removals and Fire Abatement Requirements (December 30, 2014) and will be maintained in perpetuity.
- The CSSC site will contain less than 20% cover of invasive [non-native] plant species within five years and shall be maintained annually.
- Areas around existing pallid manzanita individuals at the CSSC site will be clear of competing vegetation.
- Monitoring of the existing CSSC pallid manzanita population will occur on an annual basis provided that the soil is dry enough. Annual monitoring will be conducted for five years if performance standards are met, or longer until performance standards are met.

Adaptive management will be necessary, and the above performance standards may change over time to continue the habitat improvement necessary for the survival of the pallid manzanitas.

2.2 MAINTENANCE AND MONITORING SITE VISITS

Table 2 details all activities that were conducted from January 1, 2019 to December 31, 2019, as well as volunteer attendance. The timing of monitoring and maintenance activities are summarized in Table 3.

TABLE 2. MONITORING AND MAINTENANCE ACTIVITIES CONDUCTED IN YEAR 4 (1/1/19-12/31/19)

Date	# of Volunteers	Total Hours	Activity
5/8/2019	25	50	Champions of Science field trip; Education and French broom removal
5/24/2019	4	8	Pallid training and seedling monitoring; native and non-native shrub removal
5/25/2019	2	4	Habitat enhancement workday
6/8/2019	2	6	Habitat enhancement workday; French broom removal and monitoring (Big Trees)
7/13/2019	1	3	Habitat enhancement workday; French broom and thistle removal
7/22/2019	2	6	Vegetation cover class and photo monitoring
8/10/2019	3	9	Habitat enhancement workday; French broom removal
9/14/2019	1	3	Habitat enhancement workday; Redwood and California bay stump sprout tarping, thistle removal
10/12/2019	19	57	Habitat enhancement and fuels reduction workday; Invasive plant and dead debris removal within pallid site and around site edges
11/9/2019	6	18	Habitat enhancement workday; Acacia, French broom and bay seedling removal; recut sprouting stumps
11/9/2019	30	30	Head Royce service field trip; Education, French and Scotch broom removal

TABLE 3. SUMMARY OF MONITORING AND MAINTENANCE ACTIVITIES CONDUCTED IN YEAR 4 (1/1/2019-12/31/2019)

MONITORING/ MAINTENANCE ELEMENT	JAN 2019	FEB 2019	MARCH 2019	APRIL 2019	MAY 2019	JUNE 2019	JULY 2019	AUG 2019	SEPT 2019	OCT 2019	NOV 2019	DEC 2019
Individual Plant Monitoring										X	X	X
Natural Recruitment Monitoring				X	X	X	X	X	X	X	X	
Vegetation Monitoring							X					
Photo Points and Other Documentation							X	X	X	X	X	X
Habitat Improvement Volunteer Work Days				X	X	X	X	X	X	X	X	
Stump Sprout Removal, Tarping										X	X	

2.3 MONITORING AND MAINTENANCE METHODOLOGY

The monitoring methods employed comply with the project's HECP and are described below. Monitoring in Year 4 was conducted by FOSC staff, Pallid Crew volunteers, and Golden Hour Restoration Institute staff under the guidance of lead biologist Lech Naumovich.

2.3.1 Individual Plant Monitoring

For individual plant monitoring of the mature pallids on site as of Year 1 monitoring, the most important parameter to continue evaluating was survival, followed by vigor (overall health) which was assessed both qualitatively by examining a plant's appearance (percent senescence, presence of new growth, level of flower and fruit production) and quantitatively by measuring plant growth (height and crown diameter).

In Year 4, individual plant monitoring was again conducted for the two surviving individuals. Each plant was measured and given a vigor class (see Table 4). Photo points from each cardinal direction were re-taken (see Appendix A).

The individual plant monitoring data sheet can be found in Appendix B.

2.3.2 Germination Experiment Plot Establishment, Maintenance, and Monitoring

Based on the HECP, one of the goals for the pallid manzanita is to restore the CSSC population to the original size prior to construction (21 plants) at a minimum. Years 1 and 2 experiments at CSSC focused on the feasibility of achieving recruitment goals by directly seeding on-site and/or utilizing the historical seed bank.

Two separate germination studies were established in Year 1: the Seed Germination Study and the Soil Seed Bank Study. See Year 1 Annual Monitoring Report for complete methods. No new seedlings had sprouted in any germination study plots as of 2018, therefore the germination plot monitoring has ceased.

2.3.3 Natural Recruitment Monitoring

Natural recruitment was first observed in 2016 when 113 presumed live pallid seedlings and 45 dead seedlings were surveyed, but not tagged or monitored. These numbers are significant when compared to natural recruitment at other sites within the species' range where populations are in decline. Annual monitoring of seedling height, canopy, and vigor was determined to be critical to understanding the population dynamics of the species in the context of an actively managed restoration site. Individuals were tagged in order to track their changes and collect valuable data. Furthermore, it is hoped that seedling monitoring data will reveal if there is a correlation between height/canopy and senescence and whether there is a critical time in the season when senescence occurs. If trends are identified, then effective measures may be taken in the future to increase survivability of the most vulnerable plants.

In 2019, the site was re-surveyed and data collected on previously recorded (tagged) seedlings, seedlings that were found with no tags and may have been missed in the 2018 monitoring efforts, as well as seedlings that are likely new recruits. As in 2018, in 2019 data continued to be collected in centimeters even though original 2017 data had been collected in inches.

For each seedling, the following metrics were recorded:

- Height of tallest live foliage in centimeters
- Canopy diameter of multi-stemmed seedlings in centimeters
- Plant vigor: The vigor classes are as follows: (3) dense foliage, no spotting or discoloration of leaves; (2) some leaf spotting or dieback; (1) sparse foliage, pronounced spotting and dieback; (0) dead.

Natural recruitment monitoring data is added to a spreadsheet and maintained by FOSC staff. A data monitoring form can be found in Appendix B. Raw data for 2019 is found in Appendix D.

2.3.4 Planting Plots

No nursery propagation or planting was done up to this point since the HECP states that nursery planting is only necessary if germination experiments prove unsuccessful. While no germination occurred in the germination plots, we did not attempt nursery propagation due to the number of seedlings that have naturally recruited.

2.3.5 Vegetation Monitoring

As specified in the HECP, vegetation monitoring was conducted as follows:

- Seven 100-foot transects were placed throughout the occupied pallid manzanita area. Transects ran northeast to southwest downhill from a 275' baseline placed along the West Ridge Trail. Due to the randomly selected starting point of the first transect, only 7 transects (as opposed to 8 in 2018) fit along the baseline. This number was accepted as sufficient coverage. The first transect was randomly assigned at 32', the subsequent transects were placed every 30' thereafter (32', 62', 92'…).
- Cover of non-native and native plant species was recorded using the point-intercept method. The observer stopped every two feet beginning at two feet for a total of 50 points along each transect line. They recorded if the point intercepted a plant species, only noting the first species encountered, in three canopy classes based on the height of vegetation layers: <1 meter, 1-2 meters, >2 meters. The point was then recorded as a species hit. Soil surface cover of rock, bare, litter, stump, or other were also recorded at each point.
- Photos were taken of each transect. Point-intercept photos can be found in Appendix A.

The vegetation monitoring data forms can be found in Appendix B. Raw transect line data is found in Appendix C.

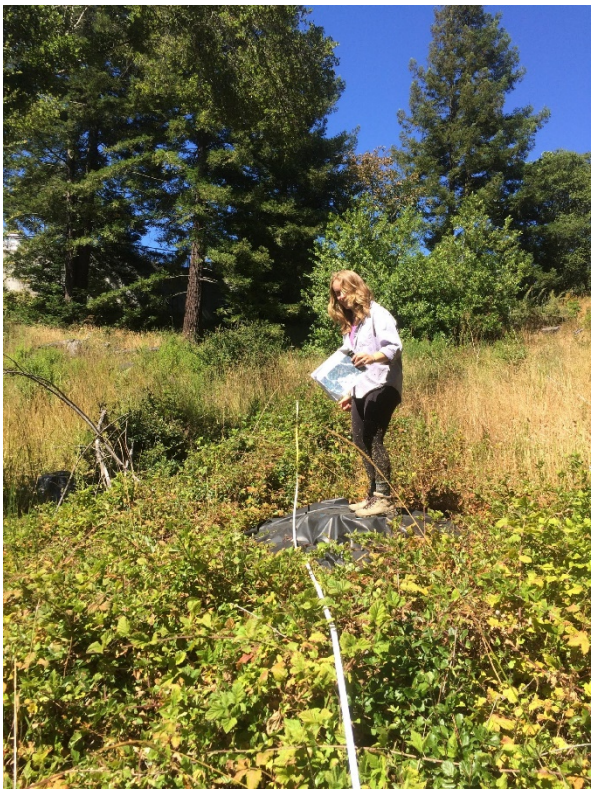


Photo: Volunteer stands next to transect line running through a patch of native blackberry. Staff uses point-intercept data to determine vegetation class cover. 7/22/2019

2.3.6 Photo Points

In November 2016, permanent photo points were established to capture relevant conditions on site. These points are to be monitored during the five-year monitoring period so that photos may be compared over time to qualitatively assess changes in plant and general site conditions as well as vegetative composition, cover, dominance, and structure.

The following methods were employed in the establishment of the photo points:

- Photographs were documented in the field with the following information: photograph number, general direction (compass heading) toward object of photograph, date and time of day, reference points, and description of surroundings or other comments that might be helpful in future identification of the site.
- Four photos were taken from each photo point: one in each of the four cardinal directions.

In future years, photo-monitoring should be taken at the same time of year or during the same physical stage (i.e., in full leaf, in bloom, etc.) for the plants being monitored. Additionally, photos should be taken at approximately the same time of day and using the same frame (camera angle and zoom) of Year 1 photos.

The photo point monitoring form can be found in Appendix B. Photos from these points are found in Appendix A.

2.3.7 Maintenance Methodology - Habitat Improvement Volunteer Work Days

The most important habitat management issue, both for currently occupied habitat and for areas where pallid manzanitas are being reintroduced, is the control of competing native and non-native vegetation. Monthly habitat improvement volunteer workdays were established in 2015 and have continued through 2019 for the primary purpose of removing competing vegetation at the CSSC pallid manzanita site. Workdays only occur in the dry season as damp soil conditions promote the spread of *Phytophthora cinnamomi*.

In Year 1, most CSSC pallid manzanita habitat workday volunteers were one-time participants who did not return to work in the following months. In Year 2, it was determined that having a dedicated crew of volunteers trained in skills relating to pallid manzanita restoration would ensure a higher level of efficiency and care when working with this sensitive species. In Year 4, FOSC staff again attempted to recruit a dedicated pallids crew. While a couple of volunteers attended more than one workday, the workdays were again largely composed of one-time volunteers.

A short training took place in April which included an orientation to pallid manzanita natural history and ecology, seedling monitoring protocol, non-native invasive species, and protocols for minimizing the risk of spreading *Phytophthora cinnamomi*. At Pallid Crew workdays, volunteers were trained in plant identification skills, habitat restoration techniques, monitoring protocols, and germination experiment design.

In addition to removing non-native species such as French broom, poison hemlock, and bull thistle, volunteers removed small native shrubs and trees from the CSSC restoration site. A couple of large trees cut in 2016 continue to grow vigorous sprouts, these were again cut and tarped or re-tarped as was necessary to control future re-sprouting.

Potential habitat areas at CSSC were cleared of competing vegetation. Competing vegetation removal primarily focused on French broom, scotch broom and thistle but also native species such as coyote brush. This year there was more dedicated push back on poison oak which is coming back vigorously. It is anticipated that it will be necessary to maintain these areas free of competing species until such time as the manzanita canopy is established and able to maintain itself through the allelopathic properties of other species' litter. It is also anticipated that FOSC staff will need to do a more thorough poison oak thinning in 2020 to keep the site accessible to volunteers.

On every workday, volunteers searched for new pallid manzanita seedlings to tag. Several new recruits were discovered, and volunteers helped monitor these seedlings as well as the two remaining mature plants from the original monitoring in 2016 (See Individual Plant Monitoring section 2.3.1).

During all maintenance and monitoring workdays, FOSC volunteers followed best management practices to prevent the introduction and/or spread of *Phytophthora* outlined in the "Hygiene [*sic*] Protocol for *Phytophthora cinnamomi*" from the *Vegetation Management Implementation Plan* by WRA, Inc., November 2013. These practices include disinfecting machinery, hand tools, footwear, and vehicles before and after leaving the site; avoidance of work during periods of precipitation (including fog drip); not removing plant or soil material from the site; and minimizing soil disturbance on site.

Section 3. MONITORING RESULTS AND RECOMMENDATIONS

This section outlines the results of Year 4 monitoring.

3.1 INDIVIDUAL PLANT MONITORING

The two remaining mature pallids were again monitored in 2019. Individual three is in poor condition with only a small percentage of live foliage persisting. Despite its poor condition, this plant is still producing some flowers and fruit. Individual two, however, is quite healthy as of 2019 with extensive new growth and flowers though, it was not observed at the correct time to check for fruit development. See Table 4 below for an overview.

TABLE 4. RESULTS OF INDIVIDUAL PLANT MONITORING (11/30/2018)

PLANT NUMBER	HEIGHT	CROWN DIAMETER	ALIVE?	VIGOR	NOTES
1	n/a	n/a	No	0 (Dead)	This plant senesced in 2018. UTM: 572157.77E 4185935.19N
2	72 inches	90 inches	Yes	3 (Good)	Extremely vigorous individual with lots of new growth in 2019. UTM: 572158.93E 4185923.55 N
3	~84 inches	~109 inches	Yes	1 (Poor)	This plant fell in winter 2017 making measurements challenging and inaccurate. Three branches with live foliage persist with a small amount of growth, but the rest of the vegetation has died. UTM: 572157.44E 4185924.19N

Photo points of individual plants can be found in Appendix A.

3.2 GERMINATION EXPERIMENT PLOT MONITORING

Year 4 has surpassed the 2-year time frame required for germination results. Consequently, FOSC no longer monitors the germination plot experiments from Year 1.

In 2016, Pallid Crew leader Judy Schwartz collected around 80 fruits (seed number unknown) from two pallid manzanitas at CSSC with considerations to 5% seed collection guidelines. The seeds not used for the Year 1 germination study are being stored at the FOSC nursery.

3.3 NATURAL RECRUITMENT MONITORING

A single seedling survey took place in April of 2019. In all, 102 seedlings were recorded. Many of the seedlings originally tagged in 2017 & 18 were relocated, although several clusters of seedlings are becoming dense enough that individuals within the clusters are difficult to relocate. This is likely why several (~9) individuals that were over 40 cm tall in 2018 were not relocated in 2019. Additionally, 15 seedlings recorded were first and second year individuals found during workdays throughout the summer.

The 2019 total of 102 seedlings is a slight decrease from the 114 seedlings recorded in 2018, and the 108 in 2017, but overall the population seems to be stable. Additionally, established plants produced extensive new growth in 2019, likely due to a wet winter. Most seedlings, 86 individuals or 84% of the total number of plants, continue to be in a healthy (vigor class 3) condition. It is the opinion of FOSC staff that if more trees were cleared around the site edges, more seedlings would germinate on these edges.

Photo: A crew of volunteers who helped to complete the 2019 vegetation monitoring (7/22/2019).

3.4 VEGETATION MONITORING

Summary

As stated in the HECP, "The CSSC site will contain less than 20% cover of non-native plant species within five years and shall be maintained annually." Cover of non-native trees and shrubs throughout the site is well below this goal with an average of 0%. However, year 4 vegetation monitoring detected an average of 24% cover of non-native forbs which is just over the 20% threshold of acceptable non-native cover as determined by the HECP performance standard. On average, about 42% of non-native coverage in this class are annual grasses. Unfortunately these are difficult to control, but pose less threat to the pallid seedlings than shrubs and have not been a high priority. Many of the non-native grasses which are present on site have colonized openings between vegetation and are shaded out by established plants. We

will continue to monitor non-native annual grass distribution on site. As pallid manzanitas gain in mass, they will also shade out these non-native annual grasses. The main priority in 2020 will be the continued removal of non-native and native trees and shrubs, as these plant types are drivers of vegetation community conversion and pose more threat for outcompeting pallid seedlings.

Another of the performance standards stated in the HECP is to "Maintain CSSC occupied areas free of woody invasive plants by removal and continued maintenance of species that compete with the pallid manzanita for light and nutrients." Included in this standard are both native and non-native trees and shrubs, classes > 2 meters tall and 1-2 meters tall respectively. In Year 4, native tree cover throughout the site was an average of 13% and native shrub cover was an average of 18%. Both of these figures represent a decrease from Year 1 findings in which native tree cover was an average of 38% and native shrub cover was 33%. There is however a slight increase in both cover classes from the coverage found in 2018. The tree canopy coverage increase is likely due to randomness of the transect lines as this cover class as a whole is not changing much. The shrub cover class though not as high as the original cover class recorded in 2016, has also increased (by about 13%) in 2019. There are several native shrubs filling in the site which the Pallids Crew only removes if they are encroaching on pallid seedlings.

Photos of point-intercept transect lines can be seen in Appendix A. Raw transect line data can be found in Appendix C.

Following the summary of transect line data shown in Table 5 is further discussion of vegetation monitoring findings.

TABLE 5. SUMMARY OF TRANSECT LINE DATA (7/22/2019)

TRANSECT NUMBER	% COVER NATIVE VEGETATION > 2 METERS TALL	% COVER NON-NATIVE VEGETATION > 2 METERS TALL	% COVER NATIVE VEGETATION 1-2 METERS TALL	% COVER NON-NATIVE VEGETATION 1-2 METERS TALL	% COVER NATIVE VEGETATION < 1 METERS TALL	% COVER NON-NATIVE VEGETATION < 1 METERS TALL
1	26%	0%	10%	0%	68%	30%
2	4%	0%	4%	0%	72%	22%
3	2%	0%	22%	0%	68%	20%
4	8%	0%	18%	2%	66%	28%
5	12%	0%	24%	0%	50%	40%
6	30%	0%	22%	0%	80%	16%
7	10%	0%	24%	0%	86%	12%
Average	13%	0%	18%	0%	70%	24%
%Change from 2016	-25%	-17%	-15%	-1%	60%	6%

3.4.1 Tree cover (vegetation > 2 meters tall)

Mature non-native tree removal in Year 1 and continued seedling and sapling removal during volunteer workdays has resulted in low non-native tree species coverage, with zero hits in 2019. Native tree cover ranged from 2% (Transect 3) to 30% (Transect 6) with an average of 13%, this

was a slight increase in cover from 2017. This is likely due to random transect line placement and not significant increase in overstory. The 13% average for both native and non-native tree coverage although low compared to tree cover in areas surrounding the restoration site, is still high for early succession maritime chaparral habitat in which pallid manzanita historically occur. Although it is difficult to determine conclusively from this transect data, it is likely that tree canopy cover influences pallid manzanita growth, whether it be from native or non-native tree species. Removal of non-native and native tree seedlings and saplings remains a priority for restoration workdays in 2020.

3.4.2 Shrub Cover (vegetation 1-2 meters tall)

Cover of non-native shrubs along all transects was at 0% in 2019. Cover of native shrubs ranged from 4% to 24%. The combined average of native and non-native shrub cover for Year 4 is 18%, which is increasing from 2017, but still 15% lower than detected in Year 1. Native shrubs along transects include poison oak (*Toxicodendron diversiloba*), California blackberry (*Rubus ursinus*), monkeyflower (*Mimulus aurantiacus*) and coyote brush (*Baccharis pilularis*). These native shrubs have the potential to compete with pallid manzanita seedlings. Some native shrubs, particularly coyote brush, were carefully cleared in the vicinity of pallid manzanitas this year, and the site will certainly need more clearing of shrubs in the future.

3.4.3 Forb Cover (< 1 meters tall)

Total cover of non-native forbs ranged from 12% to 40%, while cover of native forbs ranged from 50% to 86% cover. The average for native forbs in 2019 is considerably higher than Year 1, with an increase of 60%. This seem to reflect a resurgence of native forbs to the site which was in deep shade before 2016. Several native annual species which were not seen during the original survey in 2016 (such as tarweed, *Madia sativa*) were prolific in 2019. The average for non-native coverage rose slightly to 24%, putting it just over the HECP performance goal of less than 20% non-native plant cover. Approximately 42% of the non-native plant material in this cover class are annual grasses, which are very difficult to manage, but pose less threat to the pallid manzanita seedlings than shrubs. The likely outcome is that the pallids will shade out non-native annual grasses as they increase in size, thus bringing the site back into compliance with the HECP goal. Volunteer workday restoration efforts will continue to focus primarily on shrub and tree removal rather than non-native forbs or grasses, as these larger plants have more potential to outcompete pallid manzanitas.

3.4.4 Non-native Species

Numerous non-native species were observed on site (Table 6). Many of these are considered invasive weeds and are tracked by the California Invasive Plant Council (Cal-IPC). The highest concentration of non-native species observed on site include bull thistle, blackwood acacia, poison hemlock, Scotch broom, and French broom. As mentioned above, several species of non-native annual grasses make up a large percentage of the invasive forb coverage. Non-native weed control efforts will continue to focus on shrubby species as well as less invasive species in the immediate vicinity of pallid manzanita individuals. For this report, we have listed the species we believe will be most detrimental to the restoration of this site **in bold**. Management priorities are focused on controlling these taxa.

TABLE 6. NON-NATIVE SPECIES PRESENT IN POTENTIAL PALLID MANZANITA HABITAT AREA BELOW WEST RIDGE TRAIL (INVENTORY COMPLETED BY MICHAEL UHLER ON 12/3/2016.)

SCIENTIFIC NAME	COMMON NAME	CAL-IPC RATING[7]
Acacia melanoxylon	**blackwood acacia**	**Limited**
Briza maxima	rattlesnake grass	Limited
Bromus diandrus	ripgut brome	Moderate
Cirsium vulgare	**bull thistle**	**Moderate**
Conium maculatum	poison hemlock	Moderate
Cotoneaster pannosus	**silverleaf cotoneaster**	**Moderate**
Cynosurus echinatus	bristly dogtail grass	Moderate
Cytisus scoparius	**hairy-fruited broom**	**Moderate**
Ehrharta erecta	panic veldtgrass	Moderate
Erigeron canadensis	Canada horseweed	-
Eucalyptus globulus	**Tasmanian blue gum**	**Limited**
Euphorbia oblongata	oblong spurge	Limited
Genista monspessulana	**French broom**	**High**
Hedera helix	**English/Algerian ivy**	**High**
Hesperocyparis macrocarpa	Monterey cypress	-
Hirschfeldia incana	Mediterranean mustard	Moderate
Hypochaeris radicata	common cat's-ear	Moderate
Lactuca virosa	wild lettuce	-
Myosotis latifolia	common forget-me-not	Limited
Oxalis pes-caprae	buttercup oxalis	Moderate
Pinus radiata	**Monterey pine**	**-**
Plantago lanceolata	English plantain	Limited
Pyracantha sp.	**Firethorn**	**-**
Rubus armeniacus	**Himalayan blackberry**	**High**
Rumex acetosella	sheep sorrel	Moderate
Rumex crispus	curly dock	Limited
Silybum marianum	milk thistle	Limited
Solanum nigrum	black nightshade	-
Stellaria media	common chickweed	-
Torilis arvensis	hedgeparsley	Moderate

7 California Invasive Plant Council rating as listed in the California Invasive Plant Inventory Database (Cal-IPC 2009): High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically. Moderate – These species have substantial and apparent, but generally not severe, ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread. Limited – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify

a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. *Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.*

3.5 PHOTO POINTS

In Year 1, 12 photo points were established by Nomad Ecology, LLC and permanently marked with capped rebar less than one foot high. Photopoint UTM locations were recorded, but they were not referenced to permanent, readily identifiable objects. The coordinates recorded in Year 1 are meaningless unless a sub-meter GPS unit is used to locate the photopoints. Without access to a GPS unit with adequate accuracy, only eight of the 12 photopoints were identified in Year 3.

TABLE 7. PHOTO POINT DATA (COLLECTED ON 11/2/2016)

PHOTO POINT	UTM	TIME
1	572167.69E/4185920.36N	11:19 a.m.
2	572173.73E/4185910.83N	11:31 a.m.
3	572159.78E/4185911.26N	12:19 p.m.
4	572156.14E/4185906.57N	11:40 a.m.
5	572153.03E/4185918.17N	11:44 a.m.
6	572139.16E/4185932.68N	11:49 a.m.
7	572133.16E/4185926.74N	11:53 a.m.
8	572119.38E/4185925.25N	11:56 a.m.
9	572108.07E/4185930.77N	12:32 p.m.
10	572127.78E/4185940.78N	12:00 p.m.
11	572112.08E/4185958.24N	12:04 p.m.
12	572180.11E/4185929.28N	12:39 p.m.

Photo point photos can be seen in Appendix A. Please note that there are no photos for points 4, 8, 11, and 12.

3.6 HABITAT IMPROVEMENT VOLUNTEER WORK DAYS

Though there was not a cohesive group of volunteers on the “Pallids Crew” in 2019, habitat improvement volunteer workdays were effective at maintaining control of tree re-sprouts and competing vegetation.

Several flushes of French broom were removed in priority habitat areas. Native and non-native trees cut in 2016 that had vigorously re-sprouted were tarped and in some cases re-tarped. Litter buildup is no longer an issue as there is no longer a heavy overstory of vegetation.

Section 4. RECOMMENDATIONS AND ADAPTIVE MANAGEMENT FOR YEAR 5 (2020)

Overall, site conditions have improved considerably. Numerous pallid manzanitas are germinating due to original tree removals and continued vegetation management by volunteers. Goals and adaptive management recommendations for Year 5 are outlined below with consideration to lessons learned in 2019. Table 7 shows the recommended schedule of monitoring and maintenance activities for Year 5.

4.1 WORKDAY GOALS

Seedling density throughout the site is still a concern for volunteer workdays. Although the majority of the seedlings are sizeable (49% of them are over 60 cm tall) it is ideal to keep volunteer groups small when entering the site. Additionally, work should be performed very slowly to take care of smaller seedlings. Experienced volunteers and staff should visit the site before each scheduled public workday to mark any new seedlings with flags. This will ensure that small seedlings are visible before the workday.

Monthly volunteer workdays were again vital for clearing vegetation around pallid manzanitas, and they remain critical for meeting HECP performance goals in the future. In 2020, Pallid Crew volunteers will be asked to commit to six workdays a year for better continuity. Recruitment outreach should focus on the FOSC and larger knowledgeable plant communities (such as CNPS) in an effort to attract people with an interest in and basic understanding of native plant restoration. Although the demands on volunteer time are considerable, those people with an interest in learning natural resource management skills would gain valuable field experience. A graduate student would be an ideal candidate to develop a suitable research project that aligns with HECP performance standards.

This site is at risk for conversion to woodland or shrubland dominated by non-native species such as French broom (*Genista monspessulana*) as well as native shrubs like coyote brush (*Baccharis pilularis*). Plants other than those found in the maritime chaparral habitat of the pallid manzanita could quickly take hold and then overwhelm the volunteer labor force. The highest priority management actions in 2020 include continuation of native and non-native shrub and tree removal. A substantial poison oak (*Toxicodendron diversilobum*) clearing needs to occur in 2020 to ensure that staff and volunteers will be able to safely work in the site. It is important to note that no shrub or trees close to pallid seedlings should be removed in June - September when environmental stressors are most severe.

Furthermore, if there is enough volunteer recruitment to meet the HECP objectives in 2020, additional vegetation and duff removal could take place in areas that are on the edge of the current site, and those most likely to support pallid manzanita germination. This includes locations where seedlings are already growing and also areas with known seed banks such as adjacent to the 21 pallid manzanita skeletons surveyed in 1995. The seedling clusters identified during this project are primarily adjacent to known locations of former pallid manzanitas, but not all of these sites have yielded seedlings. More intensive vegetation and duff removal could improve conditions such that germination is promoted. In addition to removal of organic matter in seed bank locations, it is recommended that volunteers conduct more “scrape treatments” to

remove the soil's O horizon so that the mineral soil most favorable to pallid manzanita germination is exposed.

4.2 MAPPING

It is important to map the location of the 21 pallid manzanita plants identified in 1995 so that areas with the highest density seed banks are known. This information would help to prioritize restoration concentration in 2020. Seedling concentration mapping would be challenging, but may be worthwhile, especially with individuals that are several years old. Additionally, this mapping could make relocating seedlings easier.

4.3 PHYTOPHTHORA PREVENTION

In 2020 FOSC staff and volunteers will continue to follow the best management practices to prevent the introduction and/or spread of *Phytophthora* outlined in the "Hygiene [*sic*] Protocol for *Phytophthora cinnamomi*" from the *Vegetation Management Implementation Plan* by WRA, Inc., November 2013. In 2020, all maintenance and monitoring workdays will be cancelled during times when soil in the pallid manzanita habitat area is wet.

4.4 POISON OAK MANAGEMENT

Poison oak cover in the occupied pallid site has steadily increased due to more sun exposure following mature tree removal in Year 1. It is predicted that the species may become so dense as to prevent volunteers from working at the site. Control of poison oak is challenging at CSSC as the use of herbicides such as glyphosate is not permitted on Oakland public lands. Even if permitted, it is not advisable given the sensitivity of the site. Alternatives discussed in 2017 include the application of highly concentrated salt water or vinegar. Still, these treatments also have the potential to injure the pallid manzanita. Hand grubbing is an effective way to control the plant, but requires people willing to risk exposure to poison oak. An effort to cut back and grub poison oak within the site, and particularly near seedlings took place in 2019 but this effort needs to be resumed in 2020. Poison oak sprouts can grow back quickly and are persistent. Continued research into the safest and most effective methods of poison oak removal will continue in 2020.

4.5 CONTINUED TREE REMOVAL IN PALLID MANZANITA HABITAT AREA

Continued tree removal on the site will improve habitat for the pallid manzanita. The HECP specifies that tree removal should occur in a phased manner to gradually expose the pallid manzanitas to increased sunlight and avoid a drastic change of environment on site, which may result in pallid manzanita mortality. We recommend that tree removals proceed not in a phased approach, but with the goal of removing as many trees as possible at one time, since phased tree removal becomes more difficult as more and more pallid manzanita seedlings begin to germinate. It seems highly likely that tree removals around the current pallid seedling populations would result in an increased number of seedlings and site expansion following the cleared areas. Unfortunately, currently there is no funding for additional tree removals. If tree removal were to be funded, we recommend starting with a pilot set of trees (10-20% of the total to be removed) to observe site and vegetation impacts of this procedure.

4.6 MAINTENANCE AND MONITORING OF GERMINATION PLOTS

FOSC no longer monitors the germination plot experiments that were established in 2016 as enough time has passed to have seen results. The site was last surveyed in March/April of 2018 and no germination was observed.

4.7 MONITORING OF NATURALLY RECRUITED PALLID MANZANITA SEEDLINGS

In Year 5, seedling data should be analyzed for changes in height and changes in vigor class to help determine chances of survivorship and time to maturity. Importantly, reviewing the entire data set will allow us to see trends for survivorship.

To negate inconsistencies in seedling monitoring data, we will strive to recruit individuals to join a Pallid Crew and participate in a monitoring training such as was conducted in 2018 and 2019. A spreadsheet containing the previous year's data has been managed by FOSC since 2017 and should be updated shortly after monitoring. This spreadsheet could be printed out for the monitoring workday so that observers will be able to discern possible errors at the point of data collection and inconsistencies may be addressed and resolved immediately.

Given the limited volunteer force available, it will likely not be possible to conduct two complete seedling censuses as originally intended. The past several years monitoring has been conducted in April to ensure that seedlings are relocated and flagged before volunteer workdays begin, though it is recommended that the census be conducted in September-October when the majority of senescence will have occurred. In July, it is recommended that a small group of FOSC staff and/or volunteers work closely with consulting biologist Lech Naumovich to monitor a subsample of seedlings including all of those assigned a vigor class of 1 and 2 (poor and fair respectively) and 15 of those considered to be in vigor class 3 in the previous year. The objectives of this exercise will be twofold: to provide training to people who will be responsible for teaching volunteer observers completing the seedling census later in the year; to gather data that may help answer the following questions:

- Is there a correlation between seedling size and senescence?
- Is there a critical time in the season when senescence occurs?
- Once seedling vigor has deteriorated, is it possible for them to rebound?

In future monitoring, it is crucial that data are collected on all seedlings. Notes should be made for every individual that was not relocated, as well as individuals found to be deceased so that all seedlings are accounted for.

4.8 MAINTENANCE OF NATURALLY RECRUITED PALLID MANZANITA SEEDLINGS

No irrigation for the pallid manzanita seedlings has occurred or is planned for the future. Summer watering is especially not recommended as it appears to contribute to unintended mortality in manzanita species. The pallid manzanitas will continue to be observed in 2020 by FOSC staff and volunteers. If high summer mortality is observed in seedlings, shade structure installation will be considered for the following spring. However, seedling monitoring data collected in 2019 did not indicate a clear need to provide additional shading for seedlings of a particular height or vigor class.

If shading is elected in the future, it is recommended to shade only a small number of the seedlings in each height class or location so as to not negatively impact all seedlings. Shade structure design may affect seedlings, as could the timing of shelter installation; it is advised for installation to occur in February if conditions permit (i.e. soil is not too damp as to promote *Phytophthora* spread), or no later than April after which time heat and drought stress becomes acute.

No germinated seedlings will be transplanted to other areas in the potential habitat zone since transplanting of manzanitas is generally not successful and will likely result in death.

4.9 VEGETATION MONITORING

During both Year 1 and 2 of vegetation monitoring, random placement of transects resulted in a concentration of data points in the southeast area of the site. Furthermore, randomly placed transects do not provide for the same degree of consistent comparison as do evenly spaced lines that cover every part of the site. In order to capture data that are most representative of the entire site and allow for meaningful comparisons over time, the protocol was modified in 2018 so that a permanent baseline was set, as well as the protocol of transect placements at 30 feet intervals (so chosen to get about eight, seven in 2019, evenly spaced transect lines every year). A 2018 reporting error noted that transect lines would remain permanent. While the datum line will be permanent, transect lines will change slightly every year when a new randomly selected starting point is used to get more accurate overall site averages. After a random start point is chosen, the transects will be placed 30 feet apart from this starting point for a systematic sampling scheme. As mentioned in 2018 reporting, the start point for the baseline (0 feet) is a permanent landmark: the coast live oak located immediately south of the West Ridge Trail at the eastern edge of the pallid site.

In 2020, the height categories of “<1 meter,” “1-2 meters,” and “>2 meters” should continue to be utilized instead of the original life form.

Lastly, it is critical that photos are taken of each transect at the time they are established and likewise that photos are taken of data sheets on the day of monitoring in case these papers are misplaced or damaged.

4.10 PHOTOPOINT MONITORING

Photopoint monitoring should be aligned with the vegetation monitoring. For subsequent monitoring years, this data collection will occur in June when the greatest number of annual and perennial plants are at peak phenology. It is also important that photos are taken at the same time each year to allow for meaningful comparison of the site over time. Lastly, photos should be taken at the time of day when glare is least prominent. Glare can easily render the photos useless. It is recommended that photos be taken when the sun is more directly overhead.

As indicated in section 3.5, only eight of the 12 photopoints established in Year 1 were found in 2018 due to lack of access to a GPS unit with adequate accuracy to locate the photopoint coordinates. In 2020, Pallid Crew volunteers will be given coordinates and photos from Year 1 and asked to help find all 12 points. These points will immediately be marked on a site map over which a grid will be laid. Replacing the current rebar posts that are less than one foot tall with taller posts or more visible caps will also be considered. The photographer will be asked to try to match the frame of the extents of the Year 1 photos (i.e., camera angle and zoom) so that the images can be meaningfully compared.

4.11 INDIVIDUAL PLANT PHOTO MONITORING

In 2020 photo monitoring of the two living mature pallids from 2016 will occur (individual one has completely died and will not be photographed). As was done in Year 1, photographs should be taken of each individual plant from four directions so as to achieve a thorough qualitative assessment of these plants over time.

4.12 PLANTING

We are optimistic that natural germination from the seed bank will be adequate to achieve the HECP performance standards, and therefore will not be pursuing formalized planting plots in Year 5.

4.13 EDUCATION AND OUTREACH

In 2020 as in 2019 FOSC will run a monitoring workshop for all volunteers who will help with monitoring for the year. This workshop will teach proper protocol and methods for quality data collecting.

4.14 FENCING

The occupied pallid manzanita site is adjacent to the West Ridge Trail, which is heavily used by runners, hikers, dog walkers, and bikers. There is no evidence of damage inflicted upon the site by these various users, but inadvertent or intentional damage from people or off-leash dogs remains a concern. It is hoped that an interpretive sign can be completed and installed in 2020 providing critical education for motivating people to stay out of the sensitive habitat. Similarly, fencing installed on the West Ridge Trail along the edge of the pallid manzanita site may help to prevent dogs or people from entering the site and could replace the unsightly orange plastic fencing that has been a placeholder. At this time the only fencing that has taken place was along the parking are of CSSC a part of an Eagle Scout project in 2019. Given the need for city approval and a lack of funding, fencing has been a challenge for FOSC staff to pursue. Methods for incentivizing effective pro-restoration behaviors among trail users will continue to be explored in 2020.

4.15 YEAR 5 MAINTENANCE AND MONITORING SCHEDULE

See Table 8 below.

TABLE 8. RECOMMENDED YEAR 5 MONITORING AND MAINTENANCE SCHEDULE (1/1/2020-12/31/2020)

MONITORING/ MAINTENANCE ELEMENT	JAN – MAR 2020	APRIL 2020	MAY 2020	JUNE 2020	JULY 2020	AUG 2020	SEPT 2020	OCT 2020	NOV - DEC 2020
Individual Mature Plant Monitoring		X						X	
Natural Recruitment Monitoring		X						X	
Vegetation Monitoring				X					
Locate/retake Photo Points				X					
Habitat Improvement Volunteer Work Days (when dry)		X	X	X	X	X	X	X	X

APPENDIX A

Individual Plant, Photo Point, and Point-intercept Photos

APPENDIX A INDIVIDUAL PLANT, PHOTO POINT, AND POINT-INTERCEPT PHOTOS (YEAR 4)

Individual Plant Monitoring: Plant #1. Senesced in 2019

Individual Plant Monitoring: Plant #2. Facing North

Individual Plant Monitoring: Plant #2. Facing East

Individual Plant Monitoring: Plant #2. Facing South

Individual Plant Monitoring: Plant #2. Facing West

Individual Plant Monitoring: Plant #3. Facing North

Individual Plant Monitoring: Plant #3. Facing East

Individual Plant Monitoring: Plant #3. Facing South

Individual Plant Monitoring: Plant #3. Facing West

Photo Point Monitoring

Photo Point Monitoring: Point #1. Facing North

Photo Point Monitoring: Point #1. Facing East

Photo Point Monitoring: Point #1. Facing South

Photo Point Monitoring: Point #1. Facing West

Photo Point Monitoring: Point #2. Facing North

Photo Point Monitoring: Point #2. Facing East

Photo Point Monitoring: Point #2. Facing South

Photo Point Monitoring: Point #2. Facing West

Photo Point Monitoring: Point #3. Facing North

Photo Point Monitoring: Point #3. Facing East

Photo Point Monitoring: Point #3. Facing South

Photo Point Monitoring: Point #3. Facing West

Photo Point Monitoring: Point #5. Facing North

Photo Point Monitoring: Point #5. Facing East

Photo Point Monitoring: Point #5. Facing South

Photo Point Monitoring: Point #5. Facing West

Photo Point Monitoring: Point #6. Facing North

Photo Point Monitoring: Point #6. Facing East

Photo Point Monitoring: Point #6. Facing South

Photo Point Monitoring: Point #6. Facing West

Photo Point Monitoring: Point #7. Facing North

Photo Point Monitoring: Point #7. Facing East

Photo Point Monitoring: Point #7. Facing South

Photo Point Monitoring: Point #7. Facing West

Photo Point Monitoring: Point #9. Facing North

Photo Point Monitoring: Point #9. Facing East

Photo Point Monitoring: Point #9. Facing South

Photo Point Monitoring: Point #9. Facing West

Photo Point Monitoring: Point #10. Facing North

Photo Point Monitoring: Point #10. Facing East

Photo Point Monitoring: Point #10. Facing South

Photo Point Monitoring: Point #10. Facing West

Point-intercept Photos

Point-intercept Photos: Transect #1

Point-intercept Photos: Transect #2

Point-intercept Photos: Transect #3

Point-intercept Photos: Transect #4

Point-intercept Photos: Transect #5

Point-intercept Photos: Transect #6

Point-intercept Photos: Transect #7

APPENDIX B

Data Sheet Templates

APPENDIX B DATA SHEET TEMPLATES

On the following pages are the data sheet templates:

Pallid Manzanita Individual Plant Monitoring

Data Form for Seed Germination Experiment

Data Form for Seed Bank Germination Experiment

Vegetation Monitoring: Point Intercept

Vegetation Monitoring: Non-Native Species List

Pallid Manzanita Monitoring: Photo Points

Pallid Manzanita Individual Plant Monitoring

Location: _____ Date: _____ Observers: _____

Plant ID	Height (ft., inches)	Crown (ft., inches)	Vigor Rank 1-3	Notes

Vigor
3 = healthy: dense foliage, no spotting or discoloration of leaves
2 = some leaf spotting or dieback (dieback is mortality beginning at terminal portion or tip of branch)
1 = unhealthy: sparse foliage, pronounced spotting and dieback
Height: Measure to highest live foliage
Crown diameter: If not single-stem
Seedling Flush: note height range and average, estimated number of individuals

Data Form for Seed Germination Experiment

Smoke Treatment   Control (no treatment)

Date:__/___/___ Observers:__________________________ Photos:_________________

Plot ID:_____

Stake						Stake
Stake						Stake

Plot ID:_____

Stake						Stake
Stake						Stake

Plot ID:_____

Stake						Stake
Stake						Stake

Plot ID:_____

Stake						Stake
Stake						Stake

Notes:

Data Form for Seed Bank Germination Experiment

NL : No litter C : Control BW : Burnt Wood

Date:__/___/___ Observers:_____ Photos:_____

Plot ID: 100

C	NL	BW

Plot ID: 25

NL	BW	C

Plot ID: 30

BW	NL	C

Plot ID: 31

BW	NL	C

Plot ID: 33

NL	C	BW

Plot ID: 32

C	BW	NL

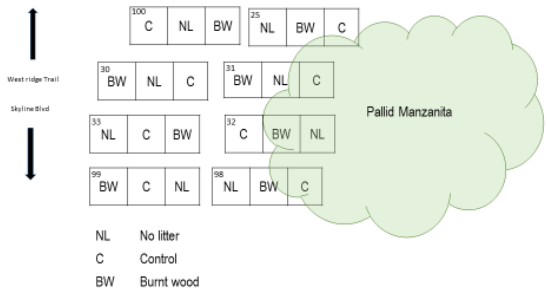
Plot ID: 99

BW	C	NL

Plot ID: 98

NL	BW	C

Notes:



Pallid Manzanita Monitoring

Vegetation Monitoring: Point Intercept

Date _____ Photo Points _____

Transect Line _____ Transect Location _____

Observer _____ Recorder _____

Pt. (feet)	> 2 m	1-2 m	< 1 m	Soil Surface	Pt. (feet)	> 2 m	1-2 m	< 1 m	Soil Surface
	Species Codes					Species Codes			
2					52				
4					54				
6					56				
8					58				
10					60				
12					62				
14					64				
16					66				
18					68				
20					70				
22					72				
24					74				
26					76				
28					78				
30					80				
32					82				
34					84				
36					86				
38					88				
40					90				
42					92				
44					94				
46					96				
48					98				
50					100				

Unknown Species Codes

T=Tree

S=Shrub

F=Forb

G=Grass

Soil Surface Codes

R=Rock

B=Bare

L=Litter

Species Code

For the speceis code use the fist two letters of the genus and the first two letters of the speceis. For example *Arctostaphylos pallida* would be ARPA

Pallid Manzanita Monitoring

Vegetation Monitoring: Non-Native Species List

non-native species

competing with pallid manzanitas

Speceis	Notes

Pallid Manzanita Monitoring

Photo Points

Observer _____

Date _____

Photo Point ID	Notes

APPENDIX C

Raw Transect Line Data

APPENDIX C RAW TRANSECT LINE DATA (YEAR 4)

TABLE A-1. RESULTS OF VEGETATION MONITORING TRANSECT LINE #1 (7/22/2019, 32')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2			CYNECH+	L
4			RUBURS*	B
6			RUBURS*	L
8			BRIMAX+	L
10			RUBURS*	L
12			CARPYC+	L
14			CARPYC+	L
16			LONHIS*	L
18			CARPYC+	L
20			RUBURS*	L
22			LONHIS*	L
24			EHRERE+	L
26			ELYGLA*	L
28			ELYGLA*	L
30			RUBURS*	L
32			BRIMAX+	L
34			BRIMAX+	L
36			GASPHL+	L
38			ELYGLA*	L
40				L
42			RUBURS*	L
44			ELYGLA*	L
46			ELYGLA*	L
48			RUBURS*	L
50			DIPAUR*	L
52			DIPAUR*	L
54			RUBURS*	L
56			RUBURS*	W
58			EHRERE+	L
60			RUBURS*	L
62			AIRCAL+	L
64	SEQSEM*		AIRCAL+	L
66	SEQSEM*		AIRCAL+	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
68	SEQSEM*		ELYGLA*	L
70	SEQSEM*		ARCPAL*	L
72	SEQSEM*		RUBURS*	L
74	SEQSEM*		BRIMAX+	W
76	SEQSEM*		EHRERE+	B
78	SEQSEM*		RUBURS*	L
80	SEQSEM*		RUBURS*	L
82			RUBURS*	L
84			LONHIS*	L
86			RUBURS*	L
88			RUBURS*	L
90			RUBURS*	L
92		FRACAL*	RUBURS*	L
94	SEQSEM*	FRACAL*	RUBURS*	L
96	SEQSEM*	FRACAL*	RUBURS*	L
98	SEQSEM*	FRACAL*	FRACAL*	L
100	SEQSEM*	FRACAL*	RUBURS*	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-2. RESULTS OF VEGETATION MONITORING TRANSECT LINE #2 (7/22/2019, 62')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2			BRIMAX+	
4			CYNECH+	
6			BRODIA*	L
8			BRIMAX+	L
10			CARPYC+	L
12			BRIMAX+	L
14				L
16			BROCAR*	L
18		DIPAUR*	DIPAUR*	L
20		DIPAUR*	DIPAUR*	L
22			DIPAUR*	L
24				L
26			DIPAUR*	L
28			DIPAUR*	L
30			BRODIA*	L
32				B
34			BRODIA*	L
36			BROCAR*	L
38			BROCAR*	L
40			FESMYU+	L
42			ARCPAL*	L
44			PHACAL*	L
46			PHACAL*	L
48			BRIMAX+	L
50			ELYGLA*	L
52			BROCAR*	L
54			CYNECH+	
56			BROCAR*	L
58			BROCAR*	L
60			BROCAR*	L
62			BROCAR*	L
64			ELYGLA*	L
66			TORARV+	L
68			RUBURS*	L
70			RUBURS*	L
72			RUBURS*	L
74			RUBURS*	L
76			ELYGLA*	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78			RUBURS*	L
80			RUBURS*	L
82			LONHIS*	L
84			RUBURS*	L
86			CHLDOU*	L
88			QUEAGR*	L
90			RUBURS*	L
92			RUBURS*	L
94			CHLDOU*	L
96			EHRERE+	L
98	PINRAD+		EHRERE+	L
100	PINRAD+		TOXDIV*	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-3. RESULTS OF VEGETATION MONITORING TRANSECT LINE #3 (7/22/2019, 92')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2		BACPIL*	BACPIL*	L
4		BACPIL*	BACPIL*	L
6		BACPIL*	BACPIL*	L
8				W
10				L
12				L
14			CARPYC+	L
16			LONHIS*	L
18			LONHIS*	L
20			BRIMAX+	L
22			LONHIS*	L
24			BRIMAX+	L
26				L
28			CYNECH+	L
30			CYNECH+	L
32			DIPAUR*	L
34		BACPIL*	ARCPAL*	R
36		QUEAGR*	ARCPAL*	L
38		DIPAUR*	ARCPAL*	L
40			DIPAUR*	L
42			ARCPAL*	L
44			ARCPAL*	L
46		ARCPAL*	ARCPAL*	L
48			ARCPAL*	L
50				L
52		UNK+	ELYGLA*	L
54			UNK+	L
56			TORARV+	L
58			TOXDIV*	L
60			RUBURS*	L
62			RUBURS*	L
64			ARCPAL*	L
66		ARCPAL*	ARCPAL*	L
68			QUEAGR*	W
70			RUBURS*	L
72			TOXDIV*	L
74			LONHIS*	L
76			CYNECH+	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78				L
80			QUEAGR*	L
82			CYNECH+	B
84			BACPIL*	L
86			LONHIS*	L
88			QUEAGR*	L
90		QUEAGR*	QUEAGR*	L
92			LONHIS*	W
94			TORARV+	L
96			RUBURS*	L
98	QUEAGR*	QUEAGR*	DIPAUR*	L
100			DIPAUR*	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-4. RESULTS OF VEGETATION MONITORING TRANSECT LINE #4 (7/22/2019, 122')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2			HIRINC+	L
4			ARTDOU*	L
6		BACPIL*	LONHIS*	L
8		BACPIL*	ARTDOU*	L
10				L
12			LONHIS*	L
14			ARTDOU*	L
16		HIRINC+	ARTDOU*	L
18		PSECAL*	LONHIS*	L
20			CARPYC+	L
22			HIRINC+	L
24			DIPAUR*	L
26		DIPAUR*	DIPAUR*	L
28		ARBMEN*	LONHIS*	L
30		ARBMEN*	LONHIS*	L
32			LONHIS*	L
34			AIRCAL+	L
36			BRODIA+	L
38			BRODIA+	L
40			TORARV+	L
42			BRODIA+	L
44			BRODIA+	L
46				L
48			SILGAL+	L
50			PSEBEN*	L
52			RUBURS*	L
54		ELYGLA*	BRODIA+	R
56		ELYGLA*	ELYGLA*	L
58			HIRINC+	W
60		BROCAR*	TOXDIV*	W
62			ELYGLA*	L
64			ELYGLA*	W
66			TORARV+	Tarp
68			RUBURS*	L
70			RUBURS*	L
72			QUEAGR*	L
74			RUBURS*	L
76			AVEBAR+	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78			CLIDOU*	L
80			TOXDIV*	L
82			ELYGLA*	L
84			RUBURS*	L
86			CLIDOU*	L
88			LONHIS*	L
90			CLIDOU*	L
92			CLIDOU*	L
94	QUEAGR*		RUBURS*	L
96	QUEAGR*		LONHIS*	L
98	QUEAGR*		TOXDIV*	L
100	QUEAGR*			L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-5. RESULTS OF VEGETATION MONITORING TRANSECT LINE #5 (7/22/2019, 152')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2		SEQSEM*	UNK+	L
4		SEQSEM*	ACEMAC*	L
6	SEQSEM*	SEQSEM*	RUBURS*	L
8		SEQSEM*	CARPYC+	L
10		SEQSEM*	SEQSEM*	L
12		ARTDOU*	ARTDOU*	L
14			UNK+	L
16			RUBURS*	L
18			CYNECH+	L
20	UMBCAL*		GENMON+	L
22	UMBCAL*		UNK+	L
24	UMBCAL*		QUEAGR*	L
26	UMBCAL*		LONHIS*	L
28	UMBCAL*		TOXDIV*	L
30		BROCAR*	BROCAR*	L
32			AIRCAL+	L
34			LONHIS*	L
36			RUBURS*	L
38				L
40				W
42		ELYGLA*	RUBURS*	B
44		ELYGLA*	UMBCAL*	L
46			RUBURS*	L
48			CLIDOU*	L
50			RUBURS*	L
52			MADSAT*	L
54			MADSAT*	L
56			MADSAT*	L
58		ELYGLA*	CYTSCO+	L
60		ELYGLA*		Tarp
62				Tarp
64			CYNECH+	L
66			CYNECH+	L
68			CYTSCO+	L
70			CYNECH+	L
72			RUBURS*	L
74			RUBURS*	L
76			CYNECH+	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78			CYNECH+	L
80			CYNECH+	L
82			BROCAR*	Tarp
84				Tarp
86		ELYGLA*	CYNECH+	L
88			RUBURS*	L
90			RUBURS*	L
92			CYTSCO+	L
94			CYNECH+	L
96			TOXDIV*	L
98			CYTSCO+	L
100			CYTSCO+	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-6. RESULTS OF VEGETATION MONITORING TRANSECT LINE #6 (7/22/2019, 182')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2	SEQSEM*		EHRERE+	L
4	SEQSEM*		RUBURS*	L
6	SEQSEM*		EHRERE+	L
8	SEQSEM*		RUBURS*	L
10	SEQSEM*	SEQSEM*	RUBURS*	L
12	SEQSEM*		EHRERE+	L
14	SEQSEM*		RUBURS*	L
16			UMBCAL*	L
18			EHRERE+	L
20		TOXDIV*	RUBURS*	L
22			TOXDIV*	L
24			TORARV+	L
26			RUBURS*	L
28			TORARV+	W
30			RUBURS*	W
32			BROCAR*	L
34			RUBURS*	L
36			RUBURS*	L
38			BROCAR*	L
40			BROCAR*	L
42			BROCAR*	L
44			BACPIL*	L
46		BROCAR*	BROCAR*	L
48		BROCAR*	GENMON+	L
50			BROCAR*	L
52		ELYGLA*	ELYGLA*	L
54		ELYGLA*	BROCAR*	L
56			BROCAR*	L
58			BROCAR*	L
60		ELYGLA*	ELYGLA*	L
62	QUEAGR*	ELYGLA*	RUBURS*	L
64	QUEAGR*		BROCAR*	L
66	QUEAGR*	BROCAR*	BROCAR*	L
68	QUEAGR*	BROCAR*	CYTSCO+	L
70	QUEAGR*	BROCAR*	BROCAR*	L
72	QUEAGR*		ELYGLA*	L
74	QUEAGR*		BROCAR*	L
76	QUEAGR*		TOXDIV*	L

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78			TOXDIV*	L
80			TOXDIV*	L
82			RUBURS*	L
84				Tarp
86				Tarp
88			TOXDIV*	Tarp
90			RUBURS*	L
92			ELYGLA*	L
94			RUBURS*	L
96			RUBURS*	L
98			LONHIS*	L
100			RUBURS*	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

TABLE A-7. RESULTS OF VEGETATION MONITORING TRANSECT LINE #7 (7/22/2019, 212')

POSITION (FT.)	TOP CANOPY/TREE	SHRUB	GRASS/FORB	SOIL SURFACE
2	SEQSEM*		BRIMAX+	L
4	SEQSEM*	BROCAR*	BROCAR*	L
6	SEQSEM*		RUBURS*	L
8	SEQSEM*		RUBURS*	L
10	SEQSEM*		TORARV+	L
12			TORARV+	W
14			TORARV+	L
16			PTEAQU*	L
18			PTEAQU*	L
20				
22			RUBURS*	L
24			MADSAT*	L
26		BACPIL*	BACPIL*	L
28		BACPIL*	BACPIL*	L
30			PTEAQU*	L
32			MADSAT*	L
34		ELYGLA*	MADSAT*	L
36		MADSAT*	BACPIL*	L
38			MADSAT*	L
40		BACPIL*	BACPIL*	L
42		BACPIL*	BACPIL*	L
44		BACPIL*	BACPIL*	L
46		BACPIL*	BACPIL*	L
48			RUBURS*	L
50			MADSAT*	L
52			MADSAT*	L
54			RUBURS*	L
56			QUEAGR*	L
58		QUEAGR*	QUEAGR*	L
60		RUBURS*	RUBURS*	L
62			RUBURS*	L
64			TOXDIV*	L
66			TORARV+	L
68			RUBURS*	L
70			BROCAR*	L
72		ELYGLA*	BROCAR*	L
74			RUBURS*	L
76			RUBURS*	W

Position (ft.)	Top Canopy/Tree	Shrub	Grass/Forb	Soil Surface
78			LONHIS*	L
80			RUBURS*	L
82			MADSAT*	L
84			MADSAT*	L
86			MADSAT*	L
88			LONHIS*	L
90			RUBURS*	L
92			MADSAT*	L
94			RUBURS*	L
96			ELYGLA*	L
98			LONHIS*	L
100			CYTSCO+	L

* A species that is native to California.

+ A non-native species that has an origin other than that of California

Species Key for Transect Data:

Code	Binomial
ACADEA	*Acacia dealbata*+
AGRPAL	*Agrostis pallens**
AIRCAL	*Aira caryophyllea*+
ARTDOU	*Artemisia douglasiana**
ARBMEN	*Arbutus menziesii**
ARCPAL	*Arctostaphylos pallida**
AVEBAR	*Avena barbata*+
BACPIL	*Baccharis pilularis**
BROCAR	*Bromus carinatus**
BRODIA	*Bromus diandrus*+
BRIMAX	*Briza maxima*+
CARPYC	*Carduus pycnocephalus*+
CARSUB	*Carex subbracteata*'*
CIRVUL	*Cirsium vulgare*+
CHLPOM	*Chlorogalum pomeridianum**
CLIDOU	*Clinopodium douglasii**
CONMAC	*Conium maculatum*+
COTPAN	*Cotoneaser pannosus*+
CYNECH	*Cynosurus echinatus*+
ELYGLA	*Elymus glaucus**
EHRERE	*Ehrharta erecta*+
EUCGLO	*Eucalyptus globulus*+
FESCAL	*Festuca californica**
FESMYU	*Festuca Myuros*+'*
FRACAL	*Frangula californica**
GASPHL	*Gastridium phleoides*+
GENMON	*Genista monspessulana*+

Code	Binomial
HIRINC	*Hirschfeldia incana*
LACSER	*Lactuca serriola*+
LONHIS	*Lonicera hispidula**
MADSAT	*Madia sativa*'*
MELCAL	*Melica californica*'*
MIMAUR	*Mimulus aurantiacus**
PHACAL	*Phacelia californica**
PINRAD	*Pinus radiata*+
PSECAL	*Pseudognaphalium californicum**
PSEMEN	*Pseudotsuga menziesii**
PSERAM	*Pseudognaphalium ramosissimum*'*
PTEAQU	*Pteridium aquilinum var. pubescens*'*
QUEAGR	*Quercus agrifolia**
RUBARM	*Rubus armeniacus*+
RUBURS	*Rubus ursinus**
SAMNIG	*Sambucus nigra*'*
SANBIP	*Sanicula bipinnatifida**
SANCRA	*Sanicula crassicaulis**
SEQSEM	*Sequoia sempervirens**
SPAJUN	*Spartium junceum*+
STIPUL	*Stipa pulchra**
STARIG	*Stachys rigida**
TORARV	*Torilis arvensis*+
TOXDIV	*Toxicodendron diversilobum**

* A species that is native to California.
+ A non-native species that has an origin other than that of California
' Added in 2018

Unknown Species Codes
T= Tree
S = Shrub
F = Forb
G = Grass

Soil Surface Codes:
R = Rock
B = Bare
L = Litter
W = Wood

APPENDIX D

Raw Natural Recruitment Monitoring Data

APPENDIX D RAW SEEDLING DATA (YEAR 4)

TABLE D-1. RESULTS OF SEEDLING MONITORING (APRIL-JULY 2019)

ID	Height (in) April-July 2019	Crown Diameter (in) April-July 2019	Vigor April-July 2019
102	44.5	33	3
103			
104	20.5	13	0.5
105	58.5	53.5	2
106	56	63.5	3
107	36	15	3
108	58.5	43	3
109	52	45.5	3
112			
113	48.5	48.5	3
114			
115	119.5	71	2
116	30.5	28	3
117	58.5	48	3
118	33	12	2.5
119			
121	29	12.5	3
200			
201			
202			
203	98	68.5	3
204	Dead		0
205	37	15	3
206	107	84	3
207	102	81.5	3
208			
301	38	23	3
302	142	84	3
303			
304			
305			
306			
307			
308			
309			
310	53.5	40.5	3

311	112	145	3
312			
313			
314			
315			
316	Dead		0
317			
318			
319	Dead		0
320	Dead		0
321			
322			
323			
324			
325			
326			
327			
328			
329			
330			
332			
333			
334			
335			
400	82.5	78.5	3
401	114.5	94	2
402	104	119.5	3
403			
404	62.5	60	3
405	48	40.5	3
406	56	37	3
407	59.5	45.5	3
408	38.5	24	3
409	115	76	3
410			
411			
412	89	101.5	3
413	84.5	45.5	3
414	60.5	42	3
415	93	84	3
500	63.5	51	3
501			
502			
503	66	35.5	3
504	91.5	38	3

505	91.5	45.5	3
508	58.5	15	2
512	25.5	30.5	3
513	63.5	25.5	3
518			
524	29	19	3
525	72.5	37	3
529	49.5	73.5	3
530	43	42	3
536	33.5	23	3
538	48.5	39	3
539	49.5	61	3
541	57.5	42	3
542	114.5	114.5	3
543	117	129.5	3
544	141	117	3
545	131	127	3
546	35	30	2.5
547	68.5	42	3
549	86.5	61	3
601	172.5	211	3
602	47	44.5	3
603	68.5	38	3
605	68.5	48	3
606			
607	76	28	3
608	48.5	15	2
609			
610	61	33	3
611	76	56	3
612	76	28	3
613	75	28	3
614	61	66	3
615	81.5	71	3
616			
617			
618	96.5	70	3
619			
620			
621			
622			
623			
624			
625			
626			

627			
628			
629			
630			
631			
632			
633			
634			
635			
636			
637			
638			
639	78.5	38	3
640	38	18	3
641	43	33	3
642	89	63.5	3
643	70	30.5	3
644	43	23	3
645	67.5	20.5	3
647			
800	28	10.5	2
801			
802	37	29	2
803	71.5	62	3
804	63.5	28	3
805			
806	37.5	10	3
807	33	8.5	3
808	31	22	3
809	23	17	3
810	30.5	12.5	3
811	47	29	3
812	21	43	2
901	81.5	37	3
902	68.5	35.5	3
903	82.5	48.5	3
904	53.5	53.5	3
905	32	15	3
906	80	71	3
907	98	42	3
908	83	40	3
909	44	18	2
910	36	9	2.5
911	22	10	2.5
912	15	8	3

913	38	14	3
914	22	30	2
915	21	6	2

SPACES LEFT INTENTIONALLY BLANK INDICATE PLANTS THAT WERE NOT RELOCATED.

PLANTS WHICH ARE LABELED N/A IN "CROWN DIAMETER" ARE SINGLE STEMMED PLANTS.