Arana Gulch Habitat Management Plan
City of Santa Cruz

Year 6 (2019) Annual Report

CDFW Permit No. 2081 (a)-13-013-RP
CDFW Permit No. 2081 (a)-18-016-RP
Coastal Development Permit No. 3-11-074 (Arana Gulch)

February 28, 2020

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1. Executive Summary

This monitoring report evaluates the City's progress implementing the Arana Gulch Habitat Management Plan (HMP). The HMP guides the long-term restoration of the 67-acre Arana Gulch Open Space. The plan provides management goals and objectives to enhance three specific management areas: Hagemann Gulch Riparian Woodland Management Area, Arana Creek Wetland and Riparian Management Area and the Coastal Prairie/Tarplant Management Area.

The HMP was developed as part of the California Coastal Commission's (CCC) Coastal Development Permit process for the adoption of the Arana Gulch Master Plan (Master Plan). The Master Plan includes management guidelines for access, resource management, and education. Since Arana Gulch lies within the CCC's Coastal Zone, a permit was necessary to implement the Master Plan. The CCC conditionally approved the permit on December 8, 2011. Special permit conditions required, among other things, developing and implementing an HMP, establishing a technical advisory group to advise the City on habitat management actions, and submitting annual monitoring reports to document compliance with the HMP.

The City finalized and began implementing the HMP in 2013. A technical advisory group was formed, the Adaptive Management Working Group (AMWG). Actions outlined in the HMP were initiated in 2013 and 2014 and continued in 2015-2019; these actions are described in the Year 1 (2014), Year 2 (2015), Year 3 (2016), Year 4 (2017), and Year 5 (2018) Annual Reports. Actions implemented in Year 6 (2019) are described in this report. The AMWG provided input to the City during the implementation of the Year 6 activities.

The purpose of this annual report is to describe the current condition of the Arana Gulch habitat areas, evaluate the performance of each area in relation to the interim performance standards outlined in the HMP and included in the CDP, and provide management recommendations for the following year to ensure progress toward and achievement of success criteria. In Year 6 (2019), the City continued to focus on improving the habitat of the Santa Cruz tarplant (SCT), a federally Threatened and a California State Endangered species. The City continued seasonal cattle grazing and continued to implement management to control invasive weeds from the prairie/tarplant management area. SCT seed, collected on-site in summer 2018 under an agreement between the City and the University of California, Santa Cruz (UCSC), was used to grow plants for seed increase and for long-term seed storage. In November, scrape plots were created in historical SCT areas to stimulate SCT seed expression. In addition, the City employed the services of staff and a restoration work crew to continue removal and control of invasive weeds in the Arana Gulch Creek and Hageman Gulch Management Areas. All of these actions taken by the City are to continue progress to meet the HMP objectives. The habitat management activities undertaken in 2019 are summarized below.

Master Plan Improvements

In 2019 the City implemented maintenance of the Coastal Prairie Loop Trail, the Arana Gulch Multi-Use Trail, and the Agnes Street Connector Trail. Plans were developed to repair a section of the Marsh Vista Trail.

Trail construction over Hagemann Gulch and Arana Creek affected riparian woodland and in 2014 the City prepared a revegetation plan pursuant to a CDFW Streambed Alteration Agreement. Revegetation at/around Arana Creek was installed in January and February 2015 by City staff and volunteers; additional plants were installed in February 2016. City staff maintained these plantings throughout 2019.

Summary of Coastal Prairie/Santa Cruz Tarplant Management Area Activities

Management actions in Year 6 included seasonal grazing and seasonal mowing. As per a grazing contract and Stocking and Work Program prepared in 2014, the City continued to contract with a local rancher for seasonal grazing. Cattle grazing commenced on December 23, 2018 and extended to July 10, 2019. Additional activities in this management area included monitoring plant composition, plant cover, canopy height, and residual dry matter (RDM) within grazed areas, implementing removal/control of invasive weed infestations, and documenting site conditions at previously established permanent photo stations. Cattle-rubbing posts installed in 2016 were monitored to see if cattle congregation created bare areas for SCT; a small area of bare ground was found around these posts. In June, a molasses bucket was placed within the southern portion of Area A to create bare ground to aid in SCT seed expression. Areas where gravel was removed from Area C in December 2016 were monitored for native plant recovery; widely spaced coast tarweed (*Deinandra corymbosa)* continue to colonize these areas in 2019. A scrape plot was created at the trail junction (small island) to stimulate coast tarweed seed expression.

Prairie site conditions were documented in April 2019 with plant species composition and cover values recorded at permanent transects. Photo-documentation was also conducted in April. Documentation of the Year 6 conditions, using permanent transects was done in compliance with the HMP. In coordination with the AMWG, sub-management areas were identified to reflect the various plant species composition, as well as presence/absence of SCT, that may direct future management and monitoring. Canopy heights were measured in February, May, and December. Additionally, residual dry matter was assessed in October. The data was collected amid a slightly above average rainfall season.

As per guidelines in the HMP, seasonal mowing was conducted for grassland/prairie areas located outside the grazing fences between January and December (Tarplant Area B) and in June and July (all other areas) to reduce the canopy height of the non-native grasses and forbs to benefit the coastal prairie species diversity and habitat function. A flail mower was used. Bird surveys were completed prior to mowing and no nests were

observed. Buffer areas were created near the wooded areas and islands were left in the drainage areas to ensure to maintain some tall grass for birds to hide and nesting as per recommendations from the Santa Cruz Bird Club. Colonies of native plants were flagged so mowing could avoid these occurrences. Blue bird nest boxes installed in 2018 continued to be monitored by the Santa Cruz Bird Club.

A census of SCT was conducted in summer and early fall 2019; 50 SCT plants were found, a decrease from 267 plants in 2018, yet an increase from 0 plants in 2017 and an increase from 35 plants in 2016. The population was recorded at 18 plants in 2013, 4 plants in 2014, and 0 plants in 2015. Increasing the SCT population to above the 2006 population level of 349 plants[1] is an HMP goal. The 50 SCT plants in 2019 is below the HMP target. The areas where SCT were observed in 2019 were subject to cattle grazing. To date, site management has not resulted in the number of SCT meeting the HMP goal and there was an insufficient number of SCT plants to allow collection of SCT seed. Under an agreement between the City and the University of California, Santa Cruz (UCSC), seed collected from plants in 2018 was used to grow plants for seed increase (for future out-planting) and for long-term seed storage. In September, plant species composition and plant cover in areas supporting SCT was recorded to aid in habitat management. Seven 1-meter square quadrats were established at four SCT sub-colonies within Area A; the data found a dominance of exotic annual forbs and exotic annual grasses. Cover by SCT was 8% (all plots), which is similar to data collected in 2018.

In August, the City and some AMWG members visited SCT populations within Wildcat Canyon Regional Park (East Bay Regional Park District). The District's botanist, Michelle Hammond, described management actions implemented within the SCT populations (year-round rotational cattle grazing, prescribed fire, and direct seeding). The group viewed SCT growing conditions at three colonies.

In November 2019, prior to winter rains, the City implemented management within Areas A, C, and D to facilitate SCT seed expression, using a series of 30x30-foot scrape plots. Six plots were created in Area A and three plots created in Area D. All plots were created within areas having historic SCT expression. In Area C, one 30x50-foot plot was created within that historic SCT area. A box scraper was used to remove the upper 1-2 inches of soil/plant material to create a bare area that would be conducive for SCT seed germination. Material scraped off was retained on site and placed adjacent to each scrape plot.

In compliance with the HMP and an Invasive Weed Work Plan (IWWP) prepared for the management area, City staff continued to remove occurrences of invasive, non-native plant species within the central prairie/grassland. The City continued to remove/control cotoneaster, Himalaya blackberry, and English ivy from the prairie and removed basal

[1] See Section 3.3, Page 52 of Arana Gulch HMP

rosettes and flowering stalks from thistles. A large patch of cotoneaster, located near the harbor entrance trail and the Coastal Prairie Loop Trail that was removed in June 2017 was re-treated in 2019.

Summary of Hagemann Gulch Riparian Woodland and Arana Gulch Creek Riparian Woodland and Wetland Areas Activities

Pursuant to a survey that mapped occurrences of invasive, non-native plant species within the Hagemann Gulch Riparian Woodland and Arana Gulch Creek Riparian Woodland and Wetland Management Areas, City staff and a contracted work crew removed and controlled occurrences of non-native, invasive weeds in both management areas in Year 6. In summer, a contracted work crew removed areas of English ivy (including ivy in the oak trees), French broom, cotoneaster, acacia, eucalyptus sprouts, poison hemlock, and pyracantha from the management areas. The City continued closure of the ad-hoc path along Arana Creek to discourage public access in the natural area. Straw wattles and straw were maintained at the northern end of the trail to reduce the amount of run-off from the Coastal Loop Trail entering Arana Creek.

The Natural History Museum's Earth Steward's Program, a program to teach youth environmental restoration job skills, had two work days with approximately six students who helped remove invasive plants and perform trial work to reduce erosion issues along the Marsh Vista Trail.

Clean-ups from illegal camping activities were performed to remove trash and waste, primarily from the woodland areas. In some instances, vegetation was removed to improve the line-of-sight from the public right-of-way into the area, deterring illegal activity and improving law enforcement patrolling and monitoring. Extensive trash and waste removal occurred near the intersection of Capitola Road and Soquel Drive. Unfortunately, the activities necessitated more staff time and resources to be diverted to daily trash and waste removal. Significant land clearing occurred and the area continued to be destroyed with trash and debris. The inhabitation of the area causes concern for the Federally Endangered steelhead population which was documented in the area while illegal camping activities endured.

City staff cut various invasive vines from the eucalyptus trees in Hagemann Gulch. Staff removed fallen limbs, invasive plants, and limbed up trees to provide for a fire clearance at Hagemann Gulch. The work was not completed in 2019 and is planned to continue in 2020.

Management Activities Proposed for 2020 (Year 7)

The following management actions are identified for 2020:

- Continue seasonal cattle grazing within the prairie/SCT management area, as per the approved grazing contract and Stocking and Work Program. Additional activities in this management area include monitoring plant composition, plant cover and residual dry matter (RDM) within grazed areas, implementing

removal/control of invasive weed infestations, and documenting site conditions at the permanent photo stations. Monitor SCT seed expression in molasses plot created in Area A

- Consider implementing interim grassland management actions (i.e., focused mowing or other management) if cattle grazing is delayed and canopy height levels are above the target objective of 2-3 inches (5-8 cm) between the months of November thru April. Within SCT areas monitor the amount of bare ground present in November/December, which coincides with the germination period of SCT.

- Within the boundaries of the prairie/SCT management area, designated woody plants growing outside of the grazing area, yet within the designated grassland, will continue to be removed and herbicide treatment may need to be applied, if needed to control stump sprouting. Continual treatments will need to be planned and implemented to keep woody plants from encroaching into the prairie. In addition, soil salvage areas created near Area C will be monitored for any expression of SCT.

- A census of SCT will be conducted in summer 2020. Seed collection of SCT may be done if more than 50 SCT are present, pending prior approval from CDFW. Continue relationship with UCSC Greenhouses for seed storage, seed increase and plant propagules. Monitor scrape plots created in Areas A, C, and D for any expression of SCT. Consider out-planting of container stock SCT plants on site. Monitor SCT expression within the 2019 scrape plots and evaluate need for additional management actions to encourage SCT seed expression.

- The City will continue to implement management actions within the Arana Gulch Creek Management Area. Pending funding and staff availability, the City will continue to implement management actions within the Hagemann Gulch Management Area.

- The City will continue to work with the AMWG to form recommendations for improving trail sections to improve walkability and deter new trails from forming.

- The City will continue to confer with the Resource Conservation District (RCD) on Arana Creek watershed management, including measures to reduce erosion and sediment entry into the watershed. The City provides funds to the RCD to apply for grant opportunities to implement erosion control projects.

- The City will continue to confer with the AMWG on adaptive habitat management activities in 2020 through periodic meetings and group email

correspondence. The tentative schedule is to hold AMWG meetings in January/February and June 2020.

- The City will continue to coordinate with the Natural History Museum and conduct educational tours on restoration activities. The Earth Steward's Program will continue to utilize Arana Gulch to teach students environmental restoration job skills. Other opportunities to coordinate with organizations and/or researchers will also be explored.

- The AMWG will finalize recommendations for aligning targets for the prairie, grassland, mixed grassland, and SCT areas.

2. Introduction

2.1 Background

Arana Gulch is 67 acres of open space owned by and located within the City of Santa Cruz. The eastern half of the property features the riparian corridor of Arana Gulch Creek and a tidal wetland where the creek drains into Monterey Bay at the Santa Cruz Harbor. The western half is remnant coastal prairie grassland that supports the Santa Cruz tarplant, a federally Threatened and a California State Endangered species. A steep and narrow intermittent drainage called Hagemann Gulch crosses the property on the western boundary. The features of the greenbelt property are depicted on **Figure 1**.

The City of Santa Cruz developed a master plan for the property to improve natural resource protection and restoration, public access and education. Implementation of the Arana Gulch Master Plan required the City to obtain a coastal development permit (CDP) from the California Coastal Commission because a portion of the planning area lies within the designated Coastal Zone. The CDP (3-11-074) included both standard and special conditions, requiring, among other things, developing the Arana Gulch Habitat Management Plan (HMP) to guide the long-term restoration of the open space. Specifically, Special Condition 3 of CDP 3-11-074 states:

> Arana Gulch Habitat Management Plan. PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the Permittee shall submit for Executive Director review and approval three copies of a final Arana Gulch Habitat Management Plan (HMP). The HMP shall provide for the restoration, enhancement, and long-term management of all Arana Gulch habitat areas (including, as referenced by the Arana Gulch Master Plan, the Coastal Prairie/Tarplant Management Area, the Arana Gulch Riparian and Wetland Management Area, and the Hagemann Gulch Riparian Woodland Management Area) as self-sustaining and functioning habitats in perpetuity. The HMP shall be prepared by a qualified expert in restoration ecology for each of the habitat types, and shall take into account the specific conditions of the site as well as restoration, enhancement, and management goals. The HMP shall be substantially in conformance with the Master Plan documents submitted to the Coastal Commission, including the August 1, 2005 document entitled "A Management Program for Santa Cruz Tarplant (Holocarpha macradenia) at Arana Gulch"), including that it can be submitted in a package that includes relevant Master Plan documentation with an addendum that addresses this condition, provided all language is modified to be directive (e.g., "shall" rather than "should") and it complies with the following requirements and includes:
>
> (a) A baseline assessment, including photographs, of the current physical and ecological condition of the restoration and enhancement areas. All existing topography, wet features, and vegetation shall be depicted on a map.

(b) A description of the goals of the plan, including in terms of topography, hydrology, vegetation, sensitive species, and wildlife usage.

(c) A description of planned site area preparation and invasive plant removal.

(d) Any planting either of seeds or container plants shall be made up exclusively of native taxa that are appropriate to the habitat and Arana Gulch region. Seed and/or vegetative propagules shall be obtained from local natural habitats so as to protect the genetic makeup of natural populations. Horticultural varieties shall not be used.

(e) A plan for monitoring and maintenance of habitat areas in perpetuity, including:

- A schedule.
- A description of field activities, including monitoring studies.
- Monitoring study design for each habitat type, including, as appropriate: goals and objectives of the study; field sampling design; study sites, including experimental/revegetation sites and reference sites; field methods, including specific field sampling techniques to be employed (photo monitoring of experimental/re-vegetation sites and reference sites shall be included); data analysis methods; presentation of results; assessment of progress toward meeting success criteria; recommendations; and monitoring study report content and schedule.
- Adaptive management procedures, including provisions to allow for modifications designed to better restore, enhance, manage, and protect habitat areas.
- Provision for submission of reports of monitoring results to the Executive Director for review and approval in perpetuity, beginning the first year after initiation of implementation of the plan. Such Monitoring Reports shall be submitted annually until success criteria are met, and then shall be submitted on an every 3-year basis after that. Each Monitoring Report (annual and 3-year) shall be cumulative and shall summarize all previous results. Each report shall clearly document the condition of the habitat areas, including in narrative (and supporting monitoring data) and with photographs taken from the same fixed points in the same directions as the baseline assessment and prior Monitoring Reports. Each report shall include a performance evaluation section where information and results from the monitoring program are used to evaluate the status of the restoration, enhancement, and long-term management in relation to the interim performance standards and final success criteria. To allow for an adaptive approach, each report shall also include a recommendations section to address changes that may be necessary in light of monitoring results and/or other information, including with respect to current restoration information and data related to the habitat areas in question, and to ensure progress toward and achievement of success criteria. Actions necessary to implement the recommendations shall be implemented within 30 days of Executive Director approval of each Monitoring Report, unless the Executive Director identifies a different time frame for implementation.

(f) Interim success criteria to be achieved in the first year of implementation, tied directly to the annual reporting requirement. Also, measurable goals to achieve habitat improvement over time, subject to modification by the Adaptive Management Working Group.

(g) Implementation procedures, cost estimates, identification and allotment of funding for all HMP activities, and related reporting procedures.

(h) Provisions for minor adjustments to the HMP by the Executive Director if such adjustments: (1) are deemed reasonable and necessary; and (2) do not adversely impact coastal resources.

(i) Identification of the membership of the Adaptive Management Working Group, which initial composition and any future changes shall be subject to Executive Director approval. The Adaptive Management Working Group shall guide all HMP activities under the plan.

(j) All details associated with the grazing program, subject to Adaptive Management Working Group and Executive Director approval, in substantial conformance with the proposed cattle grazing program (see Exhibit P Tab 4).

PRIOR TO COMMENCEMENT OF CONSTRUCTION, the HMP shall be implemented by establishing the Adaptive Management Working Group (AMWG), receiving prioritized first-year management recommendations from the AMWG, and initiating implementation of the highest priority recommendations in the field.

The Permittee shall undertake development in accordance with the approved Arana Gulch Habitat Management Plan.

The HMP guides management of three habitat areas within Arana Gulch: the Hageman Gulch Riparian Woodland Management Area, the Arana Creek Wetland and Riparian Management Area and the Coastal Prairie/Tarplant Management Area. Within the Coastal Prairie/Tarplant Management Area, the HMP focuses on restoration of the coastal prairie and recovery of the Santa Cruz tarplant (SCT); this management area continued to receive the most attention in Year 6 (2019) due to the urgency to revitalize the SCT population. The population of SCT at Arana Gulch has varied greatly in response to previous management actions; in some years the population increased, and in some years, it dramatically decreased. In 2019 the SCT population decreased to 50 plants from 267 plants in 2018, yet is an increase from 0 plants in 2017. The continued presences of SCT on site is positive and is attributed to site management actions, wherein grass cover has been reduced and more bare ground for SCT seed germination has been created over the past 6 years.

The HMP outlines various management tools for managing the three habitat areas on the site[2]. A key tool described in the HMP is an adaptive management framework for habitat restoration actions. Under this framework, and as required by the CDP, an Adaptive Management Working Group (AMWG) was formed to provide scientific expertise on

[2] See Section 3.1, page 33 of Arana Gulch HMP.

resource management activities to the City and the CCC[3]. In 2019, the AMWG provided input to the City during implementation of several components of the HMP.

Implementation of the HMP coincided with the construction of the Arana Gulch Multi-Use Trail project. Bike paths, hiking trails, cattle grazing infrastructure, and bridges were built within the greenbelt. Most of these features were completed in 2014 and the grazing infrastructure was completed in early 2015. The construction activities associated with the multi-use trail project that are relevant to the restoration effort are fully described in the Year 1 (2014) Annual Report (City of Santa Cruz, November 2015).

This is the 6th annual report since adoption of the HMP and many objectives of the plan have not yet been realized as the long-term habitat management effort is still in its early stages. The report is intended to report on the progress of the plan in the monitoring year, provide a comparison to previous year data and trends, and prepare for future management actions. The reader is directed to previous annual reports for specific details and data implemented in these years. The previous annual reports (e.g., Year 1 [2014] Annual Report, Year 2 [2015] Annual Report, Year 3 [2016] Annual Report, Year 4 [2017] , and Year 5 [2018]Annual Report) are available for review on the City's website (http://www.cityofsantacruz.com/departments/parks-recreation/parks-beaches-and-open-spaces/open-spaces/arana-gulch).

The HMP is grounded in an adaptive management framework. Implementation actions will constantly be reviewed and improved upon. Therefore, this annual report is not intended to lay out every action to be implemented for the upcoming year. It will highlight the actions that have been identified by the City and from AMWG meetings from the monitoring year; however, additional actions may be identified by the City and during AMWG meetings throughout the upcoming year.

[3] See Section 2.2, Page 22 of Arana Gulch HMP.

Figure 1. Location Map

2.2 Project Purpose and Report Organization

The purpose of this annual report is to describe the current condition of the Arana Gulch habitat areas, evaluate the performance of each area in relation to the interim performance standards outlined in the HMP and included in the CDP, and provide management recommendations for the following year to ensure progress toward and achievement of success criteria. In addition to activities approved under the CDP, this report also reports on activities authorized by a Scientific, Educational, or Management Permit issued by the California Department of Fish and Wildlife (Permit No. 2081 (a)-13-013-RP). This report includes all activities conducted in the calendar year 2019 which is considered to be Year 6 pursuant to actions outlined in the HMP and the CDFW 2081(a) permit.

Additionally, this report describes activities associated with the implementation of Arana Gulch Master Plan improvements where such activities intersect with the goals and objectives of the HMP. The City conferred with technical specialists, including AMWG members, regulatory agency personnel, the City of Santa Cruz Planning and Community Development Department, and members of the public while implementing adaptive habitat management activities on the greenbelt.

The adaptive management framework of the HMP is presented in Section 3. The habitat management actions associated with Master Plan improvements are described in Section 4. Actions implementing the HMP are presented in Sections 5 through 7 under their respective management area. Each management area section includes a summary of the implemented actions as they pertain to the goals and objectives in the HMP, and a performance evaluation. Recommendations for Year 7 (2020) are summarized in Section 8. Please refer to the HMP for technical background information on the Arana Gulch greenbelt and HMP goals and objectives. Please refer to previous annual reports (i.e., Year 1 [2014], Year 2 [2015], Year 3 [2016], Year 4 [2017], and Year 5 [2018]) for specific details on actions implemented in those years.

3. Adaptive Management Framework

3.1 Adaptive Working Group (AMWG)

The City adopted an adaptive management framework for implementation of the HMP. The City facilitated and coordinated habitat management activities with the AMWG in 2019. Two meetings were held with the AMWG in 2019; the minutes from the January 24th meeting and May 22nd meetings are presented in **Appendix A**. In addition, the City coordinated and facilitated group email correspondence between AMWG members to solicit input on management activities. The City also facilitated a field trip for AMWG members to see SCT colonies at Wildcat Canyon Regional Park (East Bay Regional Park District). The HMP outlines the formation of the AMWG, voting procedures, and other procedures.[4] The list of current members is presented in the meeting minutes **(Appendix A).** The group is currently soliciting resource professionals for additional membership.

The AMWG provided input to the City on habitat management activities within Arana Gulch throughout 2019. A detailed discussion of AMWG recommendations is included in the sections for each management area and in the meeting minutes. In short, the AMWG provided recommendations on the timing and intensity of seasonal grazing, interest in SCT management actions, and SCT seed storage and increase/out-planting.

3.2 Public Outreach

In 2019 the City maintained a webpage on the City of Santa Cruz website to communicate restoration efforts to the public and to provide a place for documents related to the requirements of the CDP. The City periodically updated the webpage throughout 2019.

The AMWG meetings were open to the public and provided a forum for members of the public to express their ideas directly to the members and City. Public comments were also generated through the City's website and the AMWG was briefed of public comments and concerns during AMWG meetings.

In preparation of the beginning of the grazing season in January 2019, City staff and park rangers spent time on site to discuss the grazing program and the importance of keeping dogs on-leash when they encountered violators of the rule. The City provided a brochure at the Parks and Recreation Department Administration Building informing the public of why grazing was being implemented and listing safety tips for human/dog and cattle interactions. The brochure was also posted on the City webpage. Signage was maintained onsite with a web address for notifying the City on any concerns regarding grazing or other public access issues within the greenbelt. When cattle were on site in 2019 (December 23, 2018 – July 10, 2019), City staff and park rangers provided information to the public on the grazing program through park brochures and on-site conversations. The City coordinated with the Natural

[4] See pages 22-24 of Arana Gulch HMP

History Museum to have the Earth Stewards program perform work at the site. As part of the program, high school aged youth learn about the unique habitat and then perform restoration work at the site.

3.3 Evaluation of Adaptive Management HMP Goals

A goal of the HMP is to maintain an adaptive management framework to allow stakeholders to conduct and evaluate actions. To meet this goal there are two objectives: conduct an annual AMWG meeting and maintain funding levels. In 2019, two meetings were held with the AMWG (January and May) and there was email correspondence with AMWG members to present information and solicit feedback. The City also included AMWG members in a field trip to East Bay Regional Park District's Wildcat Canyon Regional Park to view and discuss management of their SCT population with the EBRPD's botanist. The City dedicated funding to implement the habitat management actions identified in the HMP based on a prioritization recommended by the AMWG in 2014. The City and the AMWG began to re-visit prioritization of the HMP management actions in 2019, but this task was not completed. This task will be continued in 2020 and, if completed, the results of this prioritization will be included in the 2020 annual report.

To meet Objective 1B, the City dedicated Arana Gulch management as a line item in the City Parks and Recreation Departments operating budget. The City also hired a maintenance person that is partially dedicated (80%) to the Arana Gulch greenbelt. The position was filled in January 2016.

A second adaptive management goal is to conduct a two-tracked program of management and research with monitoring. The management actions implemented in 2019, such as seasonal grazing and perimeter seasonal mowing, were monitored to determine their effectiveness in meeting biological variables. The HMP identified a timescale for implementation of the management actions relative to the Santa Cruz tarplant with an objective of increasing the number of aboveground SCT to at least the 2006 level (348 plants) by 2016 (first year after grazing). Although management actions are being implemented to increase the number of aboveground SCT, the project has not met this target. Fifty (50) SCT were observed on site in 2019, which is below the goal. The timescale presented in the HMP for restoration of the coastal prairie or invasive plant control is to progress to a more functioning system by 2020.

The third adaptive management goal is to develop educational opportunities within Arana Gulch, with efforts to conserve and restore its rare resources. The City maintained a web page on the City's website to post information about the HMP and received input from the AMWG and the public consistent with Objective 3A. Additional recommendations for public outreach were identified by the AMWG and the public (i.e., signs for cattle grazing and developing a brochure on cattle grazing) and the City implemented them. **Table 1** presents a summary of the objectives for adaptive management, actions implemented in 2019, and whether the actions were in compliance with the HMP.

Table 1. Monitoring of Adaptive Management Variables

Objective and Variable	Actions in Year 6 (2019)	Year 6 (2019) Results	Objective Met?
Goal 1. Maintain an adaptive management framework that allows stakeholders to scientifically conduct and evaluate actions			
Objective 1A. Conduct at least 3 AMWG meetings in 2013 with a quorum of members present each time. In subsequent years, the frequency of meetings beyond an annual November meeting can be determined by the needs of the AMWG.	Meetings held January 24 and May 22	Meeting minutes presented in Appendix A	Yes, two meetings in 2019. Email correspondence was conducted with AMWG members periodically in 2019
Objective 1B. Maintain funding levels to achieve a level of habitat management that is 1) indefinitely sustainable into the future, and 2) shows a stable or increasing trend in measured biological variables over a biologically appropriate timescale.	Funding allocated by City; line item established in operating budget	Funding allocated by City for fiscal year July 1, 2018 to June 30, 2019 and July 1, 2019 to June 30, 2020	Yes, the budget funds staff, consultant, and contractor time to improve management, implement projects, conduct studies, and /or implement improvement, resulting in an increase in the measured biological variables
Goal 2. Conduct a two-tracked program of management and research with built-in monitoring			
Objective 2A. Maintain a Management Track that leads to stable or increasing trend in measured biological variables over a biologically appropriate timescale.	The City incorporated AMWG recommendations into multiple management actions	Data from studies and monitoring were considered by City and AMWG during management decisions	Yes, monitoring of biological variables and trends were conducted as outlined in the HMP. Management actions were implemented to reach desired variables for SCT (not reached in timescale) and coastal prairie by 2020
Objective 2B. Utilize a Key Management Question (KMQ) framework to guide the Research Track when research is needed to achieve the specific goals and objectives for SCT and the coastal prairie.	City received input from AMWG, CDFW and USFWS on SCT management actions	Scrape plots created in Areas A, C, and D for SCT; results to be available in summer 2020	Yes, when additional research items are identified, the KMQ framework will continue to be used
Goal 3. Develop public educational opportunities associated with Arana Gulch and efforts to conserve and restore its rare resources			
Objective 3A. Maintain a website to communicate restoration efforts to the public and provide a place for documents related to the requirements of the CDP, such as Monitoring Reports.	Webpage on City website developed in 2013	Webpage updated throughout 2019 with new information	Yes, City periodically updated website with reports and information as needed

4. Implementation of Master Plan Improvements

Construction of the Arana Gulch Multi-Use Trail was initiated in fall 2013 and was completed in December 2014. This east-west trail extends from Brommer Street (east of the greenbelt) westward to Broadway Street (west side of greenbelt, across Hagemann Gulch). The Agnes Street Trail extends southward from Agnes Street to join the east-west multi-use trail midway within the greenbelt. This trail was constructed in 2014. The Marsh Vista Trail, a pedestrian trail located along the east side of Arana Creek, was constructed in 2013. In 2018, improvements were made to a portion of the Coastal Loop Trail. Activities associated with Master Plan improvements are described in this section. The schedule of when master plan improvements were implemented is provided in each section below.

4.1 Multi-Use Trail Construction Areas

A temporary construction access road was used in 2013 and 2014 during trail construction. The area was allowed to naturally revegetate from the existing soil seed bank. The access way is contained within Grazing Area C and was subject to periodic cattle grazing from December 2018 through July 2019. Coast tarweed (*Deinandra corymbosa)* colonized this area and surrounding areas. The location of this trail and other master plan improvements is presented in **Figure 2**.

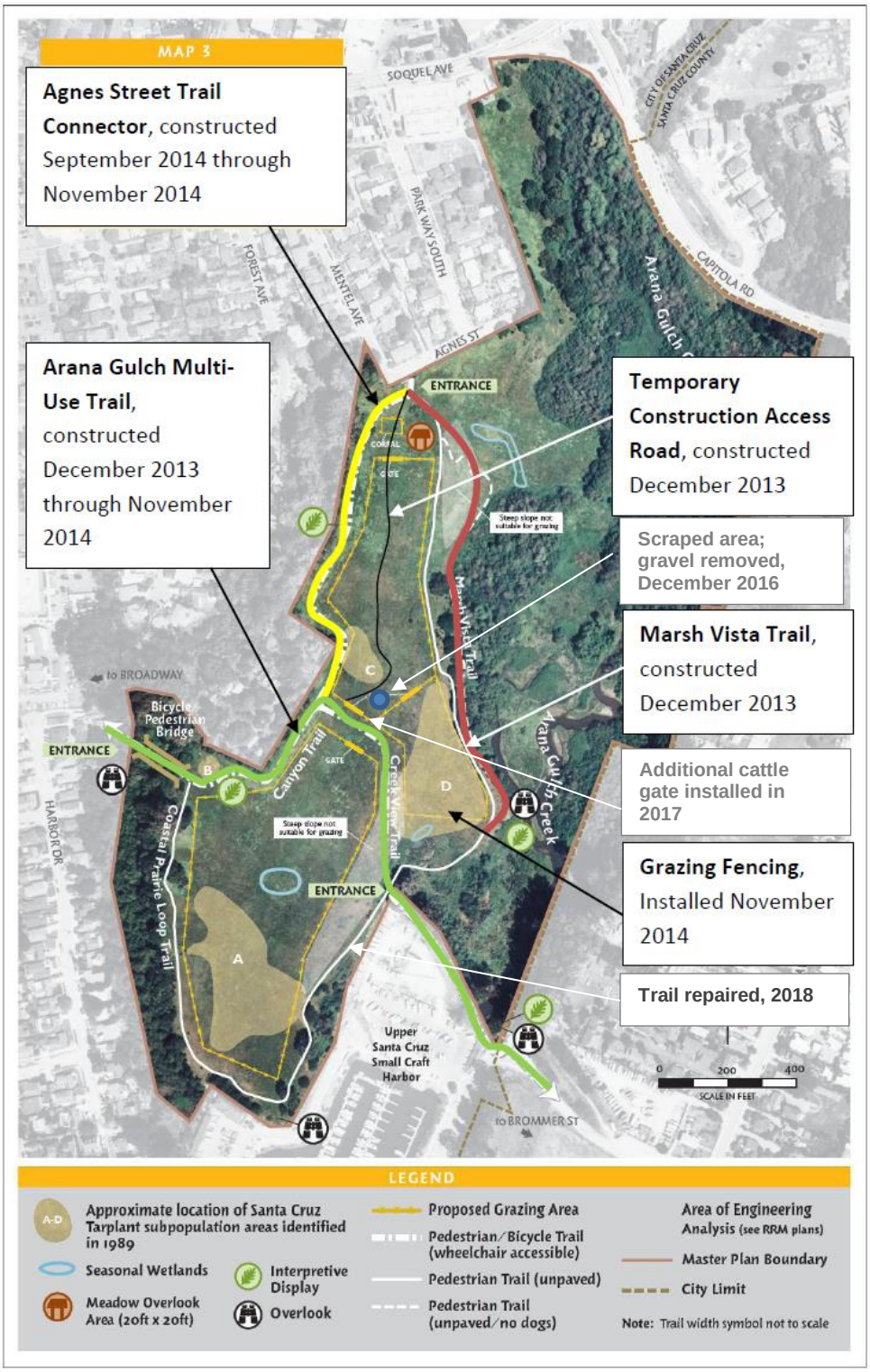
Areas subject to hydromulch and hydroseeding for erosion control as part of trail construction were observed in 2019. No erosion was noted in these areas and no additional seeding was conducted in 2019. An area with construction-related gravel was scraped in December 2016 to remove the gravel; the topsoil was retained and re-scattered in place. The location of the scraped area is depicted in **Figure 2.** Coast tarweed (*Deinandra corymbosa)* continues to be observed in portions of this treated area.

4.2 Multi-Use Trail Soil Salvage Adjacent to Mapped Tarplant Areas

Project conditions of approval required the salvage of topsoil from areas within 20-feet of mapped tarplant if such areas were disturbed during trail construction. In December 2013, the upper 6 inches of topsoil from an area upslope of Tarplant Area D was salvaged and spread onto an approximately 3,750 square foot area south of Tarplant Area C. The location of the salvage and receiver sites is depicted on **Figures 3 and 4**, respectively.

In 2019, native and non-native plants continued to occupy the Tarplant Area D receiver site, similar to previous year observations. Native species observed included coast tarweed (*Deinandra corymbosa)* and California poppy (*Eschscholzia californica)* as well as non-native species include oats (*Avena spp.)*, cat's ear (*Hypochaeris sp.),* filaree (*Erodium sp.),* wild radish (*Raphanus sativus),* ryegrass (*Festuca perennis),* and ripgut brome (*Bromus diandrus)*. No SCT was documented from this receiver site in 2019.

Figure 2. Master Plan improvements, 2013 - 2019



The Agnes Street Trail Connector construction disturbed a section of soil within 20 feet of Tarplant Area C in September 2014. On September 15, 2014, the upper 6 inches of topsoil from this area was salvaged and spread onto areas southwest and northwest of Tarplant Area C. The two receiver areas encompass approximately 2,900 square feet (see **Figure 3**). Details on the soil salvage and soil depths within this placement area are presented in the Year 1 (2015) Annual Report. The location of the receiver sites, as well as data from the November 2014 soil sampling are shown in **Figure 4**.

Figure 3. Location of Multi-use Trail Soil Salvage Sites, 2013 and 2014

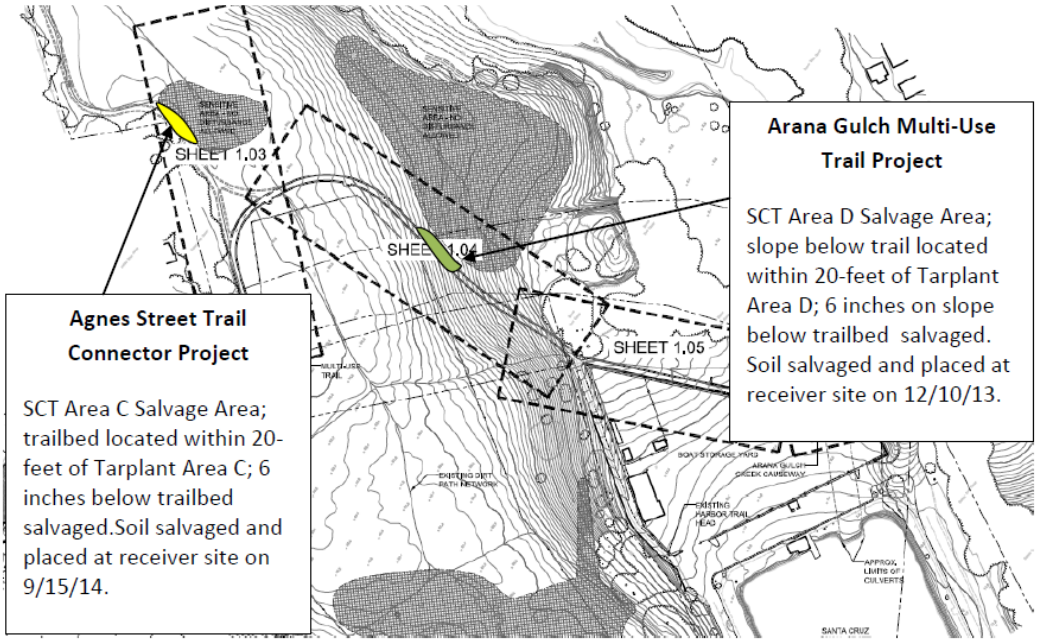
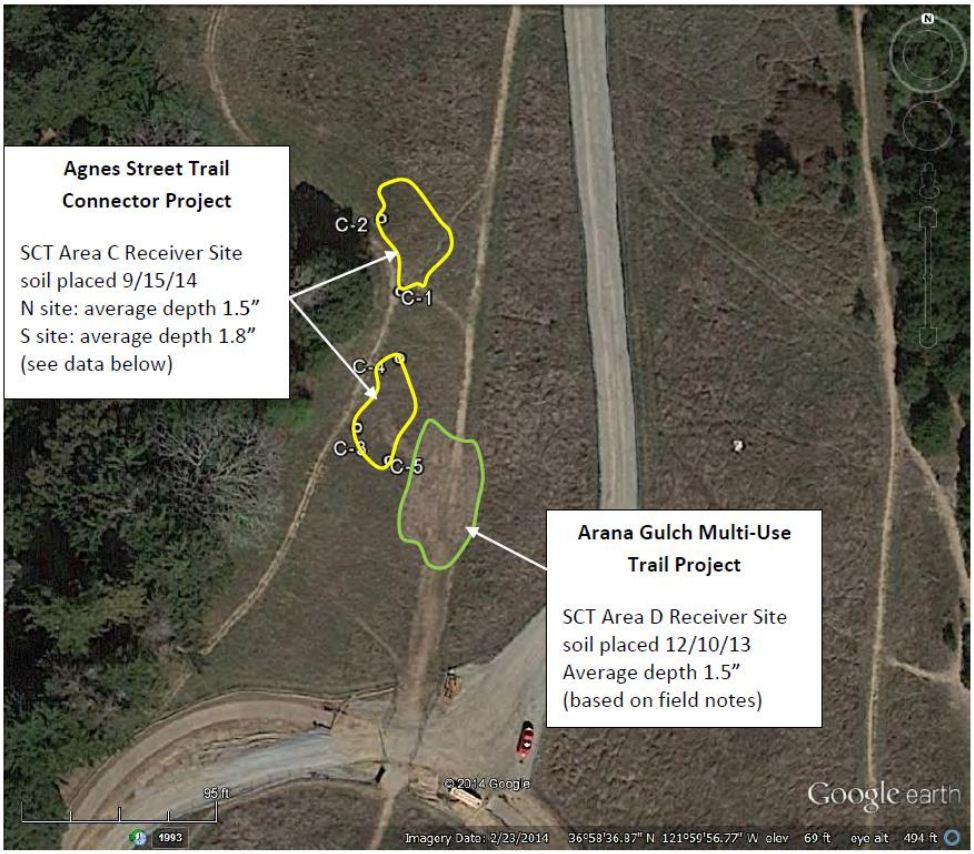


Figure 4. Multi-Use Trail Soil Receiver Sites on Aerial Photo, 2013 and 2014



In 2019, native and non-native plants continue to occupy the Tarplant Area C receiver site. Native species observed included coast tarweed (*Deinandra corymbosa)*. Species typical to the adjacent grassland occur at the site, including hare barley (*Hordeum murinum ssp. leporinum)*, cat's ear (*Hypochaeris sp.)*, filaree (*Erodium sp.)*, and ryegrass (*Festuca perennis)*. No SCT was documented from the receiver site in 2019. An experimental scrape plot, created in November to facilitate historic SCT seed expression was placed between the two SCT Area C soil salvage receiver sites (see Section 5.1.1.3)

4.3 Natural Recruitment of Native Plants along Multi-Use Trails

The construction of the multi-use trails included removal of soil under the trail's footprint in preparation for trail materials, base rock, and the pervious surface. The excavated soil was taken off-site. Areas in close proximity to the paved trail (i.e., areas within the designated, fenced construction work area) were also disturbed. In spring and summer 2017, field observations of the Arana Gulch Multi-Use trail (east-west trail) construction area documented the presence of naturally establishing native and non-native plant species within the disturbed soil areas. Individuals of the native coast tarweed (*Deinandra corymbosa)* colonized the edge of the trail construction zone; however, over time trail use and soil compaction has occurred and the area appears less suitable for plant growth. Some coast tarweed still persists along the trail. Other plant species also naturally established in the

construction area include several weedy, non-native species, such as wild oats (*Avena spp.)* and wild radish (*Raphanus sativa)*. No SCT were observed in these areas in 2019.
Poor drainage along the edge of the east-west trail was observed in winter 2016. An AMWG member expressed concern that water was not passing under the trail, as designed, and water was prevented from reaching the downslope prairie. In 2016, City staff installed a series of small gravel drains to enable water to penetrate the engineered drainage system under the pathway. Staff believed that the clay content of the top soil was not allowing effective penetration to the drainage rocks beneath it. City staff monitored these areas during winter 2018/19 and found that they continue to be effective.

4.4 Grazing Infrastructure and Stocking Program

Cattle infrastructure include fences, access gates, water line/water troughs and a temporary holding corral near Agnes Street. In January, per an agreement for cattle grazing with a local cattle rancher, cattle were brought onto the site as per the HMP Grazing Program and Stocking and Work Program. See Section 5.3 for more information on the 2019 cattle grazing program. Cattle grazing signs, installed at each entrance and along the fence, were maintained throughout the year. The signs continue to provide contact information to the City and rules of the site. The water troughs were maintained throughout the grazing season. Some vegetation recolonized the site of the former water trough site in Area A (trough was moved southward approximately 100 feet in 2016).

5. Habitat Management and Monitoring - Coastal Prairie/Santa Cruz Tarplant Management Area

Activities within this management area are summarized in the following section and include actions as outlined in Section 3.0 of the HMP as well as adaptive management actions recommended by the AMWG. Management actions in 2019 included grazing, perimeter mowing, monitoring of grazing actions, monitoring for SCT, growing of SCT for seed increase and storage, creating scrape plots for SCT seed expression, creating a bare ground molasses plot for SCT seed expression, and invasive weed control. City staff implemented most of these tasks. A log of maintenance actions is presented in **Appendix B.** The AMWG is in the process of collecting data on nearby coastal prairie reference sites that may be useful in developing performance criteria for percent cover of native and non-native plants, species richness, and percent cover that is bare ground that will be relevant to site conditions at Arana Gulch. These criteria will be applied to sub-management areas that have been identified. Once these criteria are developed by the AMWG and Coastal Commission (CC), they will be used to assess future performance of the coastal prairie at Arana Gulch.

The coastal prairie occupies about 30 of the 67 acres at Arana Gulch and is essential because it has supported the third largest standing native SCT population and is one of only 13 populations found in Santa Cruz County (USFWS, 2015). However, the population of SCT has declined precipitously over the last two decades. This section describes management and monitoring actions for the SCT (Section 5.1), coastal prairie grassland (Section 5.2), grazing and stocking work program (Section 5.3), and the invasive weed work plan (Section 5.4). Each section concludes with a monitoring and performance evaluation of progress toward meeting the goals and objectives outlined in Section 3.0 of the HMP. Proposed actions for 2020 are discussed in Section 5.5.

5.1 Santa Cruz Tarplant

Several management actions for Santa Cruz Tarplant (SCT) were implemented in 2019, as described below.

5.1.1 Management Actions

5.1.1.1 Grazing and Mowing. Management actions for the Santa Cruz Tarplant (SCT) consisted of seasonal grazing of the historic SCT Areas A, C and D (and surrounding grassland), seasonal mowing of Area B, and creating a bare ground molasses plot in Area A in June. Areas A, C, and D were grazed between December 23, 2018 and July 10, 2019. Further details on the grazing program can be found in Section 5.3. Area B was mowed or weed-whipped approximately every 2-3 weeks from January through June each time the grass grew more than 8 inches in height. No mowing occurred in July, then the area was mowed in mid-August, September, and October. Raking of grass clippings was not conducted in 2019.

5.1.1.2 Experimental Management Work Plan. The 2019 (Year 5) vegetation assessment determined that the current grazing strategy is not meeting the interim biological success criteria defined in the HMP. Therefore, the City and AMWG indicated support for an adaptive management work plan to conduct experimental management actions to improve habitat conditions for SCT. In November 2019, Alison Stanton prepared a work plan that outlined potential management actions for Arana Gulch SCT habitat enhancement on the coastal prairie. The work plan evaluated previous management strategies implemented on site and presented potential actions that could be considered for the site. The work plan was disseminated to the AMWG for review and comment. As a result of the work plan, scrape plots were created in Areas A, C, and D in November 2019, as outlined in Section 5.1.1.3.

Table 2 summarizes the SCT population size and management actions that have occurred since the City acquired the property in 1994. Actions have including mowing/raking, mechanical and hand scraping, and prescribed fire. One accidental fire has occurred and grazing was implemented in 2015.

Table 2. Santa Cruz Tarplant (SCT) Population Size and Management Actions 1994-2019

Arana Gulch		Management Action			
Year	# SCT	Mow/Rake	Scrape	Fire	Grazing
2019	50				Jan-June
2018	267				Jan-June
2017	0				Feb-June
2016	35				Jan-May
2015	0				March- June
2014	4				
2013	0				
2012	16	June			
2011	32	May/Oct	Oct 3 plots		
2010	0	May/Oct	Oct X plots		
2009	68	May/Dec			
2008	44	April/Nov			
2007	27	April/Nov			
2006	348	Oct			
2005	1,552	Experimental actions			
2004	797	Experimental actions			
2003	2,536	Experimental actions			
2002	10,230 mostly in scraped areas	Experimental actions			
2001	619	May/Aug	June/Aug	June/Oct	
2000	1,053	May			
1999	1,228				

Table 2. Santa Cruz Tarplant (SCT) Population Size and Management Actions 1994-2019

Arana Gulch		Management Action			
1998	12,800 (65,000?)	yes		Oct Rx fire north of A	
1997	35,000 in scrape/fire			Oct Rx fire	
1996	7,420 in scraped area	May		Arson fire Oct	
1995	0	May-June	Bulldozer 3ac June		
1994	0				

Summary of Past Management Actions. A summary of previously implemented management actions is presented below.

Scraping/Fire. Of all the different management tools that have been applied at Arana Gulch, soil scraping, with or without prescribed fire, has produced the most positive response in the SCT population. In June, 1995 a bulldozer scraped 3 acres in the middle of Area A. The following summer, over 7,000 SCT were found within the scraped area. Later the same season (October), a high intensity arson fire burned about half of the scraped area. In the summer of 1997, around 35,000 SCT individuals were found in the area that had been scraped and burned. The combination of the accidental fire with scraping was apparently very successful. However, it should be noted that these treatments were applied in single large blocks so results may reflect spatial differences in seed bank density rather than the relative effectiveness of each treatment. A prescribed burn conducted in October 1998 "north of Area A" and without any scraping was likely conducted in Area C and did not result in SCT recruitment.

In 2001, Bainbridge conducted a variety of experimental treatments and found significantly higher SCT recruitment in 10x10 meter scrape plots compared to mow, fire, or control plots. However, the burn treatment was very low intensity and did not adequately remove the thatch layer. Hotter or earlier burning may result in better removal of biomass and better SCT recruitment.

Grazing. Grazing was implemented in very late February in 2015 and has continued during the winter and spring over the last 5 years. During this time, canopy height has been decreased across the prairie. The HMP objective to increase the cover of bare ground has been met in Areas A and D, where the average cover of bare ground has increased significantly since 2015. Bare ground has not increased in Area C. The HMP objectives to reduce the cover of non-native species (3B), increase the cover of native species (3C), and increase native species richness (3D) have not been met. Measured changes in species composition and richness have been limited to non-native plant guilds. The most visible change on the prairie has been a decline in wild oat, which formed a very tall canopy layer in

the first baseline samplings in 2013-2014. However, the low-statured rat-tailed fescue has filled in its place and continues to contribute to litter build up. In addition, the reduction in canopy height and increase in bare ground have likely facilitated an increase in exotic annual forbs such as cat's ear, filaree, and geranium.

Most importantly, the HMP objective to increase the number of aboveground SCT at Arana Gulch to at least the 2006 level (348 plants) has not been realized after 5 years of grazing management. Since 2015, the number of SCT plants has ranged from 0 to a high of 267 in 2018. In 2019, the number declined again to 50 plants. Precipitation has not been a limiting factor during much of the period since the last 3 years have had normal or above normal precipitation.

The secondary objective to expand the distribution of the SCT population beyond Area A has also not been met under the current regime. Residual dry matter (RDM) sampling at 3 levels (above target (>650 lbs./acre), at target (500-650 lb./acre) and below target (<500 lbs./acre)] shows that late season growth is still above target across much of the prairie. This may indicate that grazing intensity has not been sufficient to reduce the thatch layer and allow for SCT germination. SCT recruitment has only occurred within Area A in the below target zone, suggesting that the target RDM level may be too high.

Seed Collection and Propagation. No out-planting or seeding of SCT has occurred at Arana Gulch since the City acquired the property. In September, 2018 there were 267 SCT plants with a combined total of 499 flower heads at Arana Gulch. The City's CDFW 2081a scientific collecting permit allows for collection of 5% of seed, therefore, 25 flower heads were collected. A total of 270 seeds were obtained from the collection and deposited at the UCSC Greenhouse. A portion of the seed was retained for long-term seed storage, yet some was used to grow out plants for seed increase. The UCSC Greenhouse was not successful in getting ray achenes (hard seed coat) to germinate, but the disk achenes successfully germinated. They achieved approximately 50% germination of the fresh disk seed, within 14 days from the sow date. Forty SCT plants were grown during the summer, yielding approximately 100,000 seeds. This seed was cleaned and is being stored ay UCSC Greenhouse (Jim Velzy, UCSC Greenhouse). No seed was collected from the field in 2019 because there were only 50 SCT and the CDFW permit allows collection only when the population size is greater than 50 plants.

Soil and Seedbank Conditions. A summary of seedbank conditions is presented below.

Quantitative data on soil conditions and the SCT seedbank at Arana Gulch indicate that a depleted seedbank and changes in soil nutrient levels may be limiting expression of SCT. Soil nutrient analysis was conducted in 2013 by Bainbridge and similar soil sampling was repeated in December 2018. Since 2013, available nitrogen and phosphorous levels have gone from optimal to very low across the prairie. In contrast, potassium has remained at optimal levels. Iron was not measured in 2013, but the level in 2018 was high and soil pH

(4.8) was strongly acidic. The SCT seedbank has also been quantified twice and has sharply declined since the population explosion that occurred in the late 1990's. Bainbridge sampling in 1999 detected 21 seeds/ dc^2 (seeds per square decimeter) in Area A and 2 seeds/ dc^2 in Area D. In 2013, only 0.2 seeds/ dc^2 were found in A and 0.03 seeds/dc^2 in Area D. This is a 100-fold decline in Area A. No seeds have been detected in Areas B or C. In these and other studies, the majority of SCT seed has been found very close to the soil surface in samples taken at 0-2.5 cm (0-1inch) depth. No or few seeds have been found in samples from a depth of 2.5-5cm (1-2 inch).

Experimental Management Work Plan. The timing and purpose of potential management actions is presented below. **Table 3** presents a summary of possible actions, timing, and purpose.

Table 3. The Timing and Purpose of Potential Management Actions for SCT at Arana Gulch

Action	Timing	Purpose
Scraping (hand or mechanical)	Fall- prior to rain and SCT germination	Remove aboveground biomass and topsoil to a depth of less than 2" to expose SCT seed to light to stimulate germination.
Prescribed fire	Fall/ early winter	Remove biomass and increase nutrient availability prior to germination. Stimulates growth of forbs and grasses.
	Spring	May reduce non-native annual grasses that still have immature seeds on the stems and not harm desirable native forbs (SCT) still at the rosette stage.
Seeding	Fall	Hand broadcasting SCT seed after a scrape or fall fire may promote recruitment.
Outplanting	Fall	Hand drilling of propagated SCT after a scrape or fall fire may promote seed production in surviving plants and increase seedbank.
Liquid smoke	Fall	Hand application of a liquid smoke solution in combination with seed application may help to break seed dormancy (ray achenes) and stimulate germination.
Grazing	Winter-summer	Grazing animals remove above ground biomass, decrease vegetation height, lower litter depths, and redistribute nutrients. Increased light penetration and soil disturbance can release seeds from the seedbank and stimulate germination.
Mowing	Variable timing and frequency	Removes aboveground biomass. Repeated mowing can favor lower-statured forbs. The response of native grasses to mowing (and grazing) appears to be specific.

Actions Not Currently Recommended. The following actions are not recommended.

Seeding/ liquid smoke. Only 270 SCT seed heads were collected in the field in 2018. Currently, the amount of seed that has been propagated and collected and there are approximately 100,000 seeds. Although this quantity could provide a sufficiently high seeding rate in a very small area, the viability of the seed has not been tested. Therefore, seeding experiments (with or without liquid smoke) are not recommended because it will not be possible to assess whether a lack of recruitment is due to viability or some other factor. In addition, the total amount of seed available is still too low to achieve standard seeding rates on a scale that can be replicated. A direct seeding study of annual and perennial forbs conducted at 3 coastal prairie sites in Santa Cruz and Monterey County utilized seed rates of 500, 1,500, and 2,500 seeds/m^2 and resulted in extremely low establishment rates with seed yield of 1-2% at best (Holl et al 2014). In addition to the low likelihood of recruitment from seeding, SCT is an obligate out-crossing species, so it is desirable to obtain seeds from a larger source population to avoid the potential for detrimental genetic consequences like inbreeding depression.

Outplanting. Experimental outplanting of SCT at Arana Gulch in 2019 and 2020 is not recommended primarily because of the low nursery seed supply, but also because of the current degraded condition of the grassland, the high effort required, and the low probability of success. Outplanting of SCT propagules at three other coastal prairie sites in Santa Cruz and Monterey Counties during 2002-2005 were not successful (Holl and Hayes 2006). However, a series of outplantings installed from 2002 -2004 at the nearby SCT population in CA State Park Twin Lakes (0.5 mile to the east) was more successful. Propagation of site-collected seed began at the UC Jepson Herbarium in 1999 to increase the seed supply for outplanting. After three years of greenhouse propagation, a total of 15 SCT propagules were planted in 2002. After further propagation, 600 SCT were planted in 2003, and 234 in 2004. Respective survival to reproduction was 80, 57, and 74%. Survivors in 2003 produced an estimated 6,400 seeds. In 2004, estimated seed production was 29, 580 seeds. Despite this successful seed increase, a relatively rapid decline in the Twin Lakes population in the years following these plantings suggest that without continued inputs, the high cost of propagation and outplanting do not lead to a sustainable SCT population.

Recommended Actions. The following actions are recommended.

Scraping: Mechanical scraping would likely be implemented with a standard wheel loader. A smaller capacity skid-steer (bobcat) would likely provide greater maneuverability, but may not be available. With either machine, topsoil removal should be shallow (1-2”), but scraping the very top layer of soil poses challenges and often leads to uneven scraping with deeper scraping than desired in some areas and piles of soil in others. The uneven treatment can be exacerbated in large plots and can be minimized in smaller plots by hand raking to more evenly distribute the disturbed soil. Choosing the appropriate plot size depends on the overall experimental design and the number of replicates. A large plot of 100 ft^2 is required to

accommodate the current 25 m vegetation monitoring transects however, the monitoring methodology can/will be adjusted to accommodate the chosen experimental design.

Prescribed fire: Implementation of prescribed fire could occur in fall/early winter in coordination with the Santa Cruz Fire Department (SCFD). It could also be done in spring. SCFD has indicated willingness to conduct a burn operation at Arana Gulch and views it as a potential training opportunity and also as a potential opportunity for community outreach and education. The City would like to provide public notification due to high public interest and potential air quality issues; therefore, a 2-3-month window for advance planning is needed prior to implementing prescribed fire as a management action.

Grazing: A new grazing operator has been selected at Arana Gulch after the operator from 2015 to June 2019 declined to continue operations in 2020. Grazing is expected to commence in winter 2020, and the decision will need to be made to exclude the cattle from some of the treated areas or not. As described above, the RDM data suggest that grazing intensity may not have been sufficient and so exclusion may not be advisable.

Experimental Design

The total area within the fences at Arana Gulch is approximately 16.2 acres. **Figure 5** shows a schematic of the grazing enclosures at with the following features:

- **Area A south** is about 4 acres and contains the 3 SCT clusters (C1, C2, C4) found in 2019 and the area delineated as coastal prairie habitat by the AMWG in 2016 (see Figure 24).
- **Area A north** (yellow line) is 4.5 acres and is not physically separated from the south part (orange line) but has not supported SCT or native coastal prairie vegetation.
- **Area C** (blue line) is 5.8 acres
- **Area D** (red line) is 1.8 acres

Figure 5. Schematic of the Grazing Enclosures at Arana Gulch

Fire and Scrape Options

1. In Area A South SCT coastal prairie habitat (orange box, approx. 4 acres)
    a. Create a patchwork of 6 alternating plots with 3 plots each of burn and scrape plots of 100 x 100 feet as shown on **Figure 6**. Red boxes represent the actual size of a 100x 100 ft burn plot (about 0.2-acres). Green boxes represent 100ft^2 scrape plots **OR**
    b. Conduct strip fires on E-W axis (width TBD) and install 4 30 x 30 ft scrape plots in unburned strips as shown in **Figure 7. OR**
    c. Conduct prescribed fire on west half of Area A plot and install 4 30x 30 ft scrape plots on the east half.

Area A North grassland (yellow box, approx. 4.5 acres)

    d. Prescribed fire on whole area **OR** install 4 new scrape plots (100 ft^2) **Figure 6**

Area C grassland (blue box, approx. 6 acres)

    e. Prescribed fire on all of Area C

Area D grassland (red box, approx. 1.8 acres)

    f. Install 2 scrape plots (approximately 100 ft^2) as shown in **Figure 6 OR**
    g. Prescribed fire on all of Area D

Figure 6. Prescribed Fire and Scrape Plots

Area A South coastal prairie (orange) with patchwork of prescribed fire and scrape plots (red boxes represent the actual size of a 0.2-acre burn plot (about 100ft^2) and green plots are scrape only plots. Area A North (yellow) receives fire OR 4 scrape plots and Area C (blue) receives all fire. Area D (red) receives scrape plots OR molasses plots.

Figure 7. Strip Fire and Scrape Plots

Area A South coastal prairie (orange) strip fire configuration. Area A North (yellow) receives fire OR 4 scrape plots and Area C (blue) receives all fire. Area D (red) receives scrape plots OR molasses plots

Scrape Only Option. If fire is not feasible, then scraping is recommended in all areas. Plot size can be reduced to reduce the unevenness of the topsoil with mechanical scraping. **Figure**

8 shows potential configuration of scraping for Areas A and D. A total of six 30x30 foot plots could be installed in an around recently occupied SCT coastal prairie habitat in Area A. Scraping in Area C should be considered in light of cattle grazing needs. Scraping the entire area may reduce desirability of using Arana Gulch for pasture, so two large scrape plots of one acre each could be used if sufficient grazing pasture remains. Likewise, a very large plot of 2 acres that covers approximately half the size of the north part of Area A could be installed with a smaller plot, if necessary. Smaller plots could be utilized, but a large-scale plot is the simplest design. Leaving sufficient grazing pasture needs to be considered. Area D can accommodate 3 small 30 x 30-foot scrape plots.

Figure 8. Scrape Plots

Area A South coastal prairie (orange) with 6 scrape plots (green plots represent approximate size of 30 x 30 ft. Area A North (yellow) with one large scrape plot of approximately 2 acres and one smaller plot. Area C (blue) with 2 one-acre scrape plots. Area D (red) with 3 scrape plots (30 x 30ft.)

5.1.1.3 Experimental Scrape Plots, November 2019. As a result of the work plan, review by the AMWG, and review and consultation with City departments (e.g., Fire and Police departments), the City decided to implement scrape-only plots in November 2019 within historic SCT areas within Area A South, Area A North, Area C, and Area D. Prescribed fire as a management tool was also considered; however, there was insufficient time after receipt of the work plan to adequately coordinate with the AMWG, State and Federal agencies, and City departments and to provide public notice for such an action.

On November 20th, prior to winter rains, the City laid out scrape plots in Area A South, Area C, and Area D. In Area A South and Area D, nine 30 x30-foot plots were created. In Area C, one 30 x 50-foot plot was created. **Figure 9** depicts the location of the scrape plots in Area. A South, and the location of 2019 SCT plants. Plots were arranged to avoid areas where there

were aboveground SCT in either 2018 or 2019. **Figure 10** shows the location of the plots in Areas C and D. In Area C, one 30x50 foot plot was placed in the historic SCT area, yet outside two soil salvage sites that were created in 2014 (see Section 4.2). In Area D, the plots were arranged to capture areas of viable seed from the 2015 seed bank study.

Figure 9. Location of Six 30 x 30-foot Scrape Plots in Area A, November 2019.

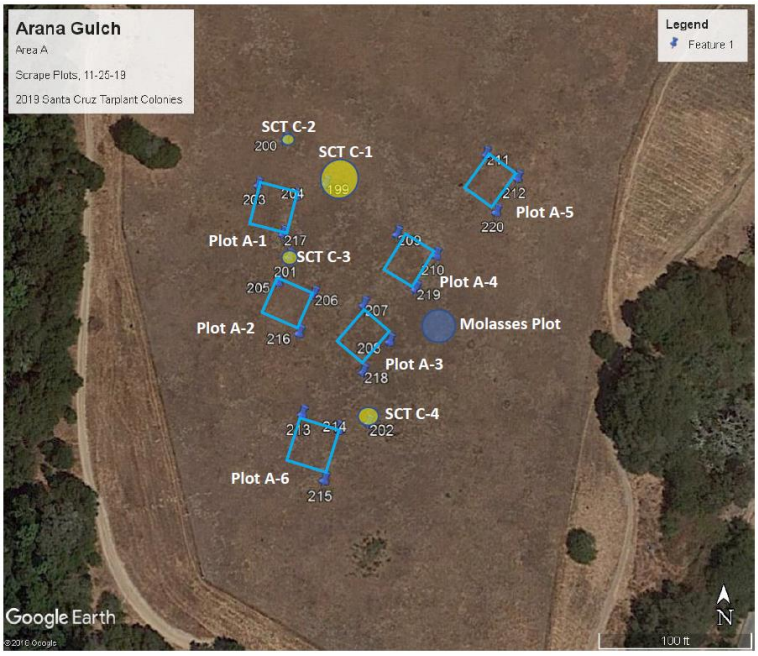


Figure 10. Location of Three 30 x 30-foot Scrape Plots in Area D and One 30 x 50-foot Plot in Area C, November 2019.

The NW, NE, and SE corners of each plot were documented by GPS. Before and after photos were taken to document site conditions. Photos of each plot are presented in **Appendix C (Item C-4).** City crews used a box scraper to remove the upper 1.0- 1.5 inches of soil and plant matter, as depicted in **Figure 11**. Removed material was side cast adjacent to the plot. This work was under the field direction of Kathleen Lyons, consulting plant ecologist. **Figure 12** depicts a finished plot (A-6).

Figure 11. Box Scraper Used for Scrape Plot, November 2019.

Figure 12. Finished Scrape Plot A-6, November 2019.

5.1.2 Monitoring and Results

A primary focus for this management area is the recovery of the SCT. The population of SCT at Arana Gulch has declined over the last two decades[5]. The HMP requires an annual census of the population (Goal 1) and a baseline assessment of SCT within the soil seed bank (Goal 4). Field surveys for SCT at Arana Gulch were first conducted in 1977 by botanist Randy Morgan but plant counts are lacking in the current database. In 1986, he estimated there were more than 100,000 plants on the property. In 1989, R. Doug Stone identified SCT in four locations he called Areas A-D (see **Figure 1**). These area designations have remained in use.

5.1.2.1 Census. A census for SCT was conducted by Kathleen Lyons, with Noah Downing. The survey followed guidelines from *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG, 2009), *CNPS Botanical Survey Guidelines* (CNPS, 2001), and *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Species* (UFWS (1996). Field surveys to determine the presence/absence of SCT were conducted in June, July, August, September, and October 2019. This survey period coincided with the blooming period of SCT. A reference population at the Santa Cruz Armory was field checked on May 14; plants at this location were in flower which suggested that the species could be flowering and detected within Arana Gulch. Surveys were conducted by walking the grassland (includes Tarplant Area A, B, C, and D) over multiple days. Meandering walking surveys, which are parallel walking routes spaced 25-50 feet apart, were conducted to detect SCT. Survey days were May 14, May 22, June 14, July 23, September 3, and September 30, totally 12 survey hours. As per protocol, if a SCT was observed a waypoint would be taken with a handheld Global Positioning System (Garmin 60sce) that would record the plant's patch location. If found, the protocol includes recording patch size, plant height, branching, flowering status, and number of flowering heads per plant. A map showing the survey route(s) is presented in **Appendix C (Item C-1).**

Fifty (50) SCT plants were documented onsite in 2019. This is a decrease from 267 plants in 2018, yet an increase from 0 plants in 2017 and an increase from 35 plants in 2016, 0 plants in 2015 and 4 plants in 2014. The survey was conducted in a slightly above average rainfall year (33.1 inches), which followed a slightly below average rainfall year (2018/19) and an above-average rainfall year (2017/18). It also follows four seasons of grazing (grazing in winter/spring seasons of 2015, 2016, 2017, and 2018).

SCT were found in four patches, all in Area A. **Table 4** presents the number of plants in each patch, the size of the patch, average plant height, and number of flowering heads. **Figure 13** displays the distribution of SCT in 2019. **Figure 14** displays the location of the 2019 plants compared to the historical distribution of the species on site. **Figure 15** displays the population trends at the site from 1996 to 2019. **Figure 16** depicts a SCT plants at colony C1.

[5] See Section 3.1, page 63 of Arana Gulch HMP.

Table 4. SCT Census Results, 2019

Area	Patch #	Size of Patch	Number of SCT[3]	Average Height (in.)	Average Number of Flower Heads	Total Number of Flower Heads
Area A						
	C1[1]	25' x 30'	36	6.3"	10/plant	375
	C2	1' x 1'	2	6.5"	3/plant	6
	C3	2' x 3'	2	6.0"	3/plant	7
	C4[1]	3' x 3'	10	3.3"	2/plant	17
Area A Total			50			405
Area B	-	-	0			
Area C	-	-	0			
Area D	-	-	0			

[1] Colony located at former scrape plot (scrape plot done in October 2011)

Figure 13. Distribution of SCT, 2019

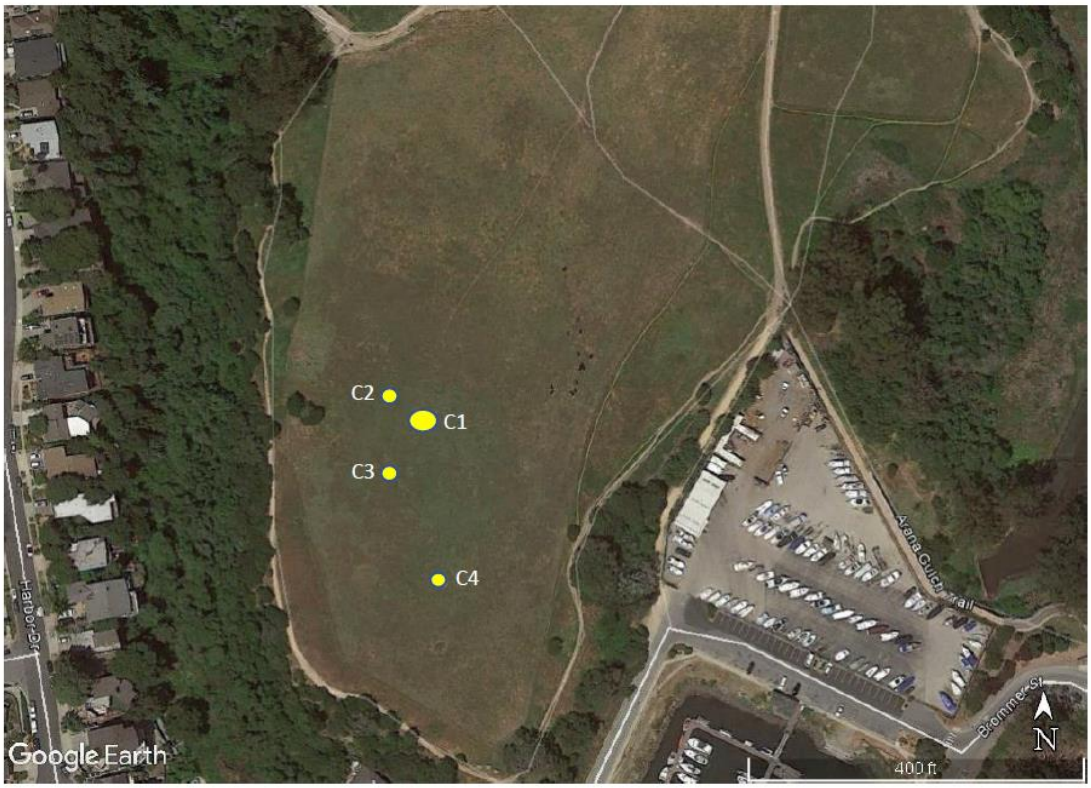


Figure 14. Distribution of SCT in 2019 and Historic Occurrence Data

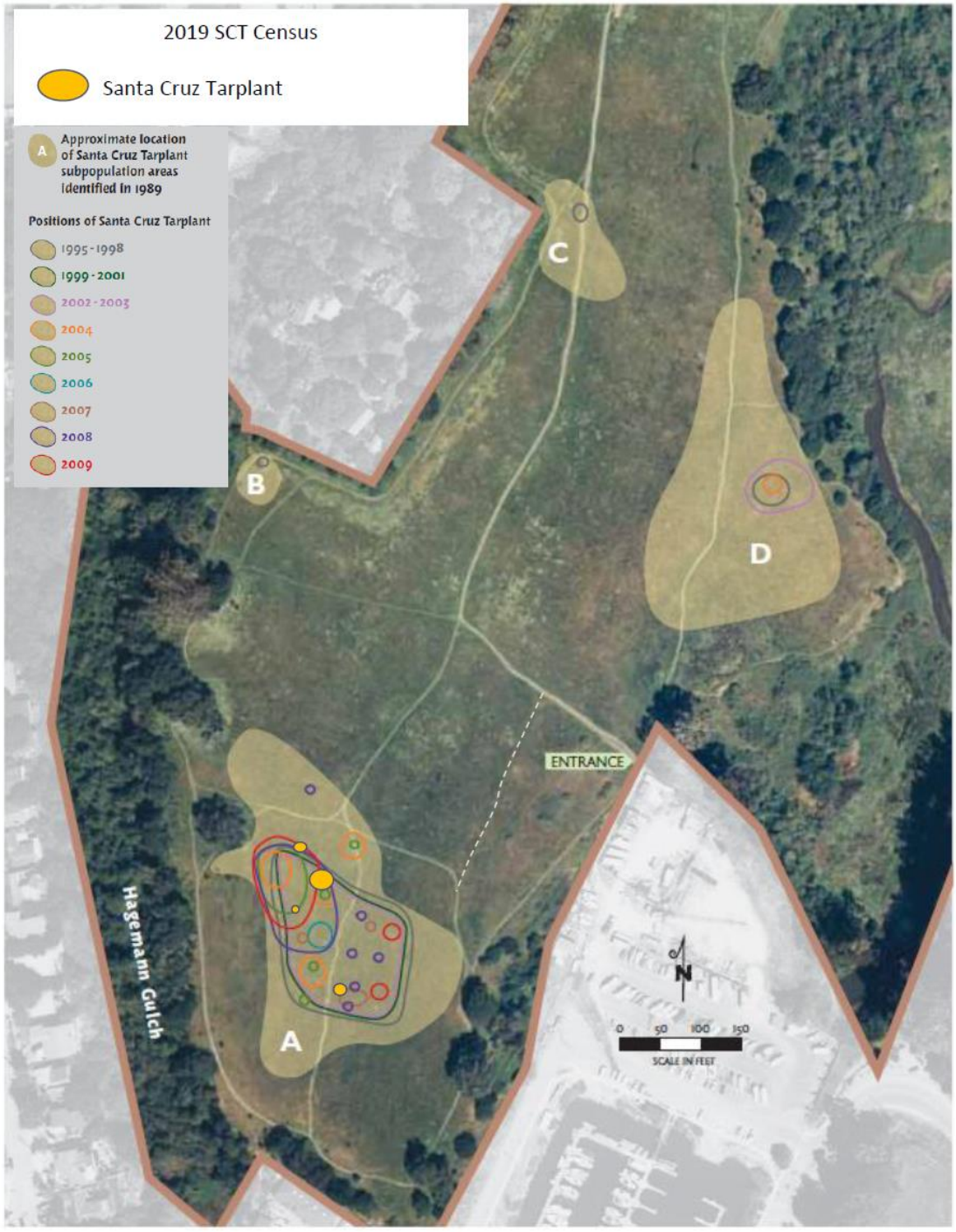
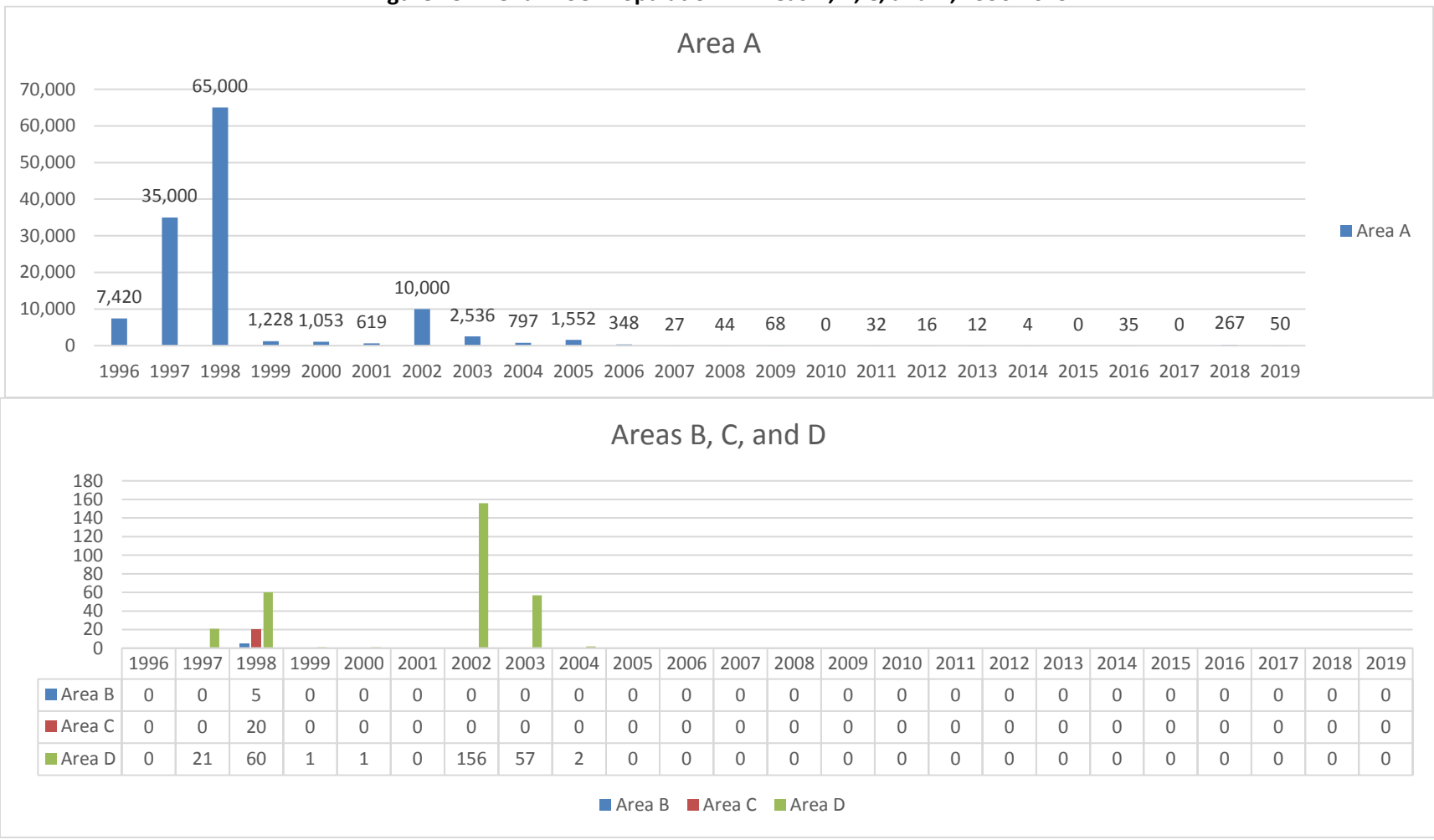


Figure 15. Trend in SCT Population in Areas A, B, C, and D, 1996-2019



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Area B	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area C	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area D	0	21	60	1	1	0	156	57	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 16. Multi-branched SCT in Area A, Colony C1, October 30, 2019

5.1.2.2 Seed Collection. No SCT seed was collected from the site in 2019. As per conditions of the City's 2081 permit with CDFW, no SCT can be collected unless there are more than 50 plants. However, seed collected from the site in 2018 was deposited with UCSC Greenhouses and under an agreement between the City and UCSC, a portion of the seed was grown into mature plants for seed increase purposes. Forty SCT plants were grown to generate SCT seed. Approximately 100,000 seeds were produced. This seed was cleaned and is stored at UCSC Greenhouse. This seed may be used for additional seed increase, growing plants for out planting on-site in 2020, and for long-term seed storage. **Figure 17** shows plants being grown at UCSC Greenhouses in July 2019.

Figure 17. SCT Being Grown at UCSC Greenhouses, July 2019

5.1.2.3 Plant Cover at SCT Patches. Plant cover and species composition was documented at each of the four SCT patches in September 2019. Four 1-meter square quadrats were used to visually assess absolute plant cover, litter, cattle dung, and bare ground. Plant cover averages 71%, which is a decrease from 82% in 2018. Most plant cover was provided by exotic annual grasses (EAG), primarily ryegrass (*Festuca perennis)* (31%). Exotic annual forbs (EAF) were dominated by cat's ear (*Hypochaeris sp.)* (7%), and English plantain (*Plantago lanceolata)* (9.4%). Cover by exotic perennial forbs (EPF) include birds foot trefoil (*Lotus corniculatus)* (2.4%) and pennyroyal (*Mentha pulegium)* (4.7%). Cover by native species included SCT (11.7%), blue-eyed grass (*Sisyrinchium bellum)* (0.2%) and California rose (*Rosa californica)* (2.3%). Cover by filaree (*Erodium botrys)* decreased to 0% from 18% in 2018. Litter provided 3.5% cover; cow dung provided 1.4% cover. Bare ground represented 23.5%, an increase from 10% in 2018. This information is portrayed in **Figure 18**. A photo of one quadrat sample is presented in **Figure 19**.

Bare ground was documented at each SCT colony in December 2019. Bare ground ranged from 10 to 15%; average value was 11.8%. Bare ground decreased between September and December as the grassland greened up after the first winter rains.

Photo-documentation of SCT habitat within Area A, between 2011 and 2018 is present in **Appendix C (Item C-2)**.

Figure 18. Mean Percent Cover of Plant Guilds and Other Features at SCT-occupied areas, September 2019

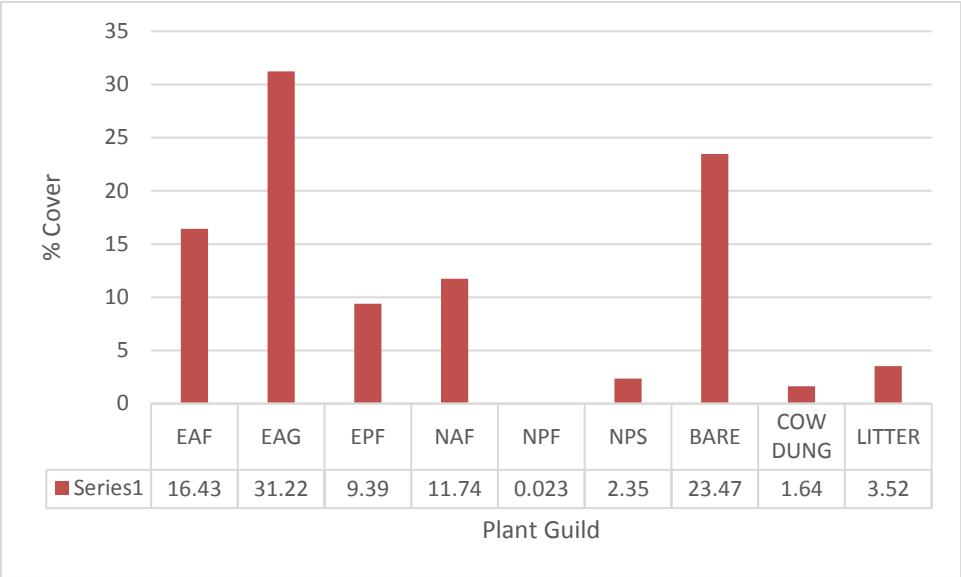


Figure 19. Quadrat sample at SCT Patch C-1, September 2019

5.1.2.4 Coordination with Other Landowners. In August, the City and some AMWG members visited SCT populations within Wildcat Canyon Regional Park (East Bay Regional Park District). The District's botanist, Michelle Hammond, described management actions implemented within the SCT populations (year-round rotational cattle grazing, prescribed fire, and direct seeding). The group viewed SCT growing conditions at three colonies.

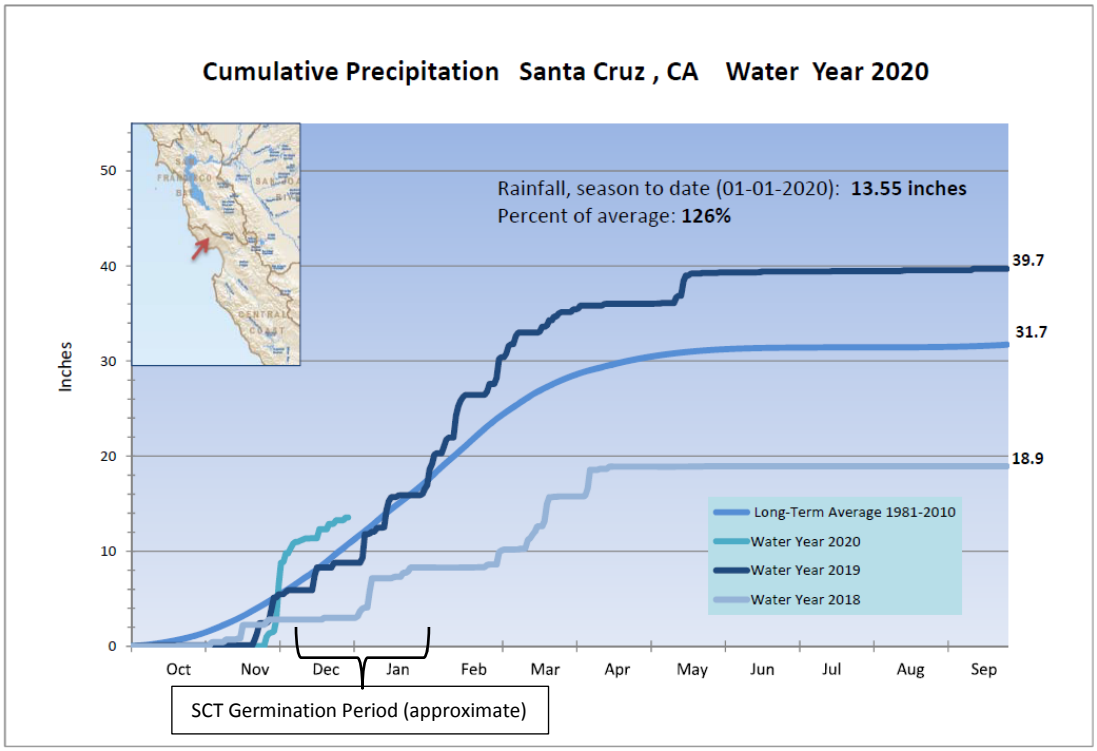
5.1.3 HMP Performance Evaluation

The HMP has a goal to maintain a viable SCT population, with objectives to increase the number of aboveground SCT to at least the 2006 level (348 plants) in the first year after the

return of grazing (i.e., summer 2016) (Objective 1A). As 50 SCT were observed in 2019, this goal has not yet been attained.

The seasonal cattle grazing that occurred over the past four years (2015/2016/2017/2018) appears to have improved growing conditions for SCT in that the amount of bare ground increased and residual dry matter has been reduced. However, in 2019, the number of SCT decreased. When compared to 2018 (267 SCT plants), 2019 had higher rainfall, particularly during the SCT germination period (December/January) which could have adversely affected germination. This is similar to site conditions in 2017 when there was heavy rainfall in January and February, and cool weather, which may have also adversely affected SCT germination and growth in that year. **Figure 20** shows rainfall patterns during this time.

Figure 20. Precipitation during SCT Germination Period, 2018, 2019, 2020 (to date)
(Source: Santa Cruz City Water Department)



The HMP has an objective to expand the distribution of SCT beyond Tarplant Area A within three years (Objective 1B). As SCT were only found in Area A in 2019, Objective 1B was not met this year. The 2015-2019 cattle grazing occurred in Tarplant Areas A, C, and D; however, if the seedbank is depleted it could take several years for expansion to occur. Under an agreement with the City and UCSC, a portion of the SCT seed collected from Area A in 2018 was grown into mature plants for seed increase purposes and/or out planting on-site in 2020, which could include out-plantings in Areas B, C, and/or D.

The HMP has a goal to maintain a genetically and demographically viable soil seed bank in perpetuity (Goal 4), with an objective to increase the density of viable ray achenes in the soil

seed bank from the baseline (first 3 years) to assessments done every 5 years (Objective 4A). As discussed in the Year 2 (2015) Annual Report, a baseline seed bank density study was conducted by Dr. Bainbridge in 2014 /2015. Future analyses of soil seed bank density will be compared to this baseline to determine compliance with this objective. To maintain a viable seed bank and to guard against an unexpected stochastic event, SCT seed collected from the site in 2018 (seed from 25 flower heads) was deposited at the UCSC Greenhouse for long-term seed storage. Under an agreement with the City and UCSC, collected/grown seed is being stored for species recovery purposes. The stored seed is one tool to maintain a genetically and a demographically viable seed bank, which could be used at a later date to enhance the soil seed bank.

5.2 Grassland/Coastal Prairie

5.2.1 Management Actions

5.2.1.1 Grassland Mowing. Grassland mowing occurred outside the grazing fences within areas delineated to remain as grassland. The grassland area to be maintained includes all areas within the grazing fences and areas extending to the drip line of the adjacent woodland, as depicted in **Figure 21**. Perimeter fuel break mowing was also identified along the trails.

The City used a weedwhacker to cut grass in (to approximately 4" height) Tarplant Area B between March and June and again in August - October. The remainder of the site was flail mowed in June. Mowing was conducted for grassland management purposes (i.e., reduce cover by non-native plants) and also for perimeter fuel break purposes. (Note: Please refer to Section 5.3 for the grazing management).

Using previous year recommendations from the AMWG, perimeter mowing occurred once a year in late May or early June, after a botanist inspects the site to assure that native plants, such as Mariposa lilies, would not be adversely affected. Prior to the June mowing, the City authorized a botanical review and a breeding bird survey of the mowing areas to ascertain if native plant species or nesting birds would be directly affected by the mowing. Kathleen Lyons, plant ecologist, conducted the botanical review and Garvin Hoefler, wildlife biologist, conducted the breeding bird survey on June 14. No breeding birds were detected in the areas subject to mowing; however, several colonies of locally unique plants along the Coastal Loop Trail were flagged such that mowing would avoid these areas. Plant species flagged include soap plant (*Chlorogalum pomeridianum)*, Mariposa lily (*Calochortus luteus)*, pretty face (*Tritelia ixiodes)*, and California poppy (*Eschscholzia californica)*. The pre-mowing survey results are presented in **Appendix C (Item C-3).** At the time of the June mowing, grass height was estimated to range 1-4 feet, based on pre-mowing visual observations. Flail mowing was conducted as close to bare ground as possible. Areas subject to mowing are depicted on **Figure 22**. Mowing outside the Area A grazing fence is depicted in **Figure 23**.

Figure 21. Delineated Grassland, April 2015

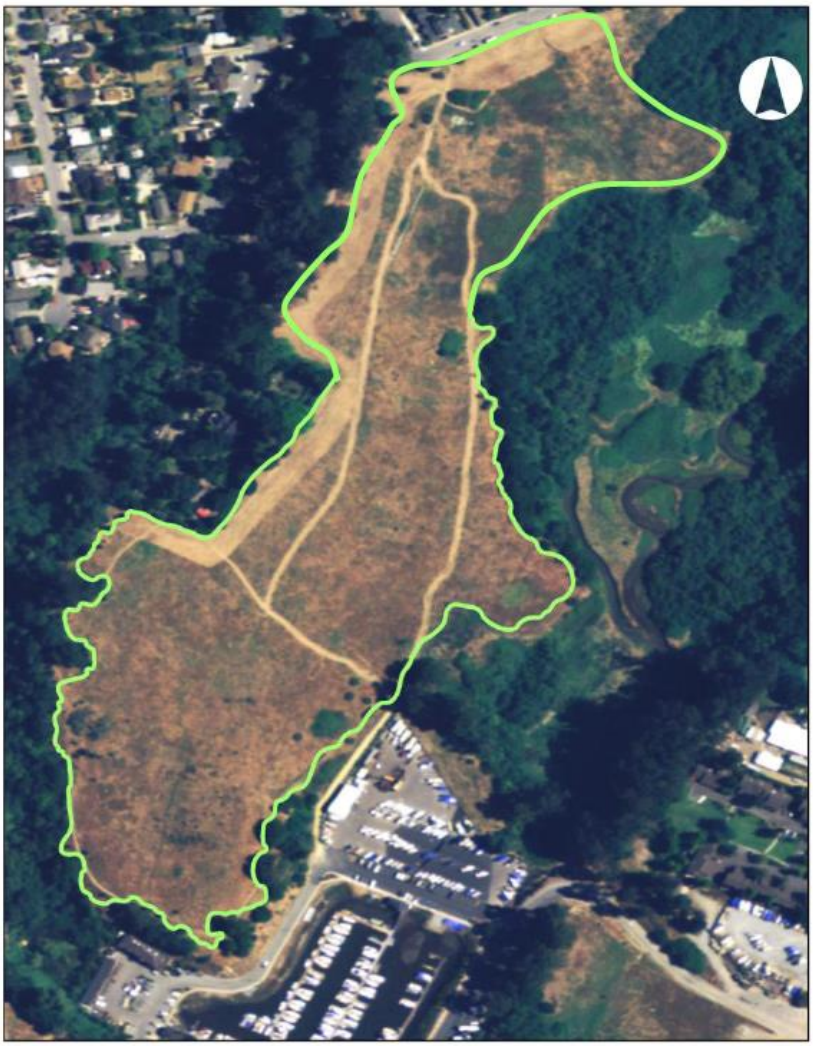


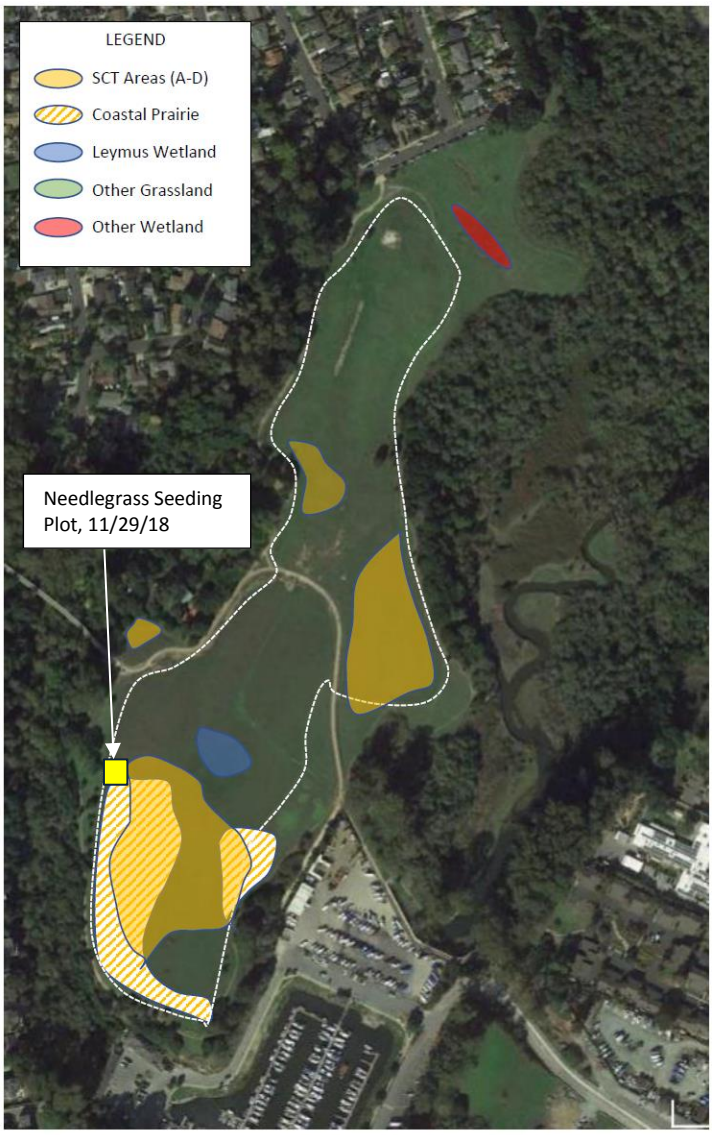
Figure 22. Areas Mowed in 2019

Figure 23. Grassland Prior to Mowing, June 2019

5.2.1.2 Invasive Plant Removal. In 2019 the City continued to remove woody plant species from the delineated grassland area. Occurrences of cotoneaster *(Cotoneaster sp.)* and Himalaya blackberry *(Rubus ameniacus)* continued to be removed/controlled. In 2019, sprouts of cotoneaster and blackberry were re-treated. A thicket of cotoneaster and Himalaya berry (*Rubus ameniacus)* between the Coastal Prairie Loop Trail and the harbor that was removed in June 2017 was re-treated. The City prevented most thistles from the grazing areas and along the Coastal Prairie Loop Trail from setting seed. This required multiple shovel cutting, weed-whipping, and weed-eating work days from February through September.

In 2017 a grassland sub-management area map was prepared. The map is presented as **Figure 24**.

Figure 24. Sub-management Areas in Grassland (updated draft)



5.1.2.3 Needlegrass Seeding. In 2018, approximately 1 pound of purple needlegrass (*Stipa pulchra)* seed (with chaff) was hand-broadcast into 15'x15' plot in grazing Area A. Seed from 20 seed heads of gumplant (*Grindelia stricta)* growing nearby were also hand broadcast onto the prepared seedbed. To date, no needlegrass or gumplant has been detected. The area has re-colonized with annual grasses and non-native forbs. The location of the seeded plot is depicted on **Figure 24**. **Figure 25** displays the condition of the seeded area in summer 2019.

Figure 25. Purple Needlegrass Seeded Plot in Area A, July 2019

5.2.2 Vegetation Assessment

The CDP requires annual assessment of the vegetation in the grassland/coastal prairie until the interim success criteria specified in the HMP are met, with continued monitoring every three years, thereafter. Goal 3 of the HMP is to 'Minimize the detrimental effects of high non-native annual grass cover and restore coastal prairie species diversity and habitat function.' There are 5 interim success criteria (Objectives A-E) that address parameters important to the functioning of the coastal prairie and SCT competitive ability including canopy height (A), cover of non-native species (B), cover of native species (C), species richness (D), and bare ground (E). The purpose of the assessment is to characterize vegetation and ground cover conditions in areas that are being grazed under guidance of the Grazing and Stocking Program, discussed in the next section (5.3). These data provide a quantitative evaluation of changes in vegetation condition over time in response to grazing and are useful in informing management actions described in the previous section (5.2.1.) The monitoring methods and results are described below and progress in meeting the specific goals and objectives of the HMP is discussed in the last part of this section (5.2.3)

5.2.2.1 Monitoring Methods. The first baseline assessment of vegetation and ground cover conditions in the grassland was conducted in June 2013. Subsequent monitoring has been conducted in April or May of 2014-2018. In 2019, the spring vegetation assessment and photo monitoring was conducted on April 22-24th and canopy height measurements were taken in February and April to capture winter and spring conditions for the current growing

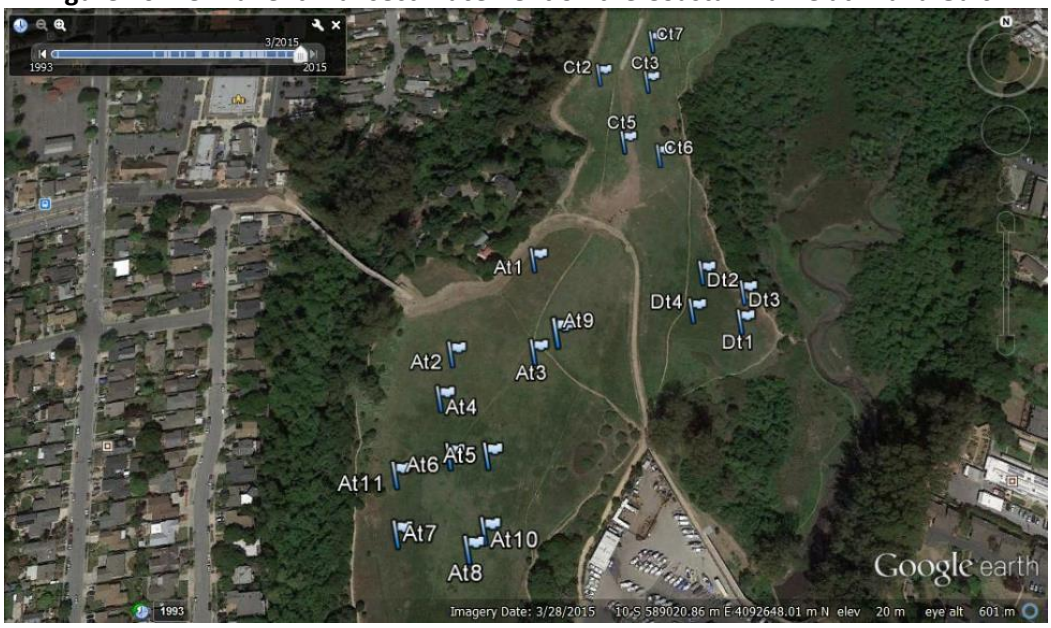
season and then again in December to assess conditions during the time when SCT is likely germinating.

The spring vegetation assessment has utilized the point intercept method on 25-meter transects to assess changes in plant species cover and ground cover. A total of 25 sample points per transect are recorded to obtain percent cover of each species encountered by the sampling rod. Ground cover (litter, bare, gopher disturbance, basal vegetation, rock) is also recorded. The average height of the canopy layer is measured at the 6, 12, 18, and 24-meter marks using a plastic dinner plate threaded on a wire pin (recorded at the height where the plate comes to rest). Each year a photo is taken at the 0-meter end looking along the length of transect with a whiteboard held up at the 5-meter point labeled with the transect number and date. The transect photos are included in **Appendix C (Item C-3)**. In addition to the point intercept data, a search is conducted within a 5-meter belt transect (using the transect as the centerline) to record the presence of any plant species not encountered on the transect. This additional method is often used to capture uncommon or rare species and more fully characterize species richness.

Transect ends have been permanently marked with rebar posts one half inch in diameter pounded into the ground and fitted with metal rebar caps imprinted with the transect ID. The GPS location of each end has been recorded along with the compass bearing of the transect from the 0-meter end. Many of the rebar and caps have been damaged by mowing or cattle since the first installation in 2013. Some have been replaced multiple times, but a few have not. The sample points are located each year using GPS and a metal detector.

During the initial monitoring set-up in 2013, transects were located using a stratified approach with satellite imagery from Google Earth to get a representative sample across the coastal prairie. 11 transects were established in Area A, 5 in Area C, and 4 in Area D, for a total of 20 transects, as shown in **Figure 26**. Preliminary data was collected and a power analysis was conducted using a statistical power calculator (http://www.dssresearch.com/toolkit/sscalc/size_a1.asp DSS Research) to determine the number of transects needed in each enclosure in order to assess a 5% change in percent cover at an 80% power level (with $\beta = 0.2$ and $\alpha = 0.1$, based on standard practice).

Figure 26. Permanent Transect Placement on the Coastal Prairie at Arana Gulch



Statistical tests on cover and canopy height data were performed using JMP version 14 software (SAS). For analysis, the transect is the sample unit and percent cover was calculated for each species encountered on the transect. The total number of species encountered on each transect was also calculated along with the percent ground cover of each category (only bare ground and litter are presented). Cover values were also summed on each transect by guild: exotic annual forb (EAF), exotic annual grass (EAG), exotic perennial forb (EPF), exotic perennial grass (EPG), native annual forb (NAF), native annual grass (NAG), native perennial forb (NPF), and native perennial grass (NPG).

Data were tested for normality and equality of variance required of ANOVA using multiple tests with a significance level at p=0.05. When data were normal, change in percent cover was examined using ANOVA with a Tukey's honest significant differences post-hoc test. For non-normal data, a Wilcoxon test was used (called a Kruskall-Wallis test if there are more than two groups). If the variances of the canopy height data were unequal across years, a Welch's test was used. The mean cover values are presented with error bars constructed using one standard deviation from the mean.

Photo Monitoring. Photo points for long-term monitoring were established in April 2015. A total of 15 points are distributed throughout the coastal prairie with two additional points on the Arana Creek Causeway and two on Hagemann Bridge (**Figure 27**). All points are located at either an interpretative sign or a fence corner for easy reference. Four photos are taken per point in a clockwise order facing into the enclosure; Photo 1 looks straight ahead, Photo 2 is to the right, Photo 3 looks straight behind, and Photo 4 to the left. All photos can be taken in about one hour, preferably when the sun is high in the sky and casting few shadows. The two points taken on the causeway looking into Arana Creek give a general idea of conditions in the riparian area. The additional points located on Hagemann Gulch Bridge look out and

down into the Gulch. One extra point is taken standing in front of the entry sign at Frederick Street in order to observe the recovery from the construction. Photos are in **Appendix C (Item C-4)**.

Figure 27. Location of Photo Points for Long-term Monitoring Established at Arana Gulch

5.2.2.2 Monitoring Results. Monitoring results are discussed in the following sections.

Precipitation Conditions. During the sampling years, rainfall has been below the long-term average of 30 inches reported for the Santa Cruz area (Western Regional Climate Center) in five of the seven years. **Table 5** presents monthly rainfall data from the DeLaveaga Golf Course, located just north of Arana Gulch. Precipitation for the 2018-2019 water year (33.17 inches) was just above the long-term average.

Table 5. Monthly Rainfall (inches) at the California Department of Water Resources (DWR) California Irrigation Management and Information System (CIMIS) Weather Station 104 (DeLaveaga)[6] for the 2013-2019 water years.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
2013	0.11	5.97	8.96	0.92	0.32	1.7	0.88	0.04	0.12	0.04	0.05	0.14	**19.25**
2014	0.06	0.31	0.12	0.02	3.16	1.4	0.45	0.04	0.05	0.16	0.02	0.96	**6.75**
2015	0	3.16	11.75	0	0.01	0	0	0.09	0.05	0.06	0.01	0	**15.13**
2016	0.04	3.38	5.36	12.92	0.17	0.31	0.72	0.24	0.03	0.06	0.13	0.07	**23.43**
2017	5.79	2.56	8.26	16	14.1	4.95	3.38	0.08	0.17	0.03	0.02	0.12	**55.46**
2018	0.07	2.85	0.17	6.11	0.3	6.67	1.33	0.04	0.04	0.04	0	0.04	**17.66**
2019	0.12	5.0	3.7	7.75	5.08	7.01	0.85	3.26	0.15	0.00	0.04	0.17	**33.13**

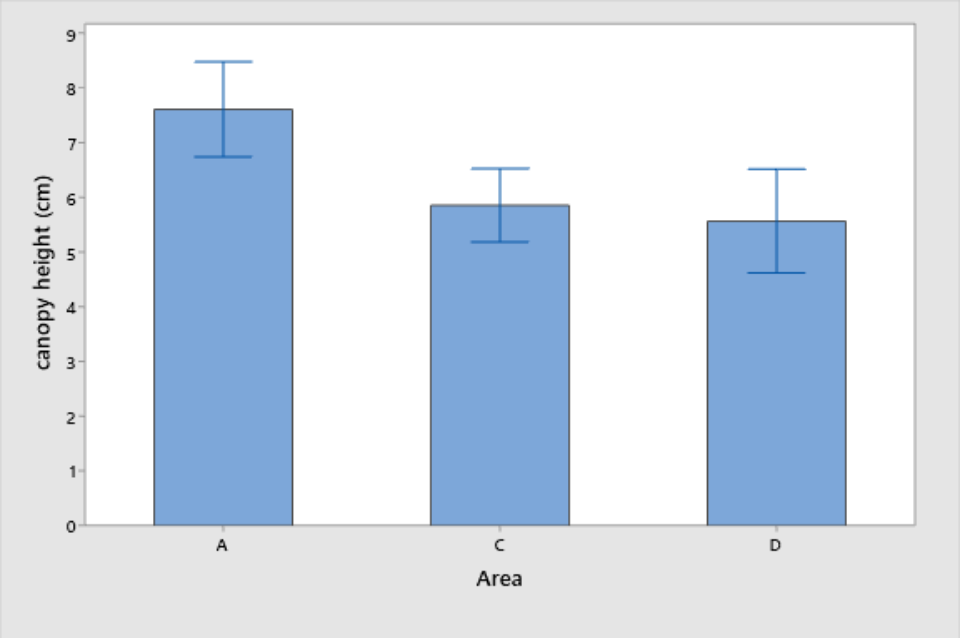
[6] see Station 104 at https://cimis.water.ca.gov/WSNReportCriteria.aspx)

Vegetation Assessment. The results below compare the un-grazed conditions in April of 2015 to grazed conditions in April-May of 2016-19. However, 2015 does not represent ideal baseline conditions because the vegetation had been subject to 6 weeks of grazing when it was sampled in April and it was also a very dry year. The 2013-2014 growing seasons were also very dry and sampling occurred late in 2013. Therefore, 2015 is the most representative baseline dataset available. Data from 2013 and 2014 have been presented in previous reports and are available on request.

Canopy Height. In the HMP, Objective 3A is to reduce canopy height between the months of November thru April to 5 to 8 cm (2-3 in). This target is intended to increase the amount of light penetrating the ground and increase the ability of SCT seed to germinate. In 2019, canopy heights in February were within the target in all management Areas **(Figure 28).**

Figure 28. Mean Canopy Height (cm) in Area A, C, and D Measured in February 2019

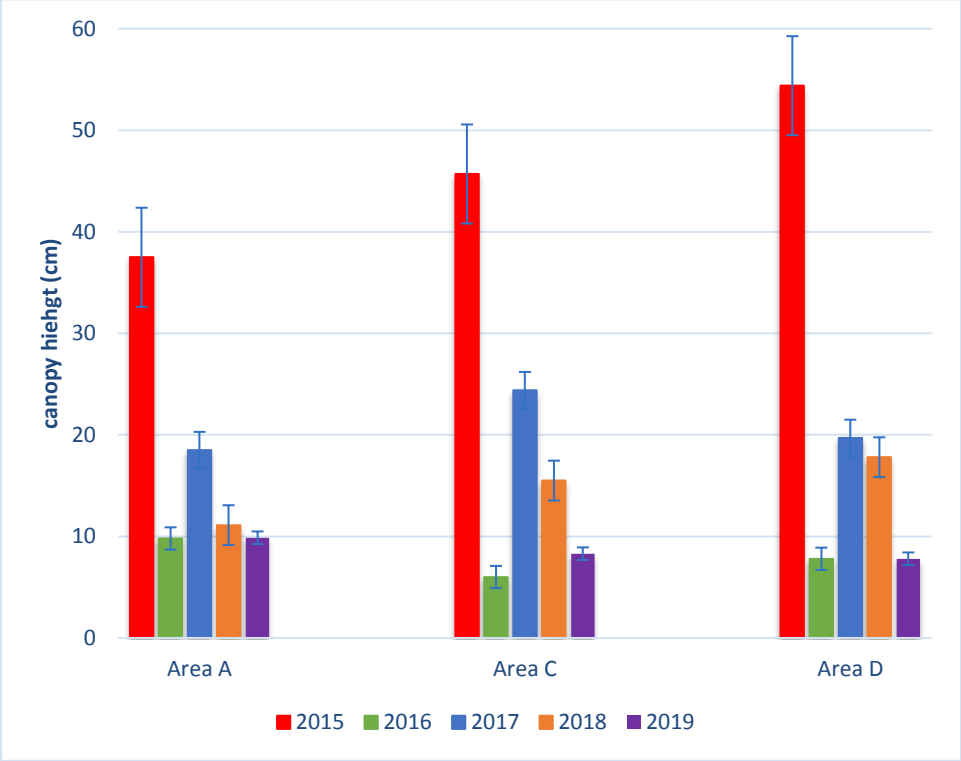
Each error bar is constructed using 1 standard error from the mean



Canopy heights measured in April have been significantly reduced compared to the 2015 baseline across all years (Kruskall-Wallis (p<.0001) in JMP v14.0) **(Figure 29).** In 2019, canopy heights in Areas C-D were at target (8 cm (3 in)] and only slightly above target in Area A (10 cm (4 in)]. Compared to last year, canopy heights were significantly reduced in Areas C and D, but stayed similar in Area A (Kruskal-Willis, p<.0001).

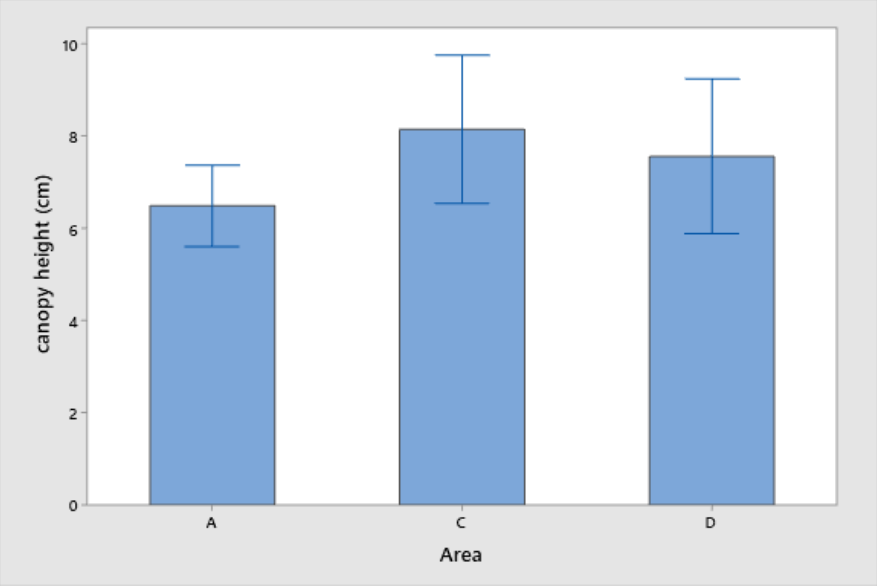
Figure 29. Mean Canopy Height (cm) in Area A, C, and D Measured in April of 2015-2019

Each error bar is constructed using 1 standard error from the mean



In previous years, canopy heights have been measured in August when SCT was still booming. In 2019, canopy heights were measured in December in order to assess the conditions during the time when SCT could be germinating in the new growing season. December canopy heights were within the target in all three Management Areas **(Figure 30).**

Figure 30. Mean Canopy Height (cm) in Area A, C, and D Measured in December 2019
Each error bar is constructed using 1 standard error from the mean

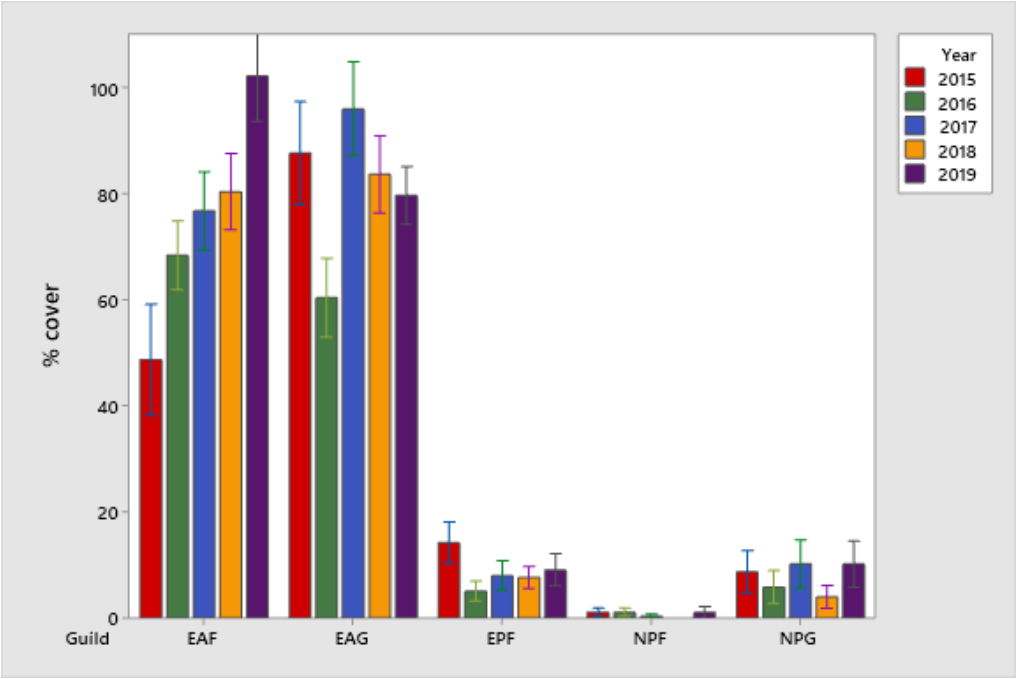


Canopy Cover. Objective 3B is to reduce the cover of non-native species and Objective 3C is to increase the cover of native species. Since grazing began in 2015, the grazing program has not significantly reduced non-native plant cover or increased the cover of native species in any of the three grazing Areas. Therefore, the interim success criteria for canopy cover have still not been met in 2019.

Exotic annual forbs (EAF) and exotic annual grasses (EAG) continue to dominate the vegetation in 2019 in Area A **(Figure 31)**. The cover of EAF has increased steadily since grazing commenced in 2015, climbing from 48 to 100% in 2019. The gradual increase in EAF is likely due to increase in clovers (*Trifolium subterraneum* and *T. dubium*), smooth and rough cat's ear (*Hypochaeris glabra, H. radicata*), and geranium (*Geranium dissectum*), which were mostly absent in 2015 but have steadily increased in cover. In contrast, cover of EAG dipped sharply in 2016 due to a sharp drop in the cover of wild oat (*Avena fatua*), but otherwise has remained greater than 80%. Exotic perennial forbs (EPF) have declined, due to declines in English plantain (*Plantago sp.*) and common vetch (*Vicia sativa sp.*). Area A is the only place on the prairie where measurable native species cover has been detected, but native species cover has not increased across the sampling years. Cover of native perennial forbs (NPF), represented only by California poppy (*Eschscholzia californica)*, has been 4% or less. Cover of native perennial grasses (NPG) has been at 10% or less and has consistently included California oatgrass *(Danthonia californica)*, spreading rush (*Juncus patens)*, purple needlegrass (*Stipa pulchra),* and California brome (*Bromus carinatus*).

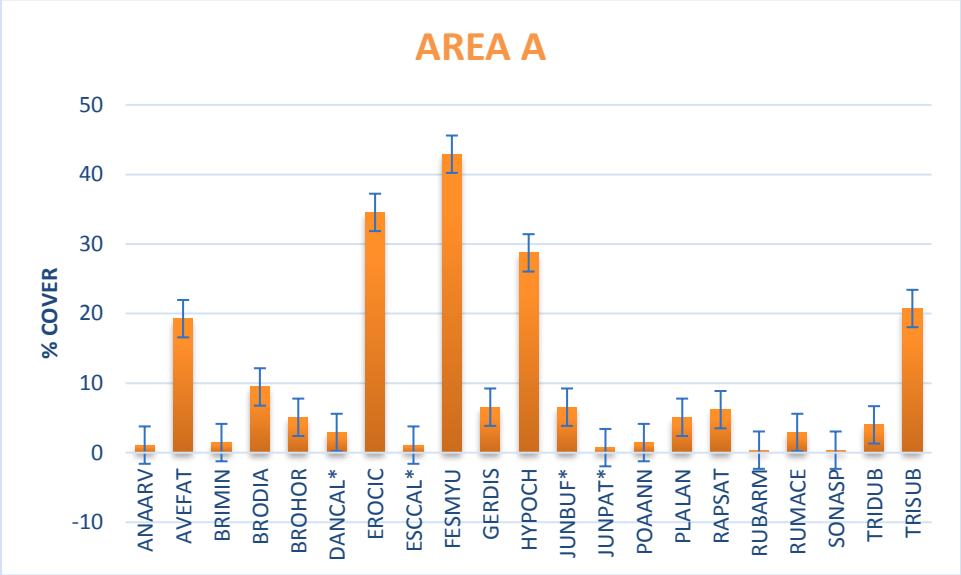
Figure 31. Mean Percent Cover of 5 Plant Guilds in Area A in April 2015-2019

Each error bar is constructed using 1 standard error from the mean.



In 2019, individual species cover was calculated from the Area A transects for 21 species with cover values ranging from less than 1 to 43% **(Figure 32)**. Rat-tail fescue (*Festuca myuros*) and filaree (*Erodium cicutarium*) remained two of the most dominant species in 2019. Prior to the start of grazing in 2015, wild oat was the most dominant species (43% cover in 2015) but since then cover has been less than 20%. Cover of cat's ear (*Hypochaeris sp.*), mostly absent in 2015, increased in 2018 (to 12% cover) and exploded in 2019 to 29% cover. Likewise, the cover of clover (*Trifolium sp.)*, also mostly absent in 2015, increased in 2018 (10% cover) and then increased dramatically to 24% cover in 2019. Native species cover has been limited to only a few species over the sampling period and is mostly represented by California oat grass and spreading rush with each having 4% cover or less. In 2019, toad rush (*Juncus bufonius*), a species not previously captured in the transect sampling, had 6% cover. The diminutive rush is usually found in wetlands and so it's appearance may be due to the wetter conditions that have occurred in two of the last three sampling years.

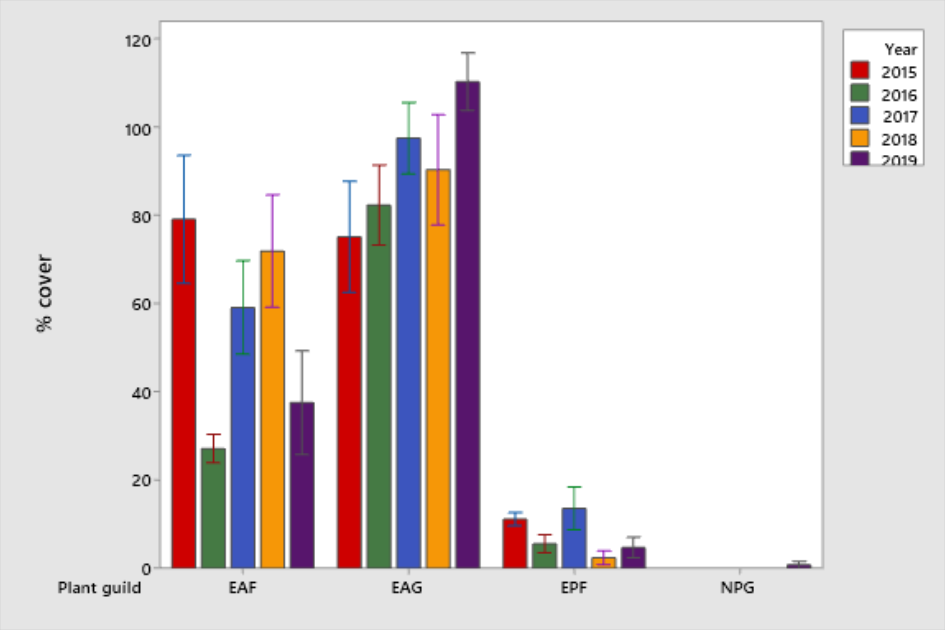
Figure 32. Mean Percent Cover of all Plant Species in Area A, April 2019
Native species are marked with *. Each error bar is constructed using 1 standard error from the mean.



Area C remains dominated by non-native species and native species are still not present in measurable quantities **(Figure 33)**. Cover of EAF has fluctuated since grazing commenced in 2015. The significant drop in EAF in 2016 was due to a decline in cover of wild radish (*Raphanus sativa)* from 58% to only 12%. In contrast, cover of EAG has increased steadily since 2015. Cover of EPF, comprised of common vetch (*Vicia sativa)* and Italian thistle (*Carduus pycnocephalus*) has declined somewhat from 11% in 2015 to 5% in 2019. This decline is likely due to increased management of Italian thistle, rather than grazing.

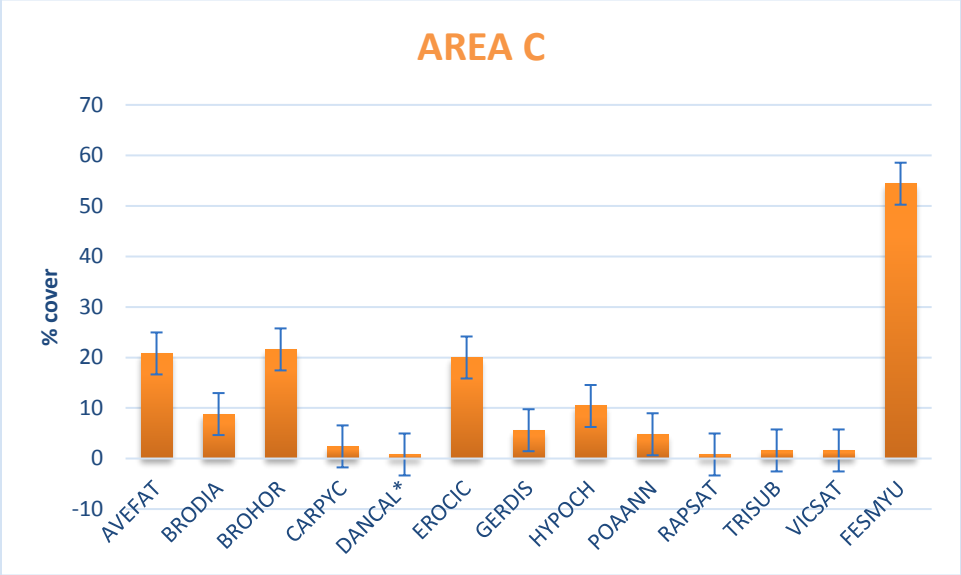
Figure 33. Mean Percent Cover of 3 Plant Guilds in Area C in April 2015-2019

Each error bar is constructed using 1 standard error from the mean.



In Area C, 13 species were recorded on the transects in 2018 with cover values ranging from <1 to 54% (**Figure 34**). Rat-tail fescue, with 53% cover in 2019, now has the greatest cover in Area C and the thick litter/thatch layer it creates is likely an important factor in the low overall species diversity. The cover of wild radish, which declined dramatically after grazing began, was <1% in 2019. The average cover of filaree (*Erodium cicutarium*), which doubled in 2018, increasing from 15 to 30%, was back to 20% in 2019. California oatgrass was recorded with <1% cover, which represents the first time a native species has been captured in the transect sampling in Area C.

Figure 34. Mean Percent Cover of all Plant Species in Area C, April 2019
Each error bar is constructed using 1 standard error from the mean.



Area D is also dominated by non-native species and no native species have been measured on the point intercept transects across the sampling years **(Figure 35)**. The cover of EAF has fluctuated over the sampling period, mainly due to changes in filaree and dissected geranium. In contrast to Areas A and C, cover of EAG has declined over the sampling period, mainly due to a large drop in wild oat, which had high cover in 2015 (48%) and only 10% in 2019 **(Figure 36)**. Cover of EPF, represented mainly by sheep's sorrel (*Rumex acetosella)*, has remained similar throughout the sampling period. Cover of velvet grass (*Holcus lanatus)*, the only exotic perennial grass detected in sampling, increased significantly in 2018 to around 10% cover and remained at that level in 2019. Only 12 non-native species were recorded on the transects in Area D, down from 16 in 2017, with cover ranging from 1 to 38% **(Figure 36)**. Filaree and rat-tail fescue were the dominant species in Area D.

Figure 35. Mean Percent Cover of 4 Plant Guilds in Area D April of 2015- 2019

Each error bar is constructed using 1 standard error from the mean.

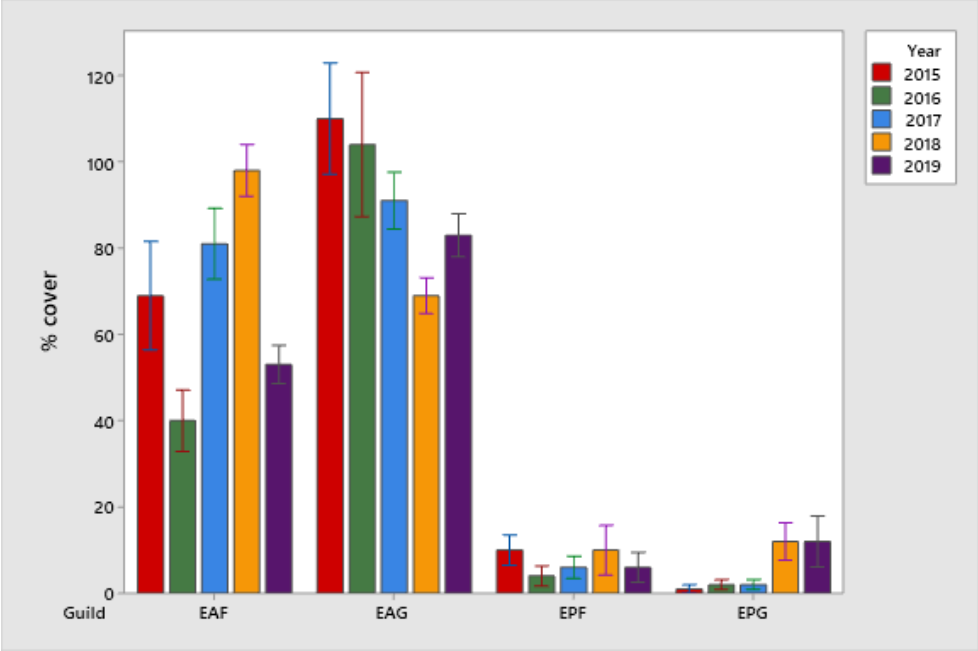
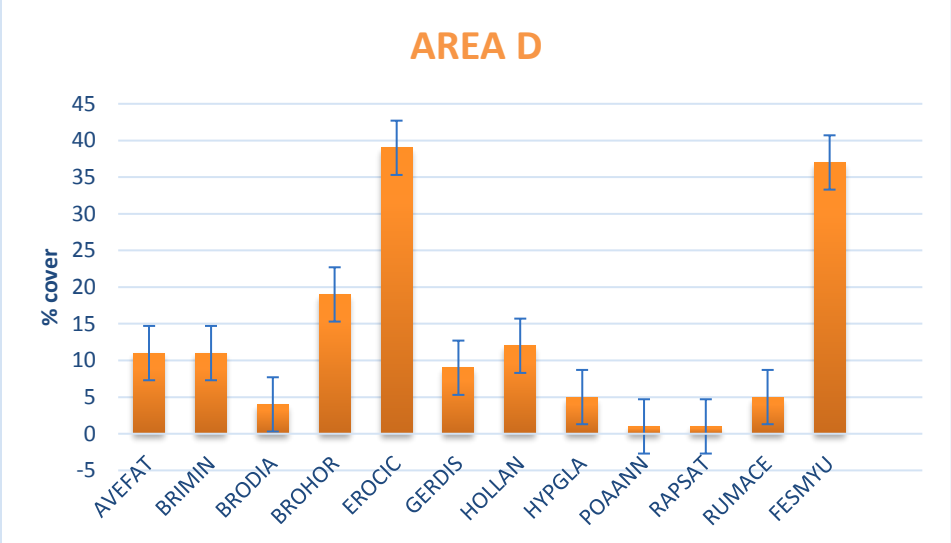


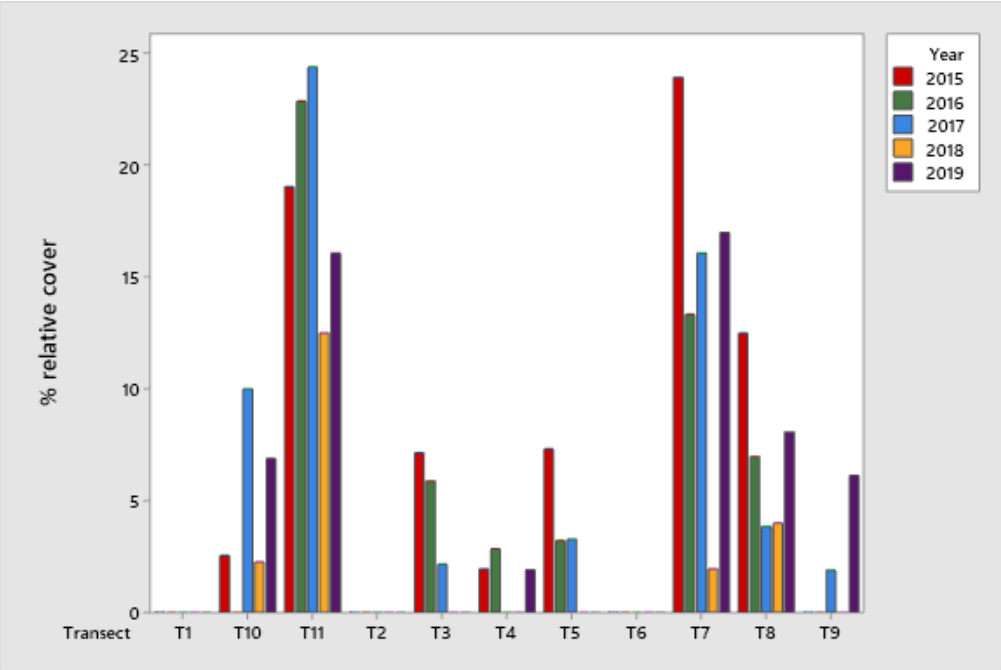
Figure 36. Mean Percent Cover of all Plant Species in Area D, April 2019

Each error bar is constructed using 1 standard error from the mean.



Relative Native Cover. New in 2019, the relative cover, or measured proportion, of native species was examined by transect in Area A (**Figure 37**). Relative cover of native species in transects 10,11,7, and 8 appears higher across the sampling years than in the other transects. Native species have been absent in the sampling in Areas C and D.

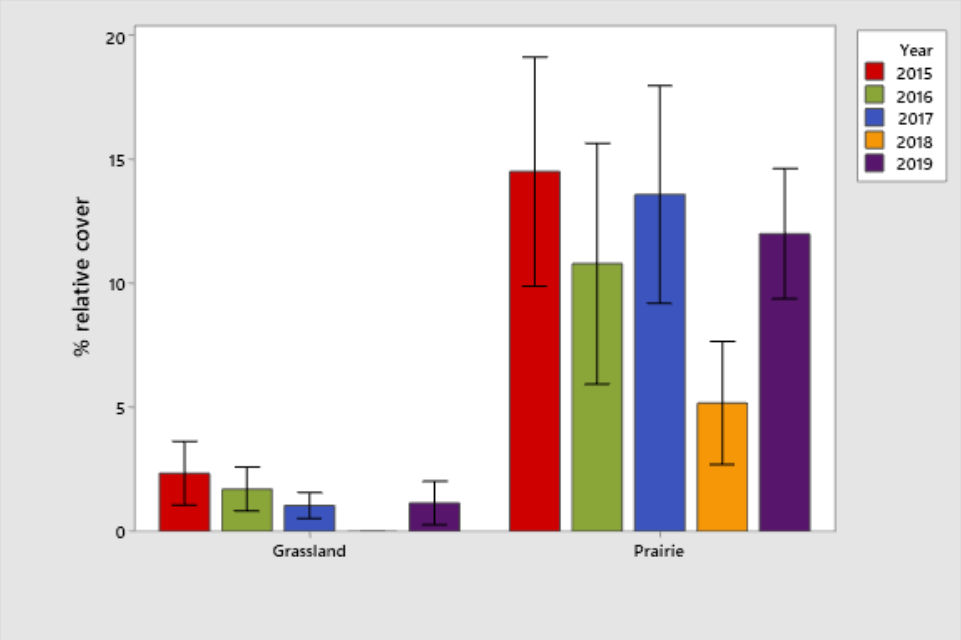
Figure 37. Relative Percent Cover of Native Plant Species in Each of the 11 Sampling Transects Located in Area A, April, 2019



Transects 10,11,7, and 8 are located within the confines of the delineated coastal prairie habitat shown in **Figure 24** in Section 5.2.1. When these four transects are combined, relative cover in the prairie transects is higher than in the 7 grassland transects (**Figure 38**). With the exception of 2018, relative native cover in the coastal prairie in Area A has been between 10-14% and less than 3% in the annual grassland.

Figure 38. Relative Percent Cover of Native Plant Species in Area A April, 2019 in Sampling Transects Located in the Coastal Prairie or the Annual Grassland

Each error bar is constructed using 1 standard error from the mean.



Species Richness. Objective 3D is to increase native species richness. Average native species richness has remained at one species or fewer across the Areas and the sampling period **(Table 6)**. Very small occurrences of native species have been observed outside of the sampling plots. While total species richness has increased an average of one to five species in all Areas, the increase is due to an increase in non-native species.

Table 6. Species Richness in Areas A, C, and D in Sampling Conducted in 2013-2019

Species Richness	2015	2016	2017	2018	2019
AREA A					
Total # species/125 m^2	11.2 (3.8)	10.5 (4.4)	12.1 (3.9)	13.3 (3.2)	13.5 (3.6)
# Native species/ 125 m^2	1.0 (1.1)	1.0 (0.9)	1.3 (1.0)	1.4 (1.3)	0.8 (0.8)
AREA C					
Total # species/125 m^2	7.4 (0.9)	10.5 (2.1)	14.5 (2.6)	12.4 (2.3)	13.2 (1.1)
# Native species/ 125 m^2	0	0.8 (1.5)	0	0.4 (.89)	0.3 (.48)
AREA D					
Total # species/125 m^2	12.3 (1.7)	11.3 (2.2)	13.5 (3.3)	13.5 (3.3)	12.7 (2.8)
# Native species/ 125 m^2	0	0.8 (0.5)	0.8 (0.9)	0.75 (1.0)	0.5 (1.1)

A total of 43 plant species have been detected in the sampling across the years **(Table 7)**. Only 11 native species have been recorded including one tree, two shrubs, three forbs, three

grasses, and two rushes. A few other native species have been observed in Area A outside of the sample plots including gumplant (*Grindelia stricta)* and coast sun cups (*Taraxia ovata*). The sun cups may be new since grazing commenced.

In Area A, the same seven native species including California oatgrass *(Danthonia californica)*, California poppy *(Eschscholzia californica)*, spreading rush (*Juncus patens)*, purple needlegrass (*Stipa pulchra)*, California brome (*Bromus carinatus*), coyote brush (*Baccharis pilularis*), and California rose (*Rosa californica*) have been consistently detected in very low levels across all sampling years.

In Area C, only two native species (toad rush and coast tarweed (*Deinandra corymbosa*) have been detected in the belt transects. In 2019, California oatgrass was detected in the transect sampling for the first time. In Area D, spreading rush and California oatgrass have been detected in the belt sampling.

Table 7. Plant Species Detected in Areas A, C, and D in Sampling Conducted in 2013-2019 (native species are in **bold).**

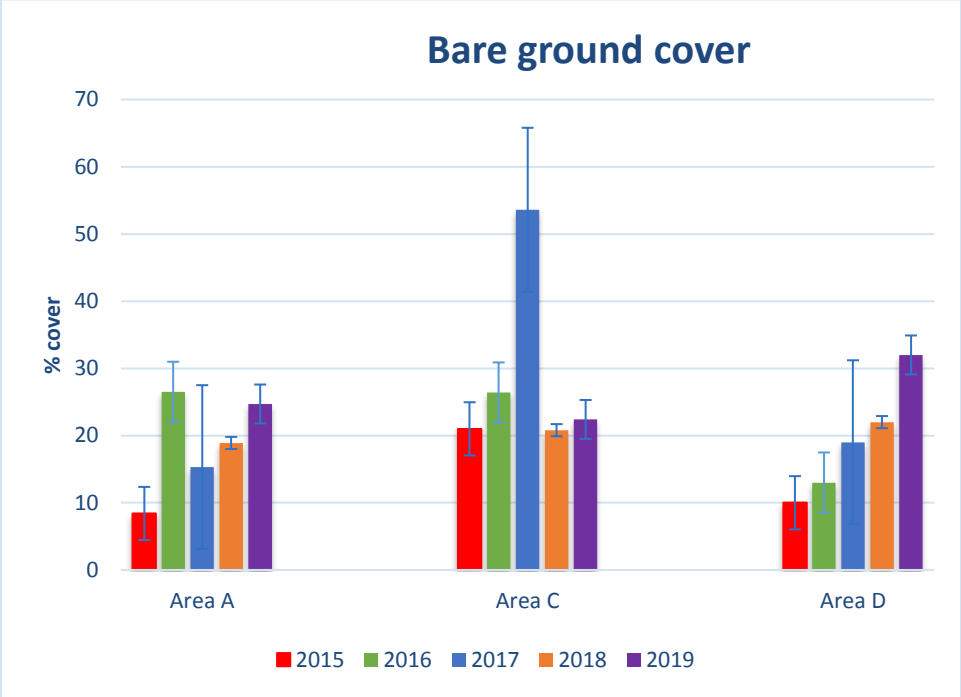
Scientific Name, TJM 2	Area(s) found	Common Name	Life form	Family	Species Code
Anagallis arvensis	A, C, D	Scarlet pimpernel	EAF	PRIMULACEAE	ANAARV
Avena fatua	A, C, D	Wild oat	EAG	POACEAE	AVEFAT
Baccharis pilularis	A	Coyote brush	Shrub	ASTERACEAE	BACPIL
Briza maxima	A, D	Rattlesnake grass	EAG	POACEAE	BRIMAJ
Briza minor	A, D	Quaking grass	EAG	POACEAE	BRIMIN
Bromus carinatus	**A**	**California brome**	**NPG**	**POACEAE**	BROCAR
Bromus diandrus	A, C, D	Ripgut brome	EAG	POACEAE	BRODIA
Bromus hordeaceus	A, C, D	Soft chess	EAG	POACEAE	BROHOR
Carduus pycnocephalus	C	Italian thistle	EPF	ASTERACEAE	CARPYN
Cerastium glomeratum	A, C	Mouse-ear chickweed	EAF	CARYOPHYLLACEAE	CERGLO
Cirsium vulgare	A	Bull thistle	EPF	ASTERACEAE	CIRVUL
Convolvulus arvensis	A, C, D	Bindweed	EPF	CONVOLVULACEAE	CONARV
Danthonia californica	**A, D**	**California oatgrass**	**NPG**	**POACEAE**	DANCAL
Deinandra corymbosa	**C**	**coast tarplant**	**NPF**	**ASTERACEAE**	DEICOR
Elymus triticoides	**A, D**	**wild rye**	**NPG**	**POACEAE**	ELYTRI
Erodium botrys	A, C, D	long bill stork's beak	EAF	GERANIACEAE	EROBOT
Erodium cicutarium	A, C, D	red stem filaree	EAF	GERANIACEAE	EROCIC
Eschscholzia californica	**A**	**California poppy**	**NPF**	**PAPAVERACEAE**	ESCCAL
Festuca (Vulpia) myuros	A, C, D	Rattail six weeks grass	EAG	POACEAE	FESMYU
Festuca perennis (Lolium multiflorum)	A, C, D	Italian ryegrass	EAG	POACEAE	FESPER
Geranium dissectum	A, C, D	Cutleaf geranium	EAF	GERANIACEAE	GENMON
Holocarpha macradenia	**A**	**Santa Cruz tarplant**	**NPF**	**ASTERACEAE**	GERDIS
Holcus lanatus	A, C, D	velvet grass	EPG	POACEAE	HOLLAN
Hypochaeris glabra	A, C, D	Smooth cat's-ear	EAF	ASTERACEAE	HYPGLA
Hypochaeris radicata	A, C, D	rough cat's-ear	EPF	ASTERACEAE	HYPRAD

Table 7. Plant Species Detected in Areas A, C, and D in Sampling Conducted in 2013-2019 (native species are in **bold).**

Scientific Name, TJM 2	Area(s) found	Common Name	Life form	Family	Species Code
Juncus bufonius	**C**	**toad rush**	**NAG**	**JUNCACEAE**	**JUNBUF**
Juncus patens	**A, C, D**	**Spreading rush**	**NPG**	**JUNCACEAE**	JUNPAT
Lactuca serriola	C, D	Prickly lettuce	EPF	ASTERACEAE	LACSER
Plantago lanceolata	A, C, D	English plantain	EPF	PLANTAGINACEAE	PLALAN
Poa annua	A, C, D	Annual bluegrass	EAG	POACEAE	POAANN
Quercus agrifolia	**A**	**Coast live oak**	**Tree**	**FAGACEAE**	QUEAGR
Raphanus sativus	A, C, D	wild radish	EAF	BRASSICACEAE	RAPSAT
Rosa californica	**A**	**California rose**	**Shrub**	**ROSACEAE**	ROSCAL
Rubus ameniacus	A, C	Himalayan blackberry	Shrub	ROSACEAE	RUBARM
Rumex acetosella	A, D	Sheep sorrel	EPF	POLYGONACEAE	RUMACE
Rumex crispus	A, C	Curly dock	EPF	POLYGONACEAE	RUMCRI
Silybum marianum	C, D	Milk thistle	EPF	ASTERACEAE	SILMAR
Sonchus asper	A, C, D	Sow thistle	EPF	ASTERACEAE	SONASP
Stipa pulchra	**A**	**Purple needlegrass**	**NPG**	**POACEAE**	STIPUL
Tragopogon pratensis	A, C, D	Salsify	EPF	ASTERACEAE	TRAPRA
Trifolium dubium	A, C, D	Subterranean clover	EAF	FABACEAE	TRIDUB
Trifolium subterraneum	A, C, D	Subterranean clover	EAF	FABACEAE	TRISUB
Vicia sativa subsp. sativa/nigra	A, C, D	common/narrow leaved vetch	EPF	FABACEAE	VICSAT

Bare Ground. Objective 3E is to increase the cover of bare ground. This objective has been met in Areas A and D, where the average cover of bare ground has increased significantly since 2015 (**Figure 39**), Kruskal-Wallis $p<.05$). Measured bare ground cover in Area C increased significantly in 2017 to 54% from 26%, but otherwise bare ground in Area C and has not changed significantly. Bare ground measurements were taken within occupied SCT areas in December (during SCT germination period) (see Section 5.1.2.3). Cover of litter across the prairie has fluctuated, but there has not been a declining trend (data not shown).

Figure 39. Mean Cover of Bare Ground Sampled in Areas A, C, and D April, 2015-2019
Each error bar is constructed using 1 standard error from the mean.



5.2.3 HMP Performance Evaluation

The purpose of the detailed vegetation monitoring is to assess progress toward meeting the interim success criteria specified in the HMP.

Objective 3A is to reduce canopy height between the months of November thru April to 5 to 8 cm (2-3 in). This target is intended to increase the amount of light penetrating the ground and increase the ability of SCT seed to germinate. Compared to pre-grazing conditions in 2015, average canopy heights have been reduced in all three areas of the coastal prairie across all sampling years and therefore, this interim objective was met in 2016 when grazing started. In 2019, canopy heights were measured in December instead of August in order to assess the conditions during the time when SCT could be germinating in the new growing season. December canopy heights were within the target in all three Management Areas.

Objective 3E is to increase the cover of bare ground. This target is intended to increase the exposure of SCT seed and increase the potential for germination. This objective has been met in Areas A and D, where the average cover of bare ground has increased since grazing started. In Area C, with the exception of a one-time increase in 2018, bare ground has remained around 20% since 2015, a level that is higher than the other Areas. The amount of bare ground became similar across all three Areas in 2018 and remained so in 2019. However, RDM sampling has indicated that late season growth is still above target across much of the prairie. Therefore, grazing intensity may have not been sufficient to reduce the thatch layer and increase bare ground to sufficiently high levels. Measurement of bare ground within occupied SCT area in December (during the time that SCT is likely to germinate) found bare ground ranged from 10 TO 15%, averaging 11%.

The other 3 interim success criteria address species composition and richness during peak production in April. Objective 3B is to reduce the cover of non-native species, Objective 3C is to increase the cover of native species, and Objective 3D is to increase native species richness. Across the prairie, the cover of non-native plant guilds has not been significantly reduced and the cover of native species has not increased since the grazing began, so these objectives are not met. Likewise, the objective to increase the number of native species present on the prairie has not been met. Across all the sampling years, only 11 of the 42 plant species captured in the sampling are native, but most of these were observations in the belt transects, rather than quantifiable hits within the sampling transects.

Changes in species composition and richness have been observed in response to the grazing, but these have been limited to non-native plant guilds. The most visible change on the prairie is a decline in the very tall canopy layer of wild oat. However, the lower statured rat-tailed fescue has filled in its place, so overall grass cover has not declined and the thick layer of rat-tail fescue continues to contribute to litter build up. The reduction in canopy height and increase in bare ground have likely facilitated an increase in exotic annual forbs such as cat's ear, filaree, and geranium. Across the grazing period, the relative cover of native species in Area A has remained less than 15% and native species are still absent in the sampling in Areas C and D.

The lack of success in reducing non-native cover or increasing the cover or richness of native species combined with a very weak (or negligible) recruitment response of SCT indicates that the current grazing strategy is not meeting the interim biological success criteria defined in the Habitat Management Plan. Although the directional objectives for canopy height and bare ground have been mostly met, current conditions at Arana Gulch have not allowed for recruitment of native species and SCT, which is the central goal. Quantitative data on soil conditions and the SCT seedbank at Arana Gulch indicate that a depleted seedbank and poor soil quality are very likely limiting expression of SCT and possibly other native species. Therefore, an emphasis on further reductions in canopy height or increases in bare ground may be insufficient.

An adaptive management work plan to conduct experimental management actions on the coastal prairie is required to enhance habitat conditions for SCT beyond what has been achieved through grazing alone. The AMWG agreed to develop a plan at the May meeting, and the Arana Gulch SCT Habitat Enhancement Work Plan was completed by Alison Stanton in November (see Section 5.1.1.2). Recommendations in that plan include a continuation of the grazing, but with increased intensity to lower the thick thatch layer, and experimental scraping and prescribed fire. Experimental actions were implemented in November as described in Section 5.1.1.3. The 2020 vegetation assessment methodology and design will need to be modified to assess response to those actions. The design should also recognize the delineated coastal prairie within Area A as a sampling unit distinct from the rest of the annual grassland in order to more accurately assess progress in meeting HMP success criteria.

5.3 Grazing and Stocking Program

5.3.1 Management Actions

The installation of cattle grazing infrastructure was completed in February 2015. The grazing enclosure includes about 18.75 acres (8.4 hectares), divided as follows: Area A = 15 acres (6 ha); Area C = 4.1 acres (1.6 ha); and Area D = 2.1 acres (0.9 ha).

Although fences were installed in 2014, a ramp from Agnes Street to the holding coral and water hook-ups for the troughs were completed in February 2015. Large "Cattle Grazing Area" signs were installed at the three trail entrances; smaller signs were installed on the fence posts where trails are in close proximity to the grazing area. Additional signs indicating that the cattle graze to help restore the SCT were installed in February 2016. The City received input from the AMWG on the language for these signs. In 2017, a gate was added in Area C to facilitate movement of animals between areas A and C. Fences, access gates, and other features to support cattle grazing were inspected and maintained throughout 2019.

The City's grazing contractor had cattle onsite from December 23, 2018 to July 11, 2019. The HMP's original estimate for cattle was 2 to 6 cow calf pairs. However, it became evident during the 2018 grazing season (as with previous years) that this number of cattle was insufficient to keep up with the rate of grass growth. As an adaptive management action, the AMWG revised its recommendation to the City to provide the City and the rancher with more flexibility to increase the number of cattle at the site to keep pace with grass growth. The specific number of cattle present onsite throughout the 2018 grazing season are presented on **Table 8**. At the height of the spring season, a total of 23 cattle was on site. Cattle were first brought onto Area C and D (gate open between areas) on December 23, 2018, then on January 28 they were moved into Area A. The cattle were moved from Area A on March 21 because nothing was left to eat. The entire site was grazed to look like it had been mechanically mowed with a tractor to a three-inch height. When cattle were placed back to Areas C and D, the canopy height was approximately 8 to 10 inches. Cattle grazed Areas C and D until April 14 before being moved back to Area A. Additional cattle were brought into Areas C and D for a couple of weeks before being rotated over to Area A with the other cattle. Twenty-one cattle grazed Area A from May 15 to June 25 before being rotated back to Areas C and D to close out the season. Cattle grazed Areas C and D until July 10.

As grazing occurred in 2019, the City conducted numerous observations of grazing operations, including the entry and exit of cattle from the site, conferring with the grazing operator, observations of feed and water troughs (regularly during the grazing season), recording residual dry matter (RDM) and adherence to BMPs (see Section 3.5.6 in HMP). In 2016, four wood rubbing posts (4x4's) installed in the grazing area in December to encourage cattle to congregate and create additional bare ground that may be suitable for SCT germination. Small area of bare ground was found around these posts in 2018, yet no SCT was detected in these areas. A molasses bucket was placed in Area A in May 2019 to create an area of bare grown to facilitate SCT seed expression. The resulting bare ground was created in the historic area of SCT. The bare ground area is depicted in **Figure 40.**

Figure 40. Bare Area Created by Cattle and Molasses Bucket, Area A, July 2019

Residual Dry Matter. Residual dry matter (RMD) is the amount of dry plant material left standing or on the ground from the previous year's growing season (Bartolome *et al*. 2006). RDM includes three components: 1) the current year's crop of palatable forage, 2) non-palatable plants, weeds, and the stubble of dry matter that is left behind when clipping and 3) thatch, which is dead plant material greater than one year old. *A Mulch Manager's Guide for Monitoring Success* (Wildland Solutions 2008) provides practical information on how to assess RDM in a manner that is objective and directly related to management objectives for rangeland health. The RDM monitoring was conducted on September 19 by Kathleen Lyons. Pursuant to the methodology outlined in *Guidelines for Residual Dry matter on Coastal and Foothill Rangelands in California* (UC Publication 8092 by J. Bartolome) the grazing areas were walked along random transects. Equipment consisted of a clip and weigh RDM kit from Wildland Solutions that included a 13.25" diameter circular hoop plot, a gram scale, and measuring bag. The RDM plot was randomly tossed and the vegetation was clipped and weighed. A photo was obtained of each plot before and after clipping; noting plot number, RDM level and date on dry erase board. The measuring bag was weighed empty, summer annual plants and any tree leaves were removed from the clip plot; old thatch was not evident and not included. Plants rooted in the plot were clipped as close to the ground as possible, clippings were placed in the bag, weighed and recorded (subtracting weight of the bag). The weight of the clippings was converted to pounds per acre (grams clipped x 100 = lbs./acre RDM).

Table. 8. Number of Cattle and Duration of Grazing Season per Grazing Area in 2019

Duration	# of Cattle in Area A	# of Cattle in Area C	# of Cattle in Area D	# of Cattle in Areas C & D (open gate)	# of months grazed	The cattle were 600 lb heifers and steers. AU Conversion (0.6)	AUM	Comments
December 23 to January 28				7	1.2	0.6	5.04 AUM Areas C/D	
January 28 to March 21	7				0.8	0.6	3.36 AUM Area A	Area A looks like a Polo Field.
March 21 to March 28				21	0.25	0.6	3.15 AUM Areas C/D	
March 28 to April 14				9	0.57	0.6	3.06 AUM Areas C/D	
April 14 to May 2	9				5.33	0.6	2.88 AUM Area A	
May 2 to May 14	9			12	0.4	0.6	2.16 AUM Area A 2.88 AUM Areas C/D	
May 14 to June 25	21				1.36	0.6	17.14 AUM Area A	
June 25 to July 10				14	0.5	0.6	4.2 AUM Areas C/D	One load of cattle is removed due to concern over newborns.

Clipping and weighing RDM plots was used to calibrate visual estimates of three RDM levels corresponding to an RDM objective of 500-650 lbs./acre (exceeds, meets, or below). Once the observer's eyes were calibrated, it was possible to assess the RDM level without a clip plot. Locations where RDM levels were assessed as well as edges of mapped boundaries were recorded with GPS waypoints.

The results were plotted onto an aerial photo to create an RDM zone map, based on GPS points mapped onto most recent Google Earth imagery available, and polygons created. The RDM zone map, portraying the following RDM levels, provides a sufficient level of detail for aiding management and cattle grazing decisions:

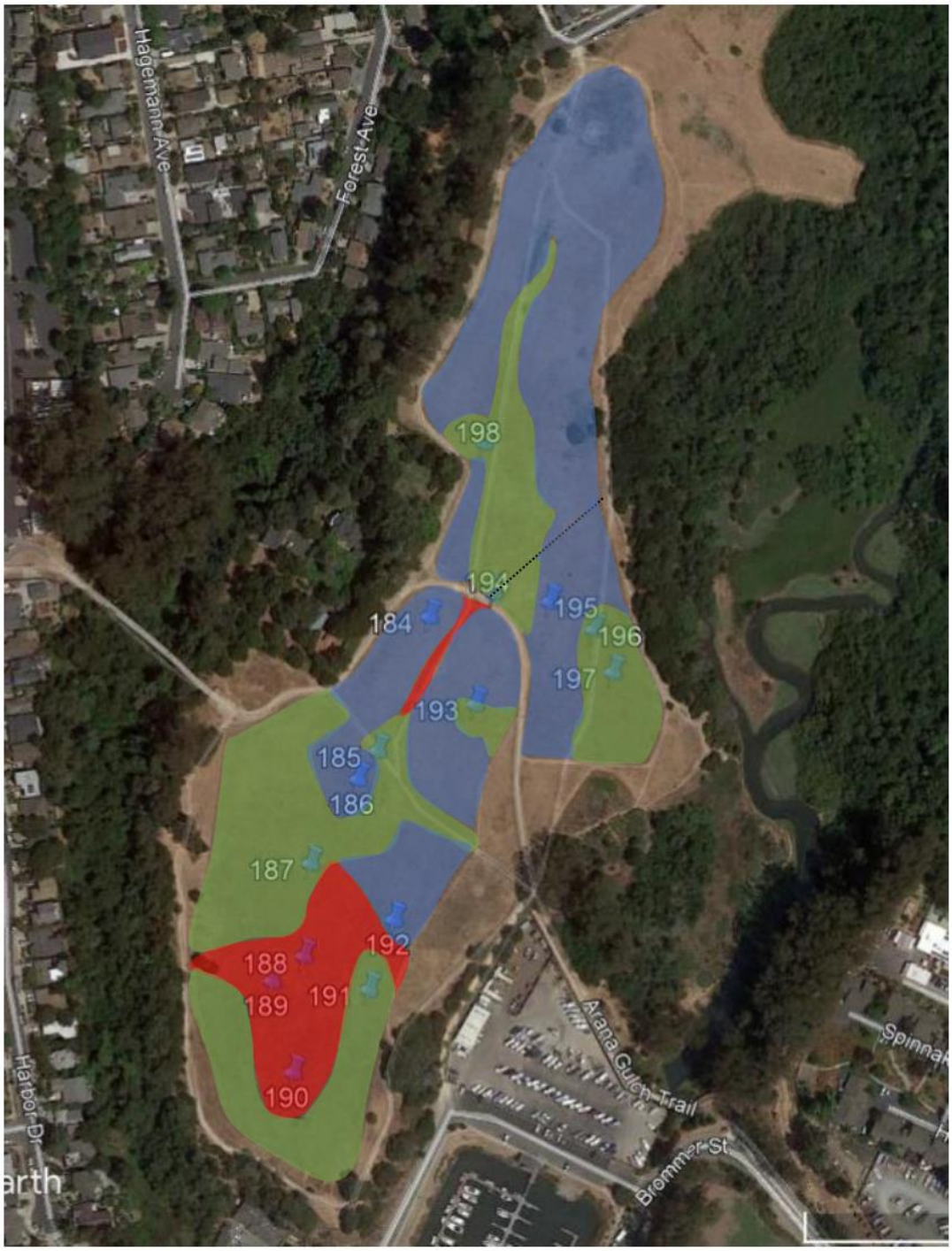
BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

5.3.2 Monitoring Results

Residual Dry Matter. In Area A, most of the southern portion of the grazing area was recorded as middle RDM (green, 500-650 lbs./acre) or the lowest RDM (red, <500 lbs./acre) which reflects the effects of seasonal grazing that occurred between December 2018 and July 2019. The northern portions of the grazing area had higher RDM values, mapped as blue and some green.

At most locations, thatch was not evident as cattle ingested the current and previous year's growth. **Figure 41** exhibits the RDM map for all grazed areas (A, C, and D). **Figures 42, 43,** and **44** show clip plots with highest RDM (>650 lbs./acre), middle RDM (500-650 lb./acre) and lowest RDM (<500 lbs./acre), respectively.

Figure 41. RDM Map for Grazing Areas, September 2019



BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

Figure 42. Clip Plot of Highest RDM (Blue), September 2019

Figure 43. Clip Plot of Middle RDM (Green), September 2019

Figure 44. Clip Plot of Lowest RDM (Red), September 2019

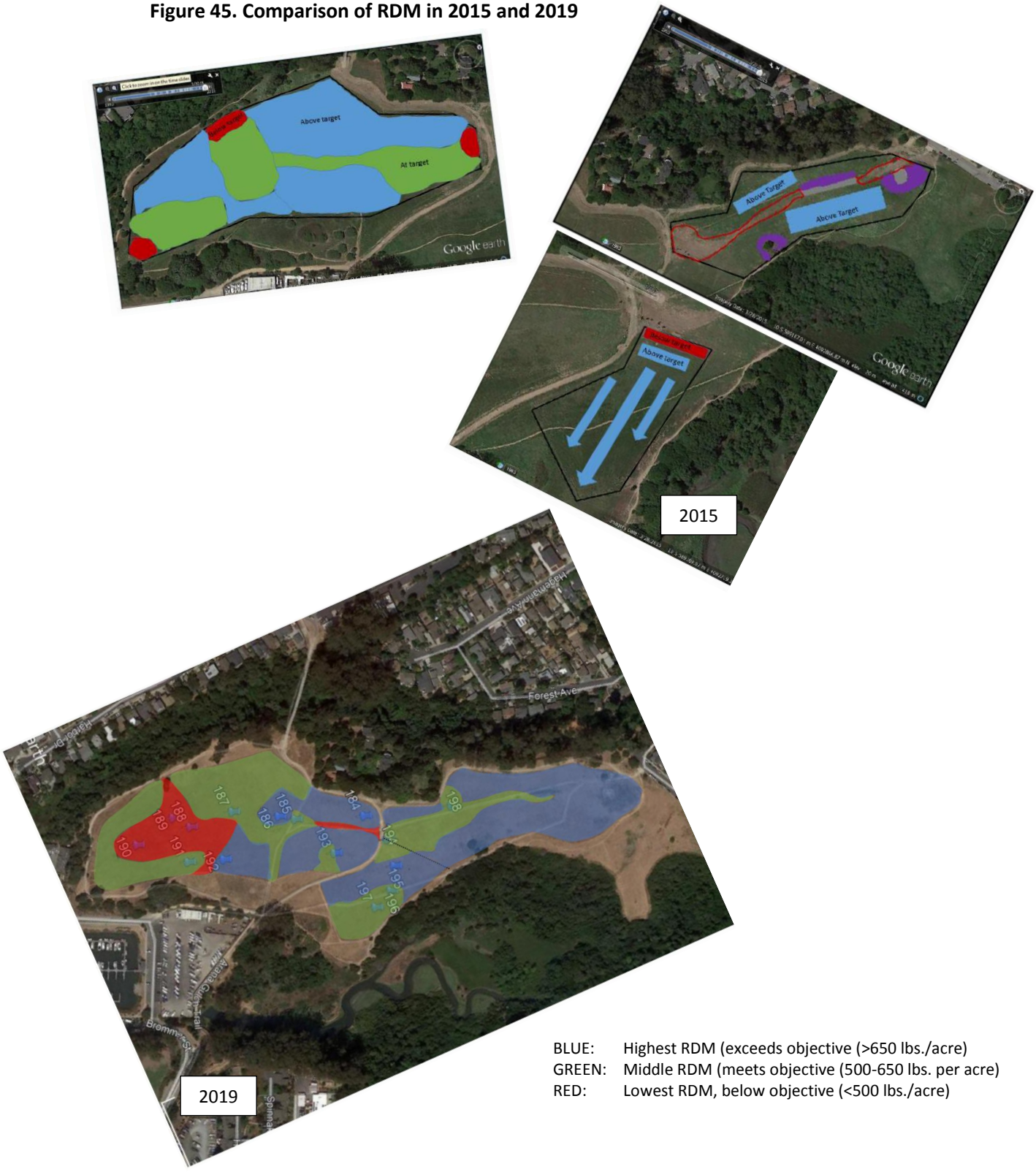
5.3.3 Discussion

In 2019, cattle grazing significantly reduced canopy height during months the cattle were on site (December 2018 – July 10, 2019). When cattle were brought onto Area A in December 2018, canopy grass height in the southern section was visually assessed at 2-4 inches (10 cm), which was within the desired target range for the SCT germination and emergence period. When canopy heights were measured in February, the heights were also within the target.

Compared to pre-grazing conditions in 2015, average canopy heights have been reduced in all three areas of the coastal prairie. In February 2019, canopy heights were within the target in all areas. In March, canopy height in Area A was uniform at 2-3 inches in height. City staff observed that it was probably the most uniform that it had ever looked from when cattle were placed there in 2015. In a typical year, cattle tend to favor certain areas over others. It was clear that there was no more feed left in Area A and supplemental feeding would have been necessary. By April, average canopy height had increased by several inches across all areas and were slightly greater than the target by 1-4 inches. By May, the grass height had jumped back up in Area A and additional cattle were placed there until there was not enough forage left to sustain them and they were moved back to Areas C and D.

Similar to 2018, once grazing was initiated, the cattle reduced biomass across the prairie and in the process also increased bare ground. Non-native species remained dominant with very high cover, but a few reductions were observed. RDM levels decreased in most of the grazed areas between 2015 and 2018, except for some areas that retained high RDM (blue RDM level). A comparison of RDM levels between 2015 and 2019 is presented in **Figure 45**.

Figure 45. Comparison of RDM in 2015 and 2019



BLUE: Highest RDM (exceeds objective (>650 lbs./acre)
GREEN: Middle RDM (meets objective (500-650 lbs. per acre)
RED: Lowest RDM, below objective (<500 lbs./acre)

Areas of lowest RDM (red) were similar to 2018, with all red areas occurring in Area A. Green RDM levels were recorded along the edges of Area A, corresponding to areas supporting two perennial grasses, purple needlegrass (*Stipa pulchra)*, and California oatgrass (*Danthonia californica)*, and area supporting creeping wild rye (*Leymus triticoides)*, and areas supporting annual grasses where grazing was intensive.

The large reduction in biomass, canopy height, and RDM across the prairie since 2015 represents positive progress in improving vegetation conditions. However, Arana Gulch has been highly disturbed for well over one hundred years and returning the prairie to reference conditions, if possible, will take many more years.

5.3.4 Evaluation of HMP Goals

The HMP has three goals that apply to the coastal prairie and are not specific to the SCT (which is addressed in the previous section). Goal 2 seeks to maintain a functioning coastal prairie through the reintroduction of grazing and the resultant disturbance regime. Objective 2A identifies implementation of the grazing program by 2014 and Objective 2a requires that the grassland achieve residual dry matter (RDM) measurements within a range appropriate for SCT growth. Seasonal grazing was continued in 2019 and many areas of the grazed areas were in the red and green RDM range, thus, the first two objectives have been met.

Observations and BMP implementation monitoring of the grazing program were implemented concurrent with grazing. The protocol for monitoring of the grazing program in 2019 are outlined in the HMP and include observations of feed and water troughs (3 times during grazing), adherence to BMPs (see Section 3.5.6 in HMP), and documenting residual dry matter (once a year in September or October). The following BMPs, as identified in the HMP[7] , were implemented and monitored:

- The AMWG recommended that temporary fencing was not needed around the seasonal wetland within the southern grazing area or its 50-foot buffer. Grazing was allowed in the seasonal wetland area between January and June.
- Water troughs were placed adjacent to grazing area gates and away from the top of steep slopes; the troughs were located outside of sensitive areas (occupied SCT areas/seasonal wetland). No supplemental feed was used in 2019.
- The 2019 grazing season was in a slightly above average rainfall year and the number of animals on site did not result in any erosion. There was no significant volume of cattle waste due to the relatively low number of animals on site during the grazing season.
- The City and the grazing contractor conducted regular visual inspections of fence lines to ensure cattle remained within the designated grazing area in 2019. There were no incidents of cut fence lines during the grazing season. The City and the

[7] See page 68 (Section 3.5.6) of Arana Gulch HMP.

grazing contractor monitored the fences during the grazing season; at no time did any cattle escape the grazing area.

- During rainfall events, the City conducted visual inspections (by foot) to document whether there was any rilling or other erosion within and from the grazing area. No erosion issues were detected in 2019. There was no need to install erosion control measures, such as straw wattles, to prevent any accelerated or channelized runoff toward steep slopes.
- The grazing contractor avoided motorized vehicle use during rainy season/soil saturation.

The observations of SCT in 2019 occurred in areas with red RDM levels, suggesting the HMP target for SCT (green RDM level) is too high for SCT establishment and growth. The SCT target RDM may need to be revisited in light of these observations. Some grazing areas were measured at the blue RDM level. Increasing the stock rate or extending the grazing period should be considered to bring these areas into the green RDM level.

5.4 Invasive Weed Work Plan

5.4.1 Management Actions

In 2015 the City mapped the invasive plants within this management area and prepared an Invasive Weed Work Plan (IWWP). The IWWP outlined methods for the removal and control of invasive, non-native plant species in the management area. Species addressed in the plan include: Italian thistle (*Carduus pycnocephalus)*, bull thistle (*Cirsium vulgare)*, poison hemlock (*Conium maculatum)*, cotoneaster (*Cotoneaster sp.)*, Bermuda grass (*Cynodon dactylon)*, French broom (*Genista monspessulana)*, English ivy (*Hedera helix)*, velvet grass (*Holcus lanatus)*, Harding grass (*Phalaris aquatica)*, *Prunus sp.*, pyracantha (*Pyracantha sp.)*, wild radish (*Raphanus sativa)*, Himalaya blackberry (*Rubus ameniacus)*, and milk thistle (*Silybum marianum).* The IWWP is presented in the Year 2 Annual Report, Appendix B.

In 2016 the City filled a park maintenance position with dedicated hours for Arana Gulch. Park maintenance continued throughout 2019. Maintenance tasks included the continued removal of thistles (*Cirsium sp. and Carduus pycnocephalus)* and re-sprouts of cotoneaster (*Cotoneaster sp.)*, Himalaya blackberry (*Rubus ameniacus)*, and English ivy (*Hedera helix)* from the coastal prairie on the hillside near the Harbor entrance.

In addition, significant maintenance was provided to remove and control thistles from the grassland, including the grazing areas. In spring 2019, thistle rosettes were routinely shovel cut and/or weed-whipped from the grassland. As per the IWWP, the City implemented control actions and if seed heads of thistles were observed, they were cut and disposed of off-site. As thistles (*Cirsium, Silybum,* and *Carduus spp.)* were previously widespread on site, control of these species was a significant effort and the control efforts has significantly

reduced cover by these species. Large thickets of Himalaya berry (*Rubus ameniacus)* in the northern portion of the grassland were also routinely mowed and/or weed-whipped. Occurrences of ivy (*Hedera helix)* and non-native vines were removed/controlled along the western property line. A log of the City's maintenance actions is presented in **Appendix B**.

5.4.2. Evaluation of HMP Goals. The HMP has three goals that apply to the coastal prairie and are not specific to the SCT (which is addressed in the previous section). Goal 2 seeks to maintain a functioning coastal prairie through the reintroduction of grazing and the resultant disturbance regime. Objective 2A identifies implementation of the grazing program by 2014 and Objective 2a requires that the grassland achieve residual dry matter (RDM) measurements within a range appropriate for SCT growth. These objectives have been met for some of the management area in 2019 (see **Table 9**).

5.5 Proposed Actions for 2020

The following actions and expected timing are proposed for 2020:

- Continue the cattle grazing program, beginning in January 2020, with grazing extending to June, depending upon presence of SCT flowers.
- Consider implementing interim grassland management actions (i.e., focused mowing or other management) in winter (December – January) if cattle grazing is delayed and canopy height levels are above the target objective of 2-3 inches (5-8 cm) between the months of November thru April. Evaluate need to mow in fall to reduce canopy height.
- Monitor grazing operation and implement the HMP-designated BMPs (see Section 3.5.6 in HMP and bullet list above) (January– June 2020).
- Mow delineated areas outside the grazing areas (May/June 2020). Conduct pre-mowing surveys for breeding birds and locally unique flora.
- Continue to implement invasive plant species control as per the IWWP, focusing on removal/control of the following species:
    - Himalaya blackberry (*Rubus ameniacus)*
    - Cotoneaster *(Cotoneaster sp.)*
    - French broom (*Genista monspessulana)*
    - Velvet grass (*Holcus lanatus)*
    - Thistles (*Cirsium sp., Carduus sp., Silybum marianum)*
    - Medusa head (*Elymus caput-medusae)*
- Using soil sampling test data evaluate soil deficiencies that may affect the growth of SCT and other native plant species.
- Review results of scrape plots and SCT seed expression. Consider implementing additional grassland management actions (i.e., additional scraping, prescribed fire, or other management) in fall 2020 (prior to winter rains) to increase SCT seed expression.

- Evaluate out-planting SCT seed and/or plants in summer 2020, using seed/plants grown at UCSC Greenhouses.
- Conduct census for SCT and monitor plant cover at occupied sites.
- Collect SCT seed if there are more than 50 plants; store seed for seed increase, storage, and possible out-planting.
- Monitor plant cover, canopy height, species richness, and bare ground at permanent transects and compare data to previous years and HMP desired direction of change (April/May 2020).
- Document canopy height three times a year: February, April/May, and December 2020
- Document RDM in September/October 2020.
- Document amount of bare ground in SCT occupied areas in December 2020 (SCT germination period).
- Evaluate and update, as needed, the draft sub-management area map and develop/finalize specific performance targets for percent cover of native species, nonnative species and bare ground, and species richness for coastal prairie that will be used to determine whether HMP objectives have been met. In the absence of acceptable data on reference coastal prairies, the AMWG may use these three years of baseline data and a first year of monitoring data under grazing in April 2016 to begin refining the objectives under Goal 3.
- Document site conditions from the permanent photo-points.

Table 9. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 6 (2019) Results	Objective Met?
Goal 1. Maintain a viable SCT population at Arana Gulch						
Objective 1A. Increase number of aboveground SCT to at least the 2006 level by 2015 (Note: 2006=348 plants in Area A)	# of above ground SCT plants	Yearly in Aug./Sept.	Increase	2014	50 SCT	No [8]
Objective 1B. Expand the distribution of SCT beyond Area A within 3 years (Note: Year 3 = 2017)	Distribution of SCT plants	Yearly in Aug./Sept.	Expansion	2017	SCT limited to Area A	No
Goal 2. Reintroduce grazing to restore a disturbance regime that maintains functioning coastal prairie						
Objective 2A. Implement the Grazing Program by 2014	2A.1 Observation of feed and water troughs	3x during grazing	Stable	2015	City monitored water troughs in 2019	Yes
	2.A.2 BMP implementation monitoring	3x during grazing	Stable	2015	City monitoring plant height and other BMPS through grazing season	Yes, BMPs were implemented
Objective 2B. Maintain RDM within a range that allows SCT to complete its lifecycle and protects coastal prairie grassland from erosion (700-1,500 lbs./acre)	Residual dry matter (RDM)	Yearly in Sept./Oct.	Maintain within range	2017	RDM measured in September; areas were at target, yet several areas above target	Yes, some areas were above target; SCT detected in target and below target areas

[8] HMP acknowledges that number of aboveground SCT is not likely to increase until after grazing program is implemented; SCT increase from grazing may not be fully detected for several seasons.

Table 9. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 6 (2019) Results	Objective Met?
Goal 3. Minimize detrimental effects of high non-native plant cover and restore coastal prairie species diversity and habitat function						
Objective 3A. Reduce canopy height during the basal rosette stage for SCT (Nov. – April) from the baseline level to 2-3 inches[9] by 2015	Average canopy height	3x during growing season	Reduction	2015	Canopy heights were at target in February, April in Area A; all areas in December.	Partially, cattle grazing reduced canopy height in Area A and portions of Area C.
Objective 3B. Reduce cover of non-native species in the coastal prairie from the baseline to one more representative of a reference functioning coastal prairie system by 2020	Percent cover of non-native plants	Yearly at peak growth in April	Reduction	2020	There was continued decline in the cover of EAG in Area A, yet increase in EAF Total non-native cover was well above 100% in all 3 areas.	No, cattle grazing reduced cover of some non-native plant guilds and a few select species but total cover remains very high and non-native species dominate the plant communities.
Objective 3C. Increase cover of native species from baseline levels to one more representative of a reference functioning coastal prairie system by 2020.	Percent cover of native plants	Yearly at peak growth in April	Increase	2020	Cover of native species remains at <1%. Reference systems have range of 20-40% cover as per Holl and Reed (2010), Hayes and Holl (2003).	No, cover of native species has not increased significantly and native plants are encountered very infrequently. Native grass revegetation plot implemented in 2018
Objective 3D. Increase native species richness from baseline levels to one more representative of a reference functioning	Native species richness	Yearly at peak growth in April	Increase	2020	11 native species including one tree, two shrubs, two forbs and six grasses have been detected in the sampling across Areas A,	Yes, meeting trend of increased native species richness; coast tarplant and toad rush were

[9] AMWG reduced threshold from 0.5 m (1.6 feet) to 2-3 inches in January 2015

Table 9. Biological Variables Monitored in Coastal Prairie/Tarplant Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Interim Target Date	Year 6 (2019) Results	Objective Met?
coastal prairie system by 2020.					C, and D. Reference systems have a range of 4 to 21 species as per Holl and Reed (2010), Hayes and Holl (2003).	detected for the second time since 2016.
Objective 3E. Increase cover of bare ground in the coastal prairie from baseline level to a level that enables SCT plants to complete their lifecycle by 2015.	Percent bare ground	3x during growing season	Increase	2015	Average cover of bare ground increased in Areas A, C and D	Yes, meeting trend of increased bare ground in Area A, C and D.
	Permanent photo points with GPS location and compass direction	Before, during and post construction and then yearly at peak growth	Improving	2015	Photo points established in April 2015, approximately 8 weeks after initiation of cattle grazing.	Yes, photo points were re-sampled in 2019
Goal 4. Maintain a genetically and demographically viable soil seed bank in perpetuity.						
Objective 4A. Increase the density of viable ray achenes in the soil seed bank from baseline in the first 3 years and then assessed every 5 years.	Seed bank density (#of viable ray achenes)	Yearly	Increase	2015	No viable seed in Areas B and C; viable seed found in Areas A and D	N/A, baseline determined in 2015 and will be reassessed every 5 years; SCT collected ad deposited at UCSC Greenhouses for plant propagation, seed increase, and seed storage.

6. Habitat Management and Monitoring - Hagemann Gulch Riparian Woodland Management Area

Bridge and trail construction were completed in 2014 and erosion control and wildlife protection measures were implemented, consistent with Goal 3 of the HMP. Historic "Rose of Castille" bushes were relocated to City Hall, consistent with Goal 5 of the HMP and a riparian revegetation plan was prepared and approved by CDFW to compensate for impacts of the bridge project. Mapping and identification of invasive, non-native plant species was completed in 2017.

In 2019, the City removed and controlled occurrences of invasive, non-native plant species. Volunteers, City staff, and contractors were used for this work.

6.1 Management Actions

6.1.1 Bridge Construction Project

Management actions associated with the bridge construction project were in place until the completion of bridge construction, which was December 2014.

The City prepared a riparian revegetation plan which was reviewed by the AMWG and approved by CDFW to compensate for impacts to native trees and shrubs by the bridge project. This plan was contained in the Year 1 Monitoring Report. The plantings, six native California roses (*Rosa californica)* were planted near the Arana Creek causeway in 2018.

6.1.2 Integrated Pest Management (IPM)

The extent of invasive plant species was mapped in the management area in 2017. The following species were identified in the gulch: eucalyptus (*Eucalyptus sp.)*, elm (*Ulmus sp.)*, poplar (*Poplar sp.)*, privet *(Ligustrum sp.)*, English ivy (*Hedera helix)*, Cape ivy (*Delairea odorata)*, nasturtium (*Tropagaluem majus)*, Himalaya berry (*Rubus ameniacus)*, French broom (*Genista monspessulana)*, poison hemlock (*Conium maculatum)*, Monterey pine (*Pinus radiata)*, cotoneaster (*Cotoneaster sp.)*, and *Prunus.* The distribution of invasive plant species is depicted on **Figure 46**.

In 2019, occurrences of invasive, non-native plant species were removed from the management area. Occurrences of English ivy, French broom, Monterey pine, and cotoneaster were removed. A work crew removed non-native *Prunus* upstream and downstream of the Hagemann Gulch bridge, removed two patches of French broom (*Genista monspessulana)* downstream of the bridge, and removed French broom (*Genista monspessulana)*, English ivy (*Hedera helix)*, and *Prunus* along the Prairie Loop Trail.

City staff cut vines from the Eucalyptus trees in Hagemann Gulch.

6.1.3 Fire Hazard

No fire hazard management actions were implemented in 2019; however, the invasive plant removal reduced cover by invasive, non-native plant species which reduced the fire hazard within the areas treated.

6.1.4 Wildlife Protection

Prior to construction of the bridge over Hagemann Gulch, measures were implemented to avoid impacts to wildlife. These measures were completed in 2014. With the exception of surveying for nesting birds prior to vegetation management actions, no additional wildlife management actions were implemented in 2019.

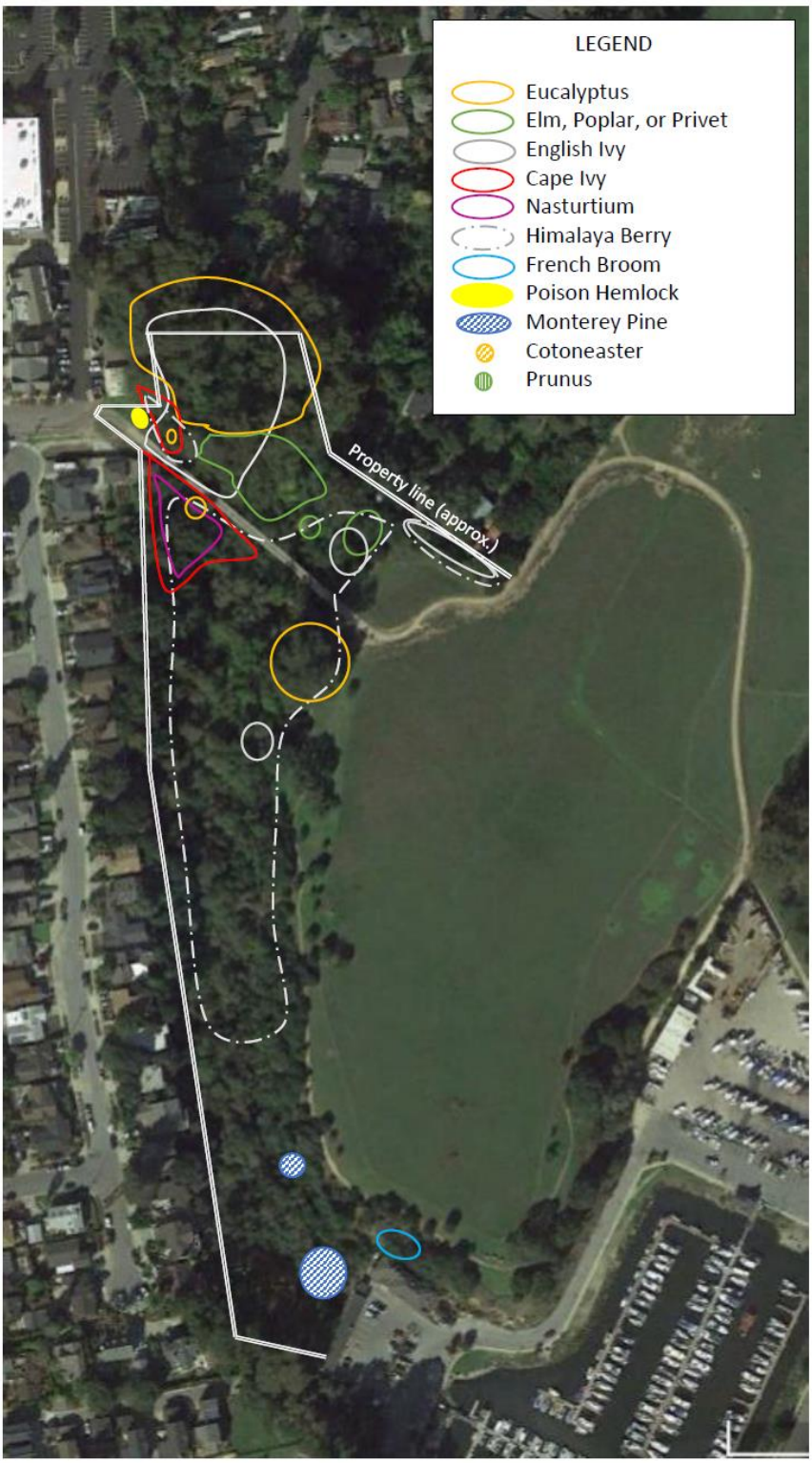
6.1.5 Appropriate Uses in Hagemann Gulch

Rangers and City maintenance staff periodically patrolled open space activities in and around the gulch for transient encampments and other illegal activities. Encampments were removed as needed. Branches were placed to block areas that appeared to be used for unauthorized access to the riparian area.

6.1.6 Rose of Castille Bushes

The “Rose of Castille” bushes located near the Hagemann Gulch bridge construction area were relocated to City Hall in 2013, in consultation with the City Arborist. The roses receive regular maintenance and care and are thriving in their new location. Staff has decided that adding interpretive signage is too risky and may lead to vandalism or theft. The potential risks to the plants outweigh the educational benefits from the signage.

Figure 46. Updated Distribution of Invasive Plant Species, Hagemann Gulch Management Area, 2019



6.2 Monitoring and Performance Evaluation

6.2.1 Monitoring Methods

Areas where invasive, non-native plant species were documented were monitored after treatment and invasive maps were updated.

6.2.2 Monitoring Results

The invasive plant species map was updated to reflect occurrences of invasive, non-native plant species after treatment/removal actions were implemented in 2019.

6.2.3 Evaluation of HMP Goals

Table 10 presents a summary of the biological variables monitored, the Year 6 (2019) values, and the desired direction of change.

The HMP has a goal to seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch (Goal 1, Objectives 1A, 1B, and 1C). The City allocated funds in 2019 for this task; and thus, these objectives were met. Removal and control of invasive, non-native plant species was implemented in 2019.

Goal 2 (Objective 2A) of the HMP for this management area identifies the need to reduce the fire hazard within the gulch. The objectives include reducing the cover of woody thickets (comprised of invasive, non-native species) and prioritize the removal of eucalyptus trees, as feasible. Construction of the multi-use bridge resulted in the removal of a several eucalyptus trees near the western abutment and from the central gulch; however, several large stands of eucalyptus trees remain. As noted above, the City began implementation of the IPM plan for the removal of the woody invasive plant species, consistent with this objective.

Protection of wildlife habitat features is a goal of the HMP (Goal 3). This goal and it associated objectives were met concurrent with construction of the trail and the bridge over Hagemann Gulch in 2014. Objective 3A requires the identification and protection of San Francisco dusky-footed woodrats with the bridge construction zone (within 25m of the bridge). No woodrat nests/houses were documented within the construction zone. No further action is required; however, the City will continue to search for nests when work is performed in the area. Objective 3B requires monitoring for sensitive bird and bat roots and/or nests occurring within 25m of the Hagemann Gulch bridge, with monitoring and protection of such resources for 3-5 years post-construction. The 2013 bat survey found that the trees in the area provide only foliage roosting habitat. No cavities or crevices were found to support sensitive bat roosts. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor bat roosts to document if there is an increase in bat roosting after the trail and bridge project. Similarly, the 2014 nesting bird survey was negative for sensitive bird nesting. As the baseline is zero, no additional monitoring is required; however, the City could elect to monitor the area for sensitive bird nesting to

document if there is an increase in such nesting after the trail and bridge project. These objectives are no longer applicable as part of the plan.

Goal 4 for this management area requires observing uses in Hagemann Gulch after trail and bridge construction and to determine if there are changes in use from site improvements. In 2019 City park rangers routinely patrolled the greenbelt to detect appropriate and inappropriate uses; off-leash dog use and periodic illegal encampments were noted in/around the bridge and other areas in/around the gulch. Objective 4A has been met.

Goal 5 of the HMP is to preserve the "Rose of Castille" bushes located near the Hagemann Gulch bridge construction area. To preserve these shrubs, the City elected to relocate them to City Hall in 2013, in consultation with the City Arborist. The shrubs are in excellent condition and Objectives 5A and B have been met.

6.3 Proposed Actions for 2020

The following actions and expected timing are proposed for 2020:

- Monitor appropriate uses within Hagemann Gulch through periodic City ranger patrols (January– December 2020).
- Continue to remove and control invasive, non-native plant species within the management area.

Table 10. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 6 (2019) Results	Objective Met?
Goal 1. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in Hagemann Gulch					
Objective 1A. Use a combination of methods to reduce the cover of non-native invasive woody plant thickets from baseline levels in the first year.	Non-native invasive woody plant cover	Before and after every removal effort	Decrease	Eucalyptus trees removed near western bridge abutment and along bridge sightline	Partial compliance; some eucalyptus trees removed but some stands remain on City property
Objective 1B. Monitor re-sprouting of removed vegetation and recruitment of new seedling on a regular basis, for at least 5 years after initial removal efforts.	Re-sprout and seedling emergence of target weeds	After every removal effort	Decrease	Minor re-sprouting of eucalyptus branches from trees limbed for the bridge placement	Yes, re-sprouts were monitored; re-sprouts included in IPM plan that was developed in 2017
Objective 1C. If passive restoration is not adequately controlling erosion, use revegetation with appropriate native species or other cultural methods to limit the amount of exposed soil and the potential for re-infestation and erosion.	Area of exposed soil (bare ground)	After every removal effort	Decrease	No action; no erosion detected	Yes, no erosion has been detected; no actions needed at this time
Goal 2. Reduce the fire hazard within Hagemann Gulch					
Objective 2A. Reduce the cover of woody thickets as per Objective 1A to reduce overall fire risk.	Non-native invasive woody plant cover	Before and after every removal effort	Decrease	Thickets of *Prunus,* French broom, removed in 2019	Partial compliance; non-native thickets have been

Table 10. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 6 (2019) Results	Objective Met?
					controlled within management area
Objective 2B. Prioritize the removal of eucalyptus trees where feasible.	Area occupied by eucalyptus	After every removal effort	Decrease	Eucalyptus trees removed near western bridge abutment and along bridge sightline	Partial compliance; some eucalyptus trees removed but some stands remain on City property
Goal 3. Protect wildlife habitat features in Hagemann Gulch					
Objective 3A. The number of SF dusky-footed woodrat nests occurring within Hagemann Gulch bridge construction zone will be identified and the nests protected.	Number of SF dusky-footed woodrat nests within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within construction area Hagemann Gulch bridge; unknown number within 25m of bridge	N/A. No nests were identified prior to construction
Objective 3B. Monitoring for sensitive bird and bat roosts and/or nests occurring within 25 m of the Hagemann Gulch bridge construction zone will be identified and protected and continued for 3-5 years post-construction.	Sensitive bird or bat detections within 25m of Hagemann Bridge construction zone	Yearly, if observed prior to construction.	Stable	None detected within 25m Hagemann Gulch bridge	N/A. No nests were identified prior to construction

Table 10. Biological Variables Monitored in Hagemann Gulch Riparian Woodland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 6 (2019) Results	Objective Met?
Goal 4. Increase appropriate uses in Hagemann Gulch					
Objective 4A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter.	Observation of infrastructure conditions	4x per year	Stable	Stable	Park rangers and maintenance staff periodically inspected the area in 2019; issues of illegal encampments were documented in close proximity to the bridge
Goal 5. Preserve the "Rose of Castille" historic roses					
Objective 5A. Relocation of the roses will occur only if no other alternative is feasible for development of the Hagemann Gulch Bridge. Any relocation will be done in the vicinity of the existing trees, in consultation with the City Arborist.	Presence of Rose of Castile	Yearly in June/July	Stable	Shrubs relocated to City Hall	Yes, roses were located to City Hall to ensure regular maintenance and care
Objective 5B. Address the public education benefits of identifying the Rose of Castille and providing interpretative panels.	Presence of Rose of Castile	Yearly in June/July	Stable	Decision was made.	Staff determined that identifying them would expose them to potential theft and vandalism. No additional action is necessary.

7. Habitat Management and Monitoring - Arana Gulch Creek Riparian Woodland and Wetland Management Area

The Arana Gulch Multi-Use Trail including the causeway over Arana Gulch Creek was completed in 2014. This construction project required the implementation of erosion control, wildlife protection measures prior to construction, and revegetation of areas near the causeway consistent with construction permit conditions. Riparian revegetation was implemented in 2015. Consistent with Goal 3 of the HMP, the City continued to work with the Resource Conservation District of Santa Cruz County (RDCSCC) on measures to implement habitat enhancement actions within the Arana Gulch watershed. In addition, the City continued in implement a plan to reduce the non-native understory in the management area. City staff and contractors removed invasive weeds from several areas of the management area in 2019, consistent with Goal 4 of the HMP.

7.1 Management Actions

7.1.1 Trail and Causeway Construction Project

In 2014, the City prepared a riparian revegetation plan which was reviewed by the AMWG and approved by CDFW to compensate for impacts to native trees and shrubs by the causeway construction. Three areas were designated for revegetation. In 2014, Area A, the slope by the causeway, was hydroseeded with sterile seed as per the CDFW-approved revegetation plan. Twenty dormant willow cuttings were installed at the toe of the slope in December 2014. In Area B, located near the northwestern causeway abutment, 40 creeping wild rye (*Elymus triticoides)* were planted (March 2015). In Area C, a flat area north of the causeway, was planted with 40 creeping wild rye (*Elymus triticoides)*, 16 California rose (*Rosa californica)*, 16 mugwort (*Artemisia douglasiana)*, and 3 coast live oak (*Quercus agrifolia)* were planted (March 2015). The plantings were installed by City staff and volunteers recruited by the RDCSCC. The City maintained these plantings, implementing periodic weeding and hand-watering; however, plant survival of the willows in Area A was low and the area was replanted in winter 2016. Plant survival of the creeping wild rye was low in Area B; therefore, the City elected to install additional native shrubs in Area C, where growing conditions were considered to be better. Roses for the Hagemann Gulch Bridge project were also planted in this area. Additional willow pole cuttings (25) were installed along the slope above Arana Creek to replace previous plantings that died.

7.1.2 Wildlife Protection

Prior to construction of the Arana Gulch Multi-Use Trail, measures were implemented to avoid impacts to wildlife. These measures were completed in 2014. No additional management actions were implemented in 2019.

7.1.3 Integrated Pest Management (IPM)

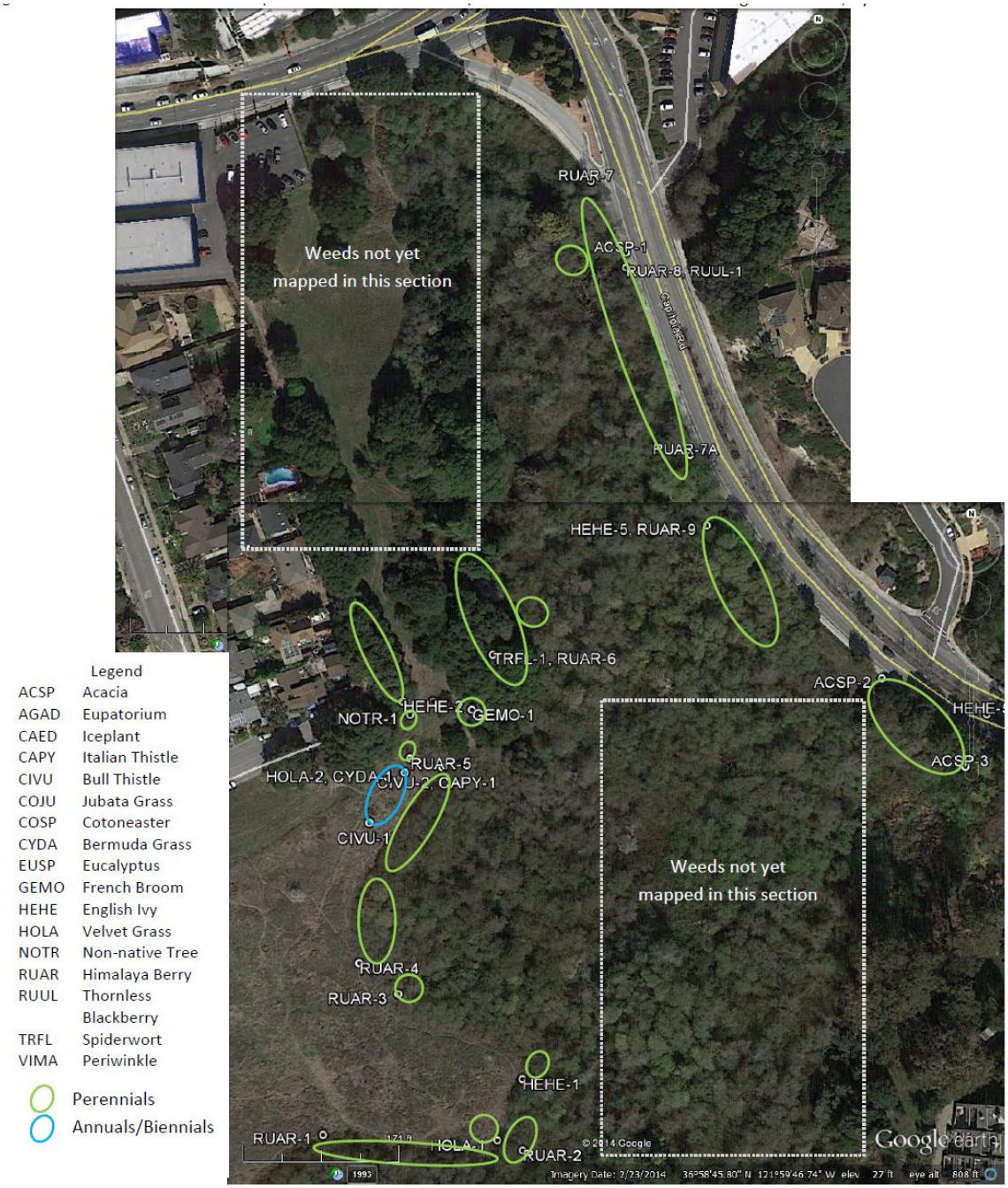
In 2014 and 2015, mapping of invasive weeds within this management area was initiated. The mapping is to guide future management activities for species removal/ control. The approximate size, density of plants (dense, moderate, and sparse) and the location of each non-native invasive species patch was documented using GPS and mapped on aerial photos. A map of data collected, as of April 2015, is presented in **Figure 47A-D**.

Invasive non-native plant species documented to date in the management area include: (*Acacia spp.)*, perennial pepperweed (*Lepidium latifolium*), eupatorium (*Ageratina adenophora)*, ice plant (*Carpobrotus edulis)*, Italian thistle (*Carduus pycnocephalus)*, bull thistle (*Cirsium vulgare)*, jubata grass (*Cortederia jubata)*, cotoneaster (*Cotoneaster sp.*), Bermuda grass (*Cynodon dactylon*), eucalyptus (*Eucalyptus sp.)*, French broom(*Genista monspessulana*), English ivy (*Hedera helix*), velvet grass (*Holcus lanatus*), Himalayan blackberry (*Rubus ameniacus*), thornless blackberry (*Rubus ulmifolius)*, spiderwort (*Tradescantia fluminensis)*, and periwinkle (*Vinca major)*.

In 2019, occurrences of invasive species were removed and controlled along the Arana Creek Trail and Marsh Vista Trail. English ivy (*Hedera helix)*, cotoneaster (*Cotoneaster sp.)*, French broom (*Genista monspessulana)*, acacia (*Acacia sp.), poison hemlock (*Conium maculatum), *fennel (*Foeniculum vulgare), eucalyptus (*Eucalyptus globulus)* sprouts were removed from the management are in 2019 by park staff and a work crew, as noted on **Figure 47B, C,** and **D**. The City continued closure of the ad-hoc path along Arana Creek to discourage public access to the natural area. Straw wattles and straw were maintained at the northern end of the trail to reduce run-off from the Coastal Loop Trail from entering Arana Creek.

Clean-ups from illegal camping activities were performed to remove trash and waste, primarily from the woodland areas. In some instances, vegetation was removed to improve the line-of-sight from the public right-of-way into the area, deterring illegal activity and improving law enforcement patrolling and monitoring. Extensive trash and waste removal occurred near the intersection of Capitola Road and Soquel Drive. Unfortunately, the activities necessitated more staff time and resources to be diverted to daily trash and waste removal.

Figure 47A. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, Updated 2019



Arana Gulch Greenbelt – Location of Invasive Plant Species in Arana Creek Management Area
April, 2015 - Sheet 1 of 4

Figure 47B. Location of Invasive Plant Species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, Updated 2019

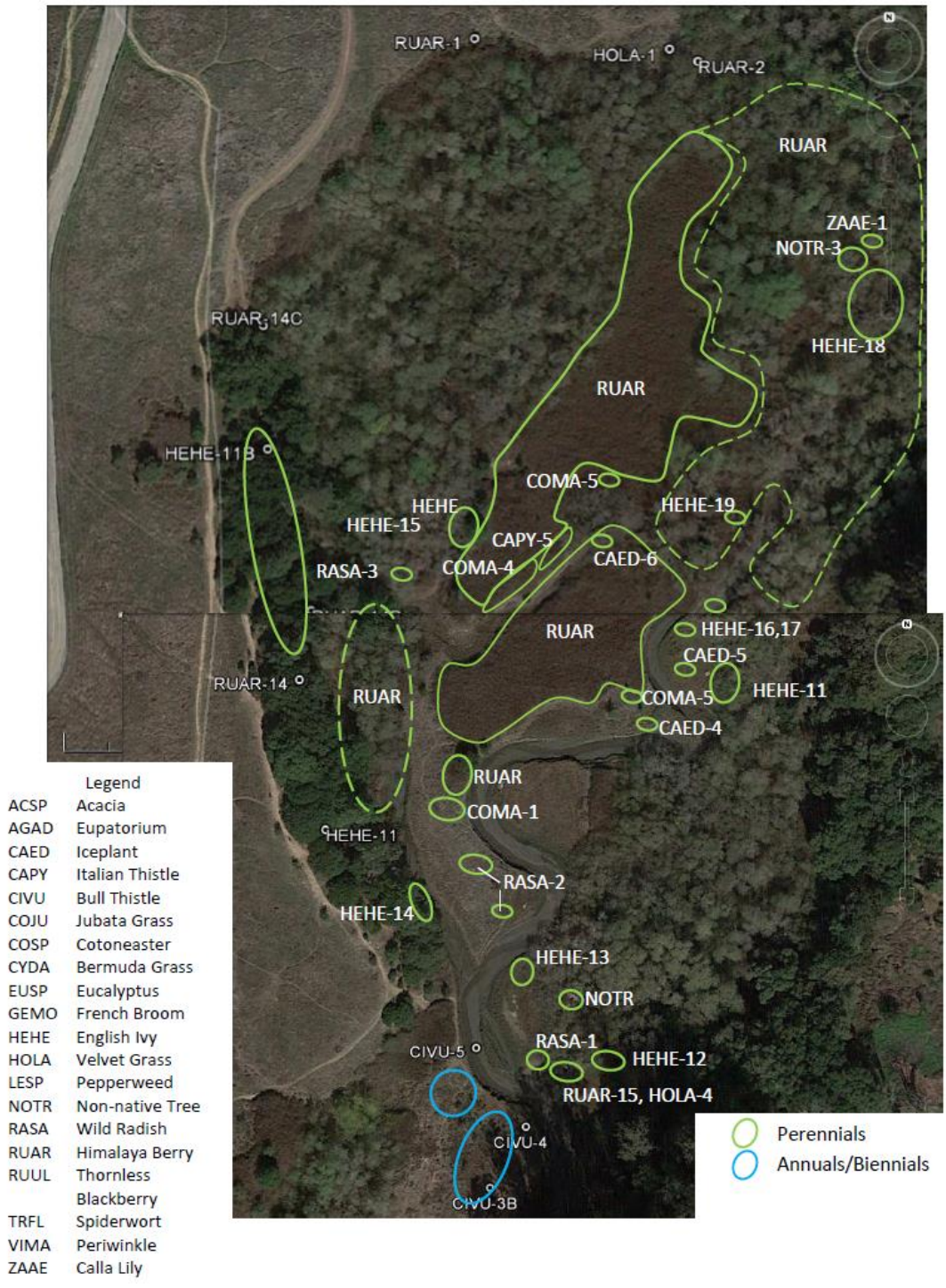
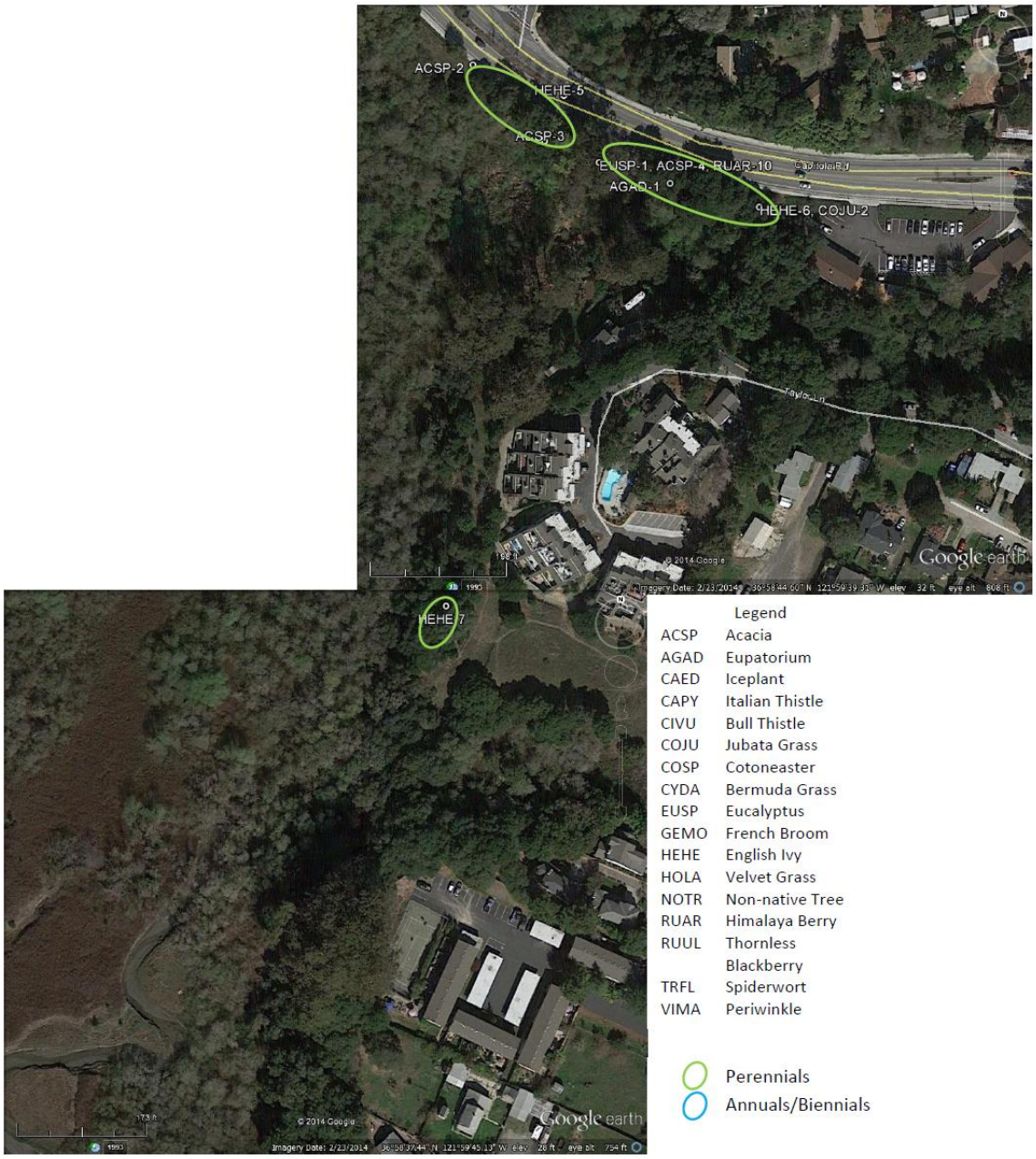


Figure 47C. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, Updated 2019

Figure 47D. Location of invasive plant species within Arana Gulch Creek Riparian Woodland and Wetland Management Area, Updated 2019



7.1.4 Coordination with the RCDSCC

The City continued to coordinate with the RCDSCC on measures to improve habitat conditions in the watershed. This coordination followed outreach conducted in 2016, wherein the RCDSCC attended an AMWG field meeting and had their consultants (Balance Hydrology) present their findings on a watershed sediment study and a discussion on erosion problems in the management area. A more recent watershed study evaluated watershed issues that have the potential to deliver significant amounts of new sediment to the harbor (two gullies in upper watershed) and compared existing conditions to the 2002 Arana Gulch Enhancement Plan. The results of that study were not available at the time of this report. Based on discussions about erosion and sediments in Arana Creek, the City closed the steep and eroding ad-hoc trail along the bank of Arana Creek.

7.2 Monitoring and Performance Evaluation

7.2.1 Monitoring Methods

The riparian revegetation areas were monitored in 2019. A plant survival count was conducted in December 2019. The revegetated areas are required to meet 80% absolute cover of native species (including planted and naturally regenerating species) and less than 5% of invasive weeds; therefore, plant cover within the revegetation area was documented by a visual assessment using the CDFW Combined Vegetation Rapid Assessment and Releve Field Form. A copy of these forms is presented in **Appendix D**.

7.2.2 Monitoring Results

Within Area A, the 2019 monitoring found a dense cover of naturally-establishing Himalaya berry (*Rubus ameniacus)*, and poison oak (*Toxicodendron diversilobum)*, and planted willow (*Salix lasiolepis).* Willow cuttings exhibited a 30% survival rate; six of the 20 willow cuttings were found to be alive. Plant cover within the revegetation area was recorded at is 95%, provided by Himalaya berry (*Rubus ameniacus)*, willow (*Salix lasiolepis)*, and poison oak (*Toxicodendron diversilobum).* Eucalyptus, which provided cover in 2017 have been removed (see **Table 11**). This area does not yet meet the required 80% native woody cover required by CDFW.

Within Area B, 40 creeping wild rye (*Elymus triticoides)* were planted in 2015. Due to poor survival and poor growing conditions; these plantings were abandoned and additional shrubs were installed in Area C; however, pre-existing creeping ryegrass plants are still present in the area, which is reflected in the plant cover measurements (see **Table 11**). Within Area C. plant cover was recorded at 80%, with cover provided by California rose (*Rosa californica)* (15%), mugwort (*Artemisia douglasiana)* (15%), creeping wild rye (*Elymus triticoides)* (20%), coast live oak (5%) and grasses and forbs (40%). These data are depicted on **Table 11**. This area does not yet meet the required 80% native cover required by CDFW. Additional growth is needed for the plantings to provide additional cover.

Table 11. Monitoring Results from Riparian Revegetation Area, Arana Creek, 2019

Species	# Installed Plants Alive, 2018	Plant Cover
Area A		
Willow	6	30%
Himalaya Blackberry	-	60
Poison Oak	-	20
Grasses and Forbs	-	10
Area C		
Creeping Wild Rye	-	20%
California Rose	38	20%
Mugwort	17	15%
Coast Live oak	2	5%
Grasses and Forbs		70%

7.2.3 Evaluation of HMP Goals

Table 12 presents a summary of the biological variables monitored, the Year 6 (2019) values, and the desired direction of change.

The HMP has a goal to seek funding to reduce sediment and improve steelhead conditions within the Arana Gulch watershed (Goal 1 of HMP), a goal to stabilize the tidal reach of Arana Gulch Creek (Goal 2), and to restore the eroded gully on the greenbelt (Goal 3). To meet this goal, the City conferred with the RCDSCC to discuss management activities within the watershed and within the greenbelt property. The City coordination with the RCDSCC is in compliance with goals of the HMP, yet the goal has not yet been met.

Goal 4 is to develop an integrated pest management (IPM) plan to reduce the understory of invasive non-native species in the management area (Goal 4). The City continued to make progress on this task by removing occurrences of invasive, non-native plant species growing within the management area in compliance with goals of the HMP.

7.3 Proposed Actions for 2020

The following actions and expected timing are proposed for 2020:

- Continue to engage with the RCDSCC on watershed and greenbelt projects through annual meeting with the RCDSCC. (January– December 2020).
- Continue to remove and control occurrences of invasive, non-native plant species within the management area.

Table 12. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 6 (2019) Results	Objective Met?
Goal 1. Reduce sedimentation and improve steelhead habitat conditions within the Arana Creek watershed					
Objective 1A. High priority sediment-related projects identified in the Arana Creek watershed enhancement plan area implemented.	# of completed sediment-related projects with the RCDSCC	Yearly	Increase	Funding provided to RCD to seek grant opportunities and help prioritize projects.	No
Objective 1B. High priority steelhead habitat improvements identified in the Arana Creek watershed enhancement plan area implemented.	# of completed steelhead habitat improvement projects with the RCDSCC	Yearly	Increase	Funding provided to RCD to seek grant funding and help prioritize projects.	No
Goal 2. Stabilize the tidal reach of Arana Gulch Creek					
Objective 2A. Engage the RCDSCC Arana Gulch Working Group staff to attend targeted AMWG meetings to identify possible solutions for the tidal reach of Arana Gulch Creek.	RCDSCC attendance at AMWG meetings	Yearly	Increase	City has engaged with RCDSCC	Yes. City will continue to coordinate with RCDSCC to meet goals
Objective 2B. Work with the RCDSCC staff to obtain funding to design and implement a bank restoration project that reduced head cutting and bank erosion along the tidal reach of Arana Gulch Creek.	Funding level for the tidal reach restoration	Yearly	Obtain/increase	Funding provided to RCD to seek grant funding and help prioritize projects.	No

Table 12. Biological Variables Monitored in Arana Gulch Creek Riparian Woodland and Wetland Management Area

Objective	Variable	Measurement Frequency	Desired Direction of Change	Year 6 (2019) Results	Objective Met?
Goal 3. Restore the eroded Greenbelt Gully					
Objective 3A. Work with the RCDSCC staff to pursue funding for the Greenbelt Gully restoration project.	Funding level for the Greenbelt Gully project	Yearly	Obtain/increase	Funding provided to RCD to seek grant funding and help prioritize projects.	No
Goal 4. Seek funding to develop an integrated pest management (IPM) plan to reduce the understory of non-native species in the Arana Gulch Creek Management Area					
Objective 4A. Remove and reduce the cover of non-native invasive species in the riparian woodland relative to baseline conditions including: black acacia found near the culverts, dense thickets of Himalayan berry, scattered French broom, tall white top, and periwinkle.	Non-native invasive woody plant cover	Yearly	Decrease	Invasive plants were removed/controlled in 2019	Yes, invasive, non-native plant species are being removed and controlled
Goal 5. Provide education opportunities and increase appropriate uses					
Objective 5A. Observe the condition of all improvements at least 4 times per year in the first 3 years and at least twice a year thereafter.	Observation of infrastructure conditions	4x per year	Stable	Conditions were monitored.	First year of monitoring was 2015

8. Conclusions from Year 6 and Recommendations for Year 7 (2020)

8.1 Conclusions from 2019

The City continued its initiation of the HMP in 2019 (Year 6). Actions were conducted in all of the management areas. Cattle were grazed in the coastal prairie for SCT management and invasive weed control was implemented in all management areas. There was effective and efficient coordination between the City, the AMWG, and the RCDSCC in 2019 as management actions and monitoring protocols were discussed. The City communicated with users of the greenbelt on the cattle-grazing and provided a ranger patrols to encourage/enforce regulations and deter vandalism and illegal camping.

8.1.1. Coastal Prairie/Santa Cruz Tarplant Management Area

Within the Coastal Prairie/SCT Management Area cattle grazing occurred on site from December 25, 2018 to July 10, 2019. Implementing cattle grazing is in compliance with the HMP. Grazing was successful in maintaining the desired canopy height from November through April. Monitoring of plant cover and residual dry matter was implemented and some objectives were met in some areas for these variables. Objectives of the HMP relating to improving the coastal prairie to a more functioning system have not yet been met.

Grassland management actions were implemented in areas not subject to seasonal grazing. Flail mowing of the perimeter was conducted in June/July. Management of the grassland is required under the HMP; therefore, the City is in compliance with the HMP.

A census of SCT was conducted in 2019. Fifty above-ground plants were documented from the site in 2019. The HMP objective of reaching 348 plants was not met in 2019. Management actions were implemented in November 2019 to encourage expression of SCT seed in Areas A, C, and D. Ten mechanically scraped plots were created. One molasses plot was created in Area A by the grazing cattle. The plot was created to open up bare ground to encourage expression of SCT seed. SCT seed deposited at UCSC Greenhouses in 2018 was used for seed storage and seed increase.

8.1.2. Hagemann Gulch Riparian Woodland and Arana Gulch Creek Riparian Woodland and Wetland Management Areas

Management actions were conducted in the Arana Creek Riparian Woodland and Wetland Management Area and the Hagemann Gulch Riparian Woodland Management Area in 2019. Invasive plant removal and control was conducted within both management areas in 2019, meting the objectives of the HMP. The City coordinated with the RCDSCC on management issues within the Arana Gulch watershed in compliance with the HMP.

8.1.3. Adaptive Management and Public Outreach

The City engaged with the AMWG in 2019 through meetings in January and May 2019 as well as email correspondence. The City received input from the AMWG on management actions and implemented the requested management actions. The City maintained a web page on the City's website for public outreach and responded to comments from the public and the AMWG on ways the site could be improved. These actions were in compliance with the HMP.

8.1.4 Schedule and Budgeting

The City established a line item in their operating budget for Arana Gulch and allocated funds for fiscal year July 1, 2018 to June 30, 2019 and fiscal year July 1, 2019 to June 30, 2020. The City established a maintenance position for the greenbelt, which became effective in January 2016. Establishing funding for management actions is in compliance with the HMP.

8.2 Recommendations for 2020

The City will discuss with the AMWG recommendations for management actions for 2020 at a March and October meeting. The AMWG will provide input to the City on actions based on management priorities. The following summary of actions is preliminary and may be revised based on input from the AMWG and available funding.

8.2.1 Coastal Prairie/Santa Cruz Tarplant Management Area

HMP activities for 2020 (Year 7) is the continuation of seasonal cattle grazing within the prairie/grassland. The City will continue to implement the Stocking and Work Program. Management activities will include monitoring plant composition, plant cover and residual dry matter (RDM) within the grazed areas, grassland conditions along the permanent transects, documenting conditions from the permanent photo-stations, and continuing to remove and control high-priority invasive, non-native plant species. The City will consider implementing additional management actions if cattle grazing is delayed and canopy height exceeds the height limits established for the period November through April.

The City will also continue to implement seasonal mowing within the non-grazed areas that are to be retained as grassland. A census of the SCT will be conducted in summer 2020. Seed collection of SCT may occur depending on the SCT population and prior approval from CDFW. Seed and/or plants grown at UCSC Greenhouses may be installed within management areas in 2020. The City will consider implementing additional management actions to encourage SCT seed expression.

8.2.2 Hagemann Gulch Riparian Woodland Management Area

HMP activities identified for 2020 (Year 7) will be to monitor appropriate uses within the gulch concurrent with public use of the trail and bridge. City park rangers will monitor use as per their regular patrol duties within the greenbelt. Riparian revegetation as per an approved

CDFW Streambed Alteration Agreement (SAA) will be maintained in 2020. Invasive plant control measures will be continued, pending funding and staffing.

8.2.3 Arana Gulch Creek Riparian Woodland and Wetland Management Area

HMP activities identified for 2020 (Year 7) will be continued removal and control of invasive, non-native plant species. Riparian revegetation plantings will be maintained and monitored throughout 2019 as per the SAA.

8.2.4 AMWG and Public Outreach

In 2020 the City will continue to confer with the AMWG on adaptive habitat management activities throughout the year through scheduled meetings and group email correspondence. The first meeting for 2020 will be conducted in March. The AMWG will provide recommendations to the City on management priorities, grazing monitoring and public outreach. The City will solicit input from the public on HMP actions through the City webpage and through public input at the scheduled AMWG meetings.

8.2.5 Schedule and Budgeting

Table 13 presents a schedule for the HMP actions scheduled for 2020. The City has allocated funds for fiscal year July 1, 2019 to June 30, 2020 and funding for fiscal year July 1, 2020 to June 30, 2021.

Table 13. Timeline for Habitat Management Actions Proposed for Year 7 (2020)

	2020												2021
Task	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
Coastal Prairie/Santa Cruz Tarplant Management													
Objective1. Santa Cruz tarplant census, measure plant cover and soil moisture; document bare ground (Nov/Dec)													
Objective 2. Monitor grazing program and variables	✶												
Objective 3. Monitor baseline condition and photo points													
Hagemann Gulch Riparian Woodland Management													
Objectives 1 and 2. Implement IPM Plan and reduce fire hazard													
Objectives 3 and 4. Document wildlife habitat features and implement infrastructure monitoring													
Objective 5A and 5B. Monitor survival of Rose of Castille shrubs													
Arana Gulch Creek Riparian Woodland and Wetland Management													
Objectives 1, 2, and 3. Collaborate with RCDSCC													
Objective 4. Implement removal/control of invasive													

Table 13. Timeline for Habitat Management Actions Proposed for Year 7 (2020)

	2020												2021
Task	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**
non-native woody plant species and target weeds													
Objective 5. Infrastructure monitoring[10]													
Adaptive Management													
Objective 1. Conduct AMWG meetings													
Prepare Yearly Monitoring Report													
✶ Initiate grassland management actions if cattle grazing does not meet canopy height targets between November and April													

[10] Includes riparian revegetation and implementing year-long maintenance and monitoring.

9. References

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Stanton, Alison. 2013. Arana Gulch Habitat Management Plan. Prepared for the City of Santa Cruz Planning Department and Department of Parks and Recreation. Revised September 2013.

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USFWS, 1996. Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Species. September 23, 1996.

Appendix A AMWG Meeting Minutes, 2019

NOTE: Please see the separate Appendix document

A-1: AMWG Meeting Minutes for:

January 2019
May 2019

Appendix B Restoration Maintenance Activity Log

NOTE: Please see the separate Appendix document

B-1. Arana Gulch Restoration Maintenance and Activity Log

Appendix C Coastal Prairie/Santa Cruz Tarplant Management Area

NOTE: Please see the separate Appendix document

C-1. SCT Survey Route Map

C-2. Pre-mow Plant and Breeding Bird Survey

C-3. Plant Cover Data, SCT Sites

C-4. Photo-documentation of SCT Scrape Plots, November 2019

C-4. Transect Photos

C-5. Photo Monitoring

C-6. Soil Sampling Data

Appendix D Arana Gulch Creek Riparian Woodland and Wetland Management Area and Hagemann Gulch Riparian Woodland Management Area

NOTE: Please see the separate Appendix document

D-1: Arana Creek Revegetation Areas: Revegetation Monitoring Results: CNPS and CDFG Combined Vegetation Rapid Assessment and Releve Field Forms

Appendix A AMWG Meeting Minutes, 2019

A-1: AMWG Meeting Minutes for:

January 2019
May 2019

Minutes

Arana Gulch Adaptive Management Working Group Meeting

Santa Cruz Bible Church (near Frederick/Broadway Entrance to Arana Gulch)

9:00 a.m. – 12:00 p.m. on Thursday, January 24, 2019

PARTICIPANTS:
Noah Downing, Planner, City of SC Dept. of Parks and Recreation
Kathy Lyons, Biotic Resources Group
Suzanne Schettler, CNPS
Bill Davilla, EcoSystems West
Lauren Garske-Garcia, CA Coastal Commission
Monica Oey, California Department of Fish and Wildlife
Matt Heber, Maintenance, City of SC Dept. of parks and Recreation

Additional Attendees: Tommy Williams, Craig Dremann

Soil Testing for Nutrient Levels. In December 2018, the City obtained a permit from CDFW to cover the potential take of SCT seed from soil testing. In December, 26 soil samples were obtained on site. 13 samples were taken at 0-2" depth and 13 samples at 3-6" depth. 10 samples were taken in Area A, 4 from Area B, 6 from Area C, and 6 from Area D. The AMWAG reviewed the results and discussed changes in nutrients compared to the 2013 soil testing conducted by Sue Bainbridge. Levels of available N and P decreased between 2013 and 2018. pH decreased slightly from a mean of 5.0 to a mean of 4.8. The data showed little difference in soil nutrient levels between the management areas, SCT vs. no SCT and coast tarweed vs. no coast tarweed. Craig Dremann commented on the high iron level and high acid. From his experience, modifications are needed to restore the prairie. Bill Davilla commented that the pH is historic and typical of Watsonville loam. Available N is expected to be lower with cattle grazing as they are consuming the N from the annual grasses. A discussion occurred on whether experimental plots to test nutrient treatment is warranted. The group discussed that any nutrient treatment should not occur within the SCT area, but could occur in other grassland areas. The group agreed that a comparison of soil nutrients with other SCT sites is important.

> Action: Noah Downing will ask East Bay Regional Park District if they have any soil testing data they may have for their seeded SCT sites. He will also ask if USFW can help facilitate testing at other locations.

SCT Recovery Actions: Noah Downing presented information on the agreement with UCSC to store and produce bulk seed for the SCT. 25 flower heads (5% of total flowering heads on site

in 2018) were collected, with seed and chaff delivered to UCSC. UCSC collected 270 seeds from this material (unknown number of disk vs. ray seeds); however, Kathy Lyons reported at least 180 ray seeds were counted in the material when it was delivered to UCSC. To date, UCSC has documented 30% germination of 28 seeds; the remainder of the seed from the 2018 collection is being stored. The group asked whether any seed treatment was done prior to germination. The group discussed recovery actions with the bulked seed (to be available in fall 2019). The group agreed that out planting of SCT seed/plants should occur in areas separate from recent historic SCT sightings. The group discussed growing some seed in native soil to compare with nursery plants. Out-seedings should occur in areas mapped with low RDM (red). The group discussed the relationship of soil hydrology to SCT during the growing season and suggested monitoring soil moisture through the growing season may be useful. Group discussed site disturbance and a mechanism to move SCT seed around after SCT flowering could be good, including by cattle and use of molasses buckets. Craig Dremann suggested looking at the proximity of SCT seedlings to annual grass seedling.

> Action: Noah Downing will ask UCSC about any seed pre-treatments and progress of seed germination. Noah Downing and Kathy Lyons will put together protocols and locations for seeding.

Installation of Blue Bird Boxes: Four blue bird nest boxes were installed, in coordination with the Santa Cruz Bird Club. The club will be monitoring the boxes for nesting activity.

Invasive Plant Control: The City indicated that work will begin soon this spring on thistle control. Matt Heber, maintenance, will be doing this task. Other invasive work is the manual removal of Himalaya berry, digging out the root mass. Matt will also monitor other invasive plant species, such as stinkwort (*Dittrichia)* which was observed in Area C in 2017.

Cattle Grazing: Noah Downing reported that cattle were brought on site on December 24. Tommy Williams reported there are 7 cattle on site. These cattle were on the site previously (in 2016) and are large, 1,000-pound animals. In 2018, the animals were smaller, weighing approximately 300 pounds. The animals are currently in Area C and are eating a lot of grass. He expects to move them into Area A the week of January 28.

RDM Results. Kathy Lyons presented data from the October residual dry matter (RDM) measurements. The SCT in 2018 were all in areas mapped as lowest RDM (red), which is similar to previous occurrences. The group discussed mechanisms to move SCT around, including corridors of low RDM (red). The group discussed keeping cattle on site longer in Areas C and D to create more low-RDM (red) areas. Tommy Williams indicated the cattle could possible stay

on site into July if there is enough on-site feed. The group discussed use of molasses barrels in high RDM (blue) areas to encourage more grazing and to reduce RDM levels.

SCT Plant Cover Data: Kathy Lyons presented data from the fall plant cover measurements at the 2018 SCT sites. Plant cover and species composition was documented at four of the five SCT patches in September 2018. Seven 1-meter square quadrats were used to record absolute plant cover, litter, cattle dung, and bare ground. Plant cover averages 83%. Most plant cover was provided by exotic annual grasses (EAG), primarily ryegrass (*Festuca perennis)* (26%) and rattail fescue (*Festuca myuros)* (7%). Exotic annual forbs (EAF) were dominated by filaree (*Erodium botrys)* (18%) and cat's ear (*Hypochaeris sp.)* (8%). Cover by native species included SCT (8%), blue-eyed grass (*Sisyrinchium bellum)* (0.1%) and California rose (*Rosa californica)* (0.1%). Litter and cow dung each provided 4% cover. Bare ground represented 10%. The group asked how this compared with the April data collected from all the management area.

> Action: Kathy Lyons will review April 2018 data and compare data to data collected at the SCT plot data once the final report is received from Alison Stanton. Plant data from SCT plots will be collected again in 2019.

Native Plant Diversity. Kathy Lyons reported that purple needlegrass seed collected in summer 2018 was out planted in November. An approximately 15'x15' plot was created for out planting of this seed. The plot is in close proximity to other needlegrass areas to expand the native grassland area. Seed was hand broadcast onto the site, application at approximately 25 seeds per ¼ meter plot. Plant growth in the plots will be assessed in spring 2019.

Management of Area B: The City presented previous management at Area B (periodic mowing). Craig Dremann indicated more specific mowing (mow to 4-6" monthly) could be done here to encourage native plant growth, as discussed at previous AMWG meetings. He suggested growing native seeds in plots of sterile soil to test fertilizer applications. The City indicated tasks in 2019 will include mowing and weed whipping Area B and continued weed control.

Next Meeting: June 2019.

> Action: Noah Downing to send out a Doodle poll for next meeting.

Minutes
Arana Gulch Adaptive Management Working Group Meeting

Santa Cruz Bible Church (near Frederick/Broadway Entrance to Arana Gulch)

9:00 a.m. – 12:00 p.m. on Wednesday, May 22, 2019

PARTICIPANTS:
Noah Downing, Planner, City of SC Dept. of Parks and Recreation
Kathy Lyons, Biotic Resources Group
Alison Stanton, Botanist
Suzanne Schettler, CNPS
Bill Davilla, EcoSystems West
Lauren Garske-Garcia, CA Coastal Commission
Todd Lemein, USFWS
Mark Ogonowski, USFWS
Mike Godsy, City of SC Dept. of Parks and Recreation
Travis Beck, City of SC Dept. of Parks and Recreation
Debbie Bulger, CNPS
Richard Stover, CNPS

Additional Attendees: Tommy Williams, Frank Locatelli

Public Comments. City received email from Jean Brocklebank regarding restroom access in North Harbor and trail map does not show pedestrian-only use on Marsh Vista Trail. City received email from Michael Lewis recommending a blog be established to report on-going conditions and to provide more public interaction with the AMWG; also expressed concern on illegal camping. Noah D. reported that City is working on camping problems; there was camping on the marsh plain this year yet City cleaned up the camp and it has not re-established. Santa Cruz Bird Club reported observing 49 bird species in the greenbelt. Bird boxes are being used by bluebirds. Noah reported a claim for $2 million was filed against the City, indicating the Habitat Management Plan (HMP) has not been effective. Noah reported the City received a letter from CNPS supporting the HMP.

Overview of Actions and Activities

1. Grassland Mowing: Scheduled to occur in 2 or more weeks depending upon rain and grass growth. A plant and bird survey will be conducted prior to mowing.
2. UCSC Greenhouses Noah reported UCSC is growing 49 Santa Cruz Tarplant (SCT) plants this year from the 2018 collected seed. Plants have robust growth to date. Disk seeds had 60% success with no treatment; ray seed had no success. Discussion followed on

genetic diversity of populations and a genetic study. Consensus of group was genetic study doesn't help on-site management and better to spend money on management at this time. Noah inquired as to interest in AMWG members to visit East Bay Regional Parks property to view and discuss their SCT work, perhaps in summer 2019. There was support for collecting seed in 2019 for UCSC storage if enough plants.

3. Cattle Grazing Management Noah reported that this will be the last season that Tommy will be grazing the site. The City will be looking for a new grazer. Discussion was held on how to move SCT seed around site – using cattle as vector and finding out methods used at Elkhorn Slough. Discussion on leaving cattle on site longer into season to create more bare ground for SCT germination. Tommy indicated he could have cattle on site until July without supplemental feed; could feed with hay bales if needed.
4. Environmental Stewards Noah reported that Youth Trails Program will be on site for a week this summer and the Environmental Stewards will be on site for one day.
5. Invasive Plant Control Invasive plant control work will occur on site over two days in June. The Huerta crew, under site supervision, will continue to removal invasive plants from the Hagemann Gulch and Arana Creek management areas.

Vegetation Assessments Alison Stanton presented results of her five years of data from the spring season vegetation assessments and relationship to objectives. The objective for a coastal prairie reference site has not yet been established by the AMWG. She indicated that the canopy height objective has been met. The amount of bare ground has increased, which meets the HMP objective; however, it might not be enough bare ground for SCT. Discussion occurred on how much bare ground is wanted. Alison suggested considering additional management actions, such as prescribed fire to stimulate the ray achenes, with 2019 being optimal as it is a normal rainfall year.

Tarplant Seeding and Planting Recommendations Discussion on outplanting seed from USSC plants in fall 2019. Suzanne suggested a test plot with liquid smoke to stimulate germination of ray achenes, perhaps 10-1meter plots watered with liquid smoke or testing at UCSC greenhouse. Mark indicated that controlled plots would be important. An experimental design is needed. Key questions:

a. bare ground – how to create; how much;
b. germination – how to stimulate;
c. seedbank and seed types – how to increase and manage with episodic disturbance (ray seeds) and other management for more persistent ray seeds;
d. dispersal – how to expand population.

Discussion followed that we may need two different strategies for ray and disk seeds. An episodic event in the oldest seed area may be warranted. If no plants this year then seed bank is very depressed.

Field Inspection and Discussion AMWG went into Area A to inspect site conditions. Discussion on management occurred; summary of items:

1. SCT plants observed at one location; approx. 20-30 plants to date.
2. Leave cattle on longer into season even if supplemental seed is needed.
3. Protect some SCT from cattle; fence off ½ of each colony to allow some plants to be clipped and others not.
4. Consider creating bare ground be penning cattle in enclosure or molasses barrels.
5. Bring 2-3 cows out after first rains to keep annual grasses short and bare areas open.
6. Add molasses bucket in Area C to create open habitat for *Deinandra*.

Next Meeting: Not yet determined.

Action: Noah Downing to send out a Doodle poll for next meeting.

Appendix B Restoration Maintenance Activity Log

B-1. Arana Gulch Restoration Maintenance and Activity Log

Appendix C Coastal Prairie/Santa Cruz Tarplant Management Area

C-1. SCT Survey Route Map

C-2. Pre-mow Plant and Breeding Bird Survey

C-3. Plant Cover Data, SCT Sites

C-4. Photo-documentation of SCT Scrape Plots, November 2019

C-4. Transect Photos

C-5. Photo Monitoring

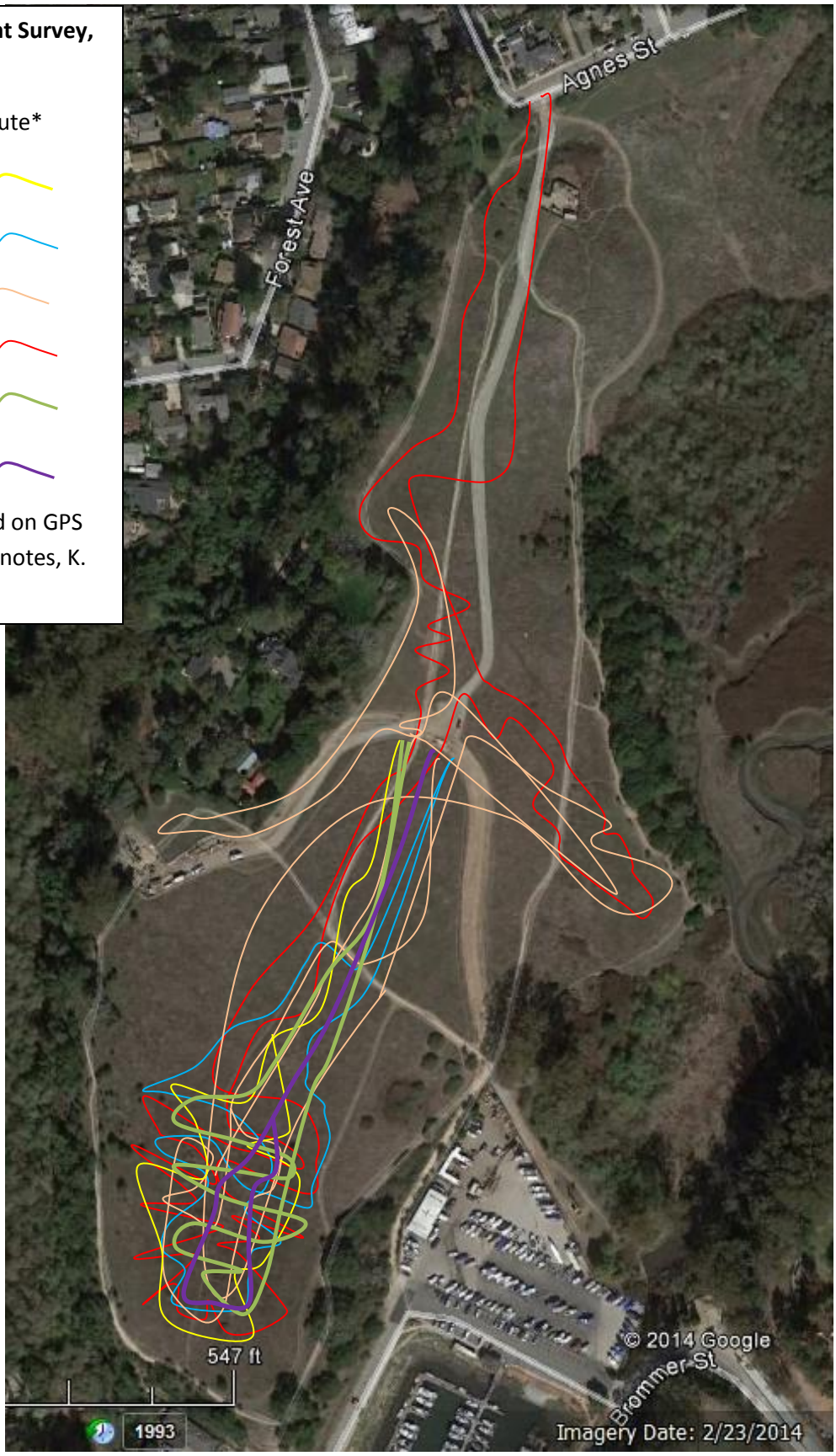
C-6. Soil Sampling Data

SCT Census Survey Routes and Dates, 2019

Santa Cruz Tarplant Survey, 2019

Date	Survey Route*
5/14/19	
5/22/19	
6/14/19	
7/23/19	
9/3/19	
9/30/19	

*Survey route based on GPS track data and field notes, K. Lyons 2019



14 Jun 2019

Pre Mowing Nesting Bird Survey

Arana Gulch

Santa Cruz CA 95060

Garv Hoefler, wildlife biologist

Introduction: The purpose of this survey was to search all possible niches for the presence of nesting birds, nests (active or inactive), courtship or feeding behaviors, or possible species of special concern such as Dusky-footed Woodrats prior to the annual mowing of the grassland areas.

Picture #1: Looking Easterly over the grasslands.

Methodology: Working this time with Kathy Lyons of Biotic Resources Group, we entered the property close to the south end near the cement walking bridge, a little after 8:00 AM. An over cast sky, no wind and a temperature of 64F greeted us. As Kathy began her work on the botanical aspects, I began searching nearby trees first scanning all around and into each, then followed this with a wandering style survey of the grasslands and understory throughout the entire site in an effort to flush any nesting bird from a nest. After working to the north through that first area, traveled

farther north and entered the next portion. There, any groups of trees on either side of the grassland – many of which on the western side were Coast Live Oak *(Quercus agrifolia)*, while much of the eastern area had willows *(Salix sp.)* adjacent the grasslands, and fronting more oaks behind – were scanned as much as possible with both the unaided eye and with binoculars looking for nests and crevices or holes that could be used as nests. With the willows being fairly dense, a pole was used to part some of the front foliage for visual access to the interiors. There was much more ground cover under the areas of the oaks, and bordering the west and north sides of the willows on the east edge of the site than historically, so all of these area were walked through and probed as well. Walking back with Kathy to the more southerly end, we surveyed a large section of Blackberry bushes *(Rubus ursinus)* looking for any evidence of Dusky-footed Wood Rats *(Neotoma fuscipes,* or *N. f. annectens)* such as constructed dens.

Picture #2; Looking to the south over some of the understory on the east side from its center.

Observations: No birds were flushed from any of the grassland areas, or from the understory sections. No old nests or new ones were seen anywhere. However, when nearing the last portion of the site on the north end, and while the trees on the west side were being scanned, two Spotted Towhees *(Pipilo maculates)* started calling loudly at me. Because these are ground nesters, the understory beneath where they were was probed thoroughly again with no results. Once though when the search was taken across the grassland to the willows on the east side, the two birds flew over to that side and hovered above calling over and over. Unable to find an active

nest, because of the density of the area, a pink flag was hung to a thin branch of one of the willows carrying the information just described with a request for the mowing operation to allow more space in that area as a precaution. There were no Woodrat dens in the blackberry bushes. Additional observations include many rodent trails, gopher mounds all around, Mule Deer *(Odocoileus hemionus)* scat, and one possible excavated nest on the ground.

Picture #3: The scrape on the ground with nesting materials seen below it.

Conclusion: We feel the mowing can proceed as planned; however, want to reiterate a hope that the area with a possible active nest described above will be avoided to ensure no damaging effects are put on a protected species.

Birds seen or heard: Turkey Vulture, California Gull, Vaux's Swift, Allen's Hummingbird, Willow Flycatcher, Black Phoebe, Hutton's Vireo, Western Scrub Jay, American Crow, Violet Green Swallow, Cliff Swallow, Bewick's Wren, Western Bluebird, Wilson's Warbler, Spotted Towhee, California Towhee, Chipping Sparrow, and House Finch.

Picture #4: Strip tag placed on a branch of the willow where the Spotted Towhees might have a nest nearby.

Location: Arana Gulch Greenbelt, Santa Cruz Tarplant Plant Cover Plots **Area: A**
Date: 9/3/19
1-meter square quadrats

	Percent Cover (absolute)						
	Area C1	Area C1	Area C4	Area C2			
	1	2	3	4	Total	Absolute Cover/Species	Relative Cover
Holocarpha macradenia	10	25	5	10	50	7.14	11.74%
Hypochaeris spp.	10	5	15	0	30	4.29	7.04%
Lotus corniculatus	10	0	0	0	10	1.43	2.35%
Festuca perennis	20	15	25	70	130	18.57	30.52%
Festuca myuros	1	1	1	0	3	0.43	0.70%
Mentha pulegium	20	0	0	0	20	2.86	4.69%
Convolulus arvensis	0	10	0	0	10	1.43	2.35%
Avena sp.	0	0	0	0	0	0.00	0.00%
Erodium botrys	0	0	0	0	0	0.00	0.00%
Trifolium subterraneum	0	0	0	0	0	0.00	0.00%
Plantago lanceolata	20	10	0	10	40	5.71	9.39%
Bromus hordeacous	0	0	0	0	0	0.00	0.00%
Briza minor	0	0	0	0	0	0.00	0.00%
Juncus bufonius	0	0	0	0	0	0.00	0.00%
Sisyrinchium bellum	1	0	0	0	1	0.14	0.23%
Rumex acetosella	0	0	0	0	0	0.00	0.00%
Rosa californica	0	0	10	0	10	1.43	2.35%
Anagalis arvensis	0	0	0	0	0	0.00	0.00%
					0	0.00	0.00%
					0	0.00	0.00%
					0	0.00	0.00%
					0	0.00	0.00%
Total Plant Cover					**304**		**71.36%**
Litter	0	0	5	10	15	2.14	3.52%
Cow Dung	0	5	2	0	7	1.00	1.64%
Bare	40	20	20	20	100	14.29	23.47%
Total Litter/Bare Ground					**122**		**28.64%**

Arana Gulch Greenbelt
Scrape Plots for Santa Cruz Tarplant Management, 11-25-19
Before and After Scraping Photo Record

Arana Gulch Greenbelt
Scrape Plots for Santa Cruz Tarplant Management, 11-25-19
Before and After Scraping Photo Record

Arana Gulch Greenbelt
Scrape Plots for Santa Cruz Tarplant Management, 11-25-19
Before and After Scraping Photo Record

Arana Gulch Greenbelt
Scrape Plots for Santa Cruz Tarplant Management, 11-25-19
Before and After Scraping Photo Record

Arana Gulch 2019 Transect Photos

AT1 2019

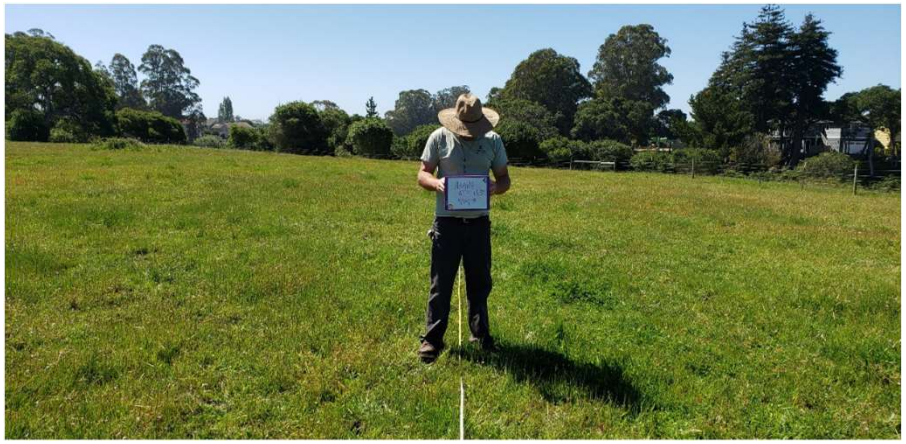
AT2 2019

AT3 2019

AT4 2019

AT5 2019

AT6 2019



AT7 2019

AT8 2019

AT9 2019

AT10 2019

AT11 2019

CT2 2019

CT3 2019

CT5 2019

CT6 2019

CT7 2019

DT1 2019

DT2 2019

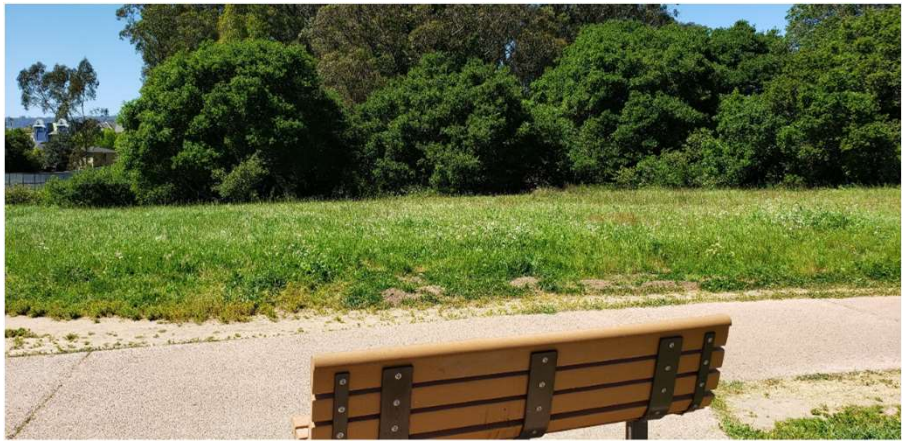
DT3 2019

DT4 2019

Arana Gulch 2019
Photo Points

PP1 1 2019

PP1 2 2019



PP1 3 2019

PP1 4 2019

PP2 1 2019

PP2 2 2019

PP2 3 2019

PP2 4 2019

PP3 1 2019

PP3 2 2019

PP3 3 2019

PP3 4 2019

PP4 1 2019

PP4 2 2019

PP4 3 2019

PP4 4 2019

PP5 1 2019

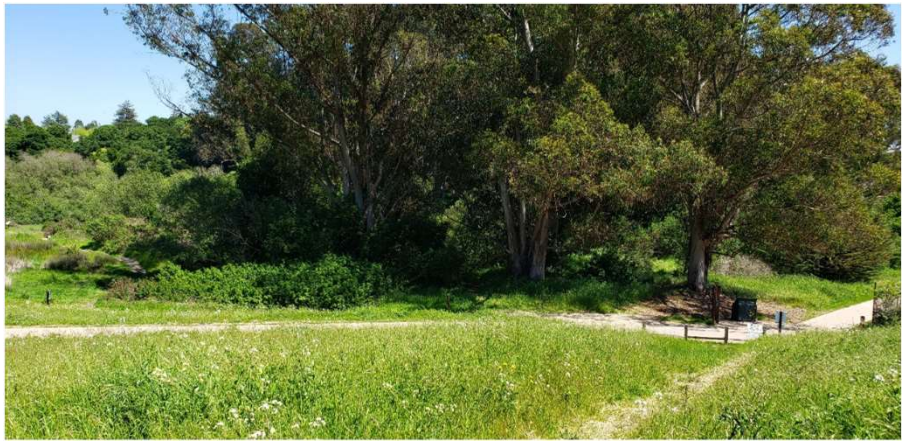
PP5 2 2019

PP5 3 2019

PP5 4 2019

PP6 1 2019

PP6 2 2019



PP6 3 2019

PP6 4 2019

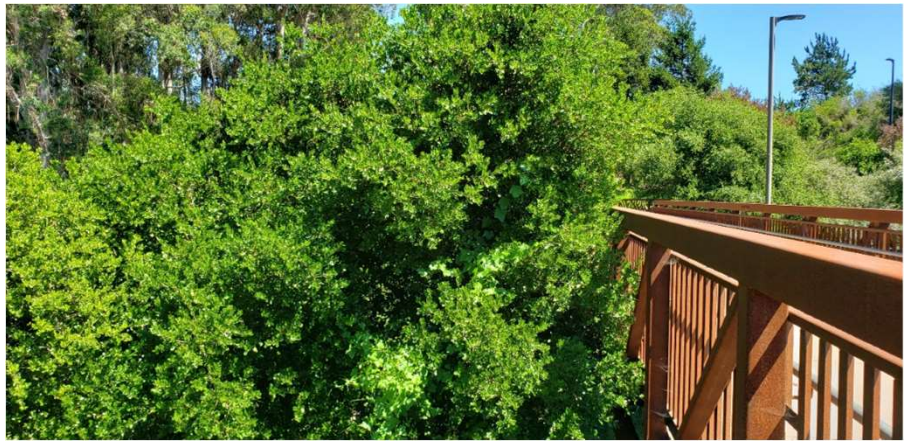
PP7 1 2019

PP7 2 2019

PP7 3 2019

PP7 4 2019

PP8 1 2019



PP8 2 2019

PP8 3 2019

PP8 4 2019

PP9 1 2019

PP9 2 2019

PP9 3 2019

PP9 4 2019

PP10 1 2019

PP10 2 2019

PP10 3 2019

PP10 4 2019

PP11 1 2019

PP11 2 2019

PP11 3 2019

PP11 4 2019

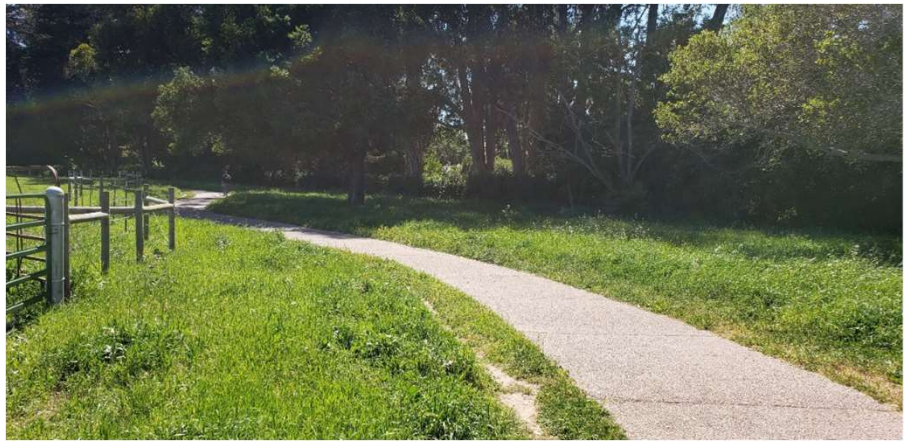
PP12 1 2019

PP12 2 2019

PP12 3 2019

PP12 4 2019

PP13 1 2019



PP13 2 2019

PP13 3 2019

PP13 4 2019

PP14 1 2019

PP14 2 2019

PP14 3 2019

PP14 4 2019

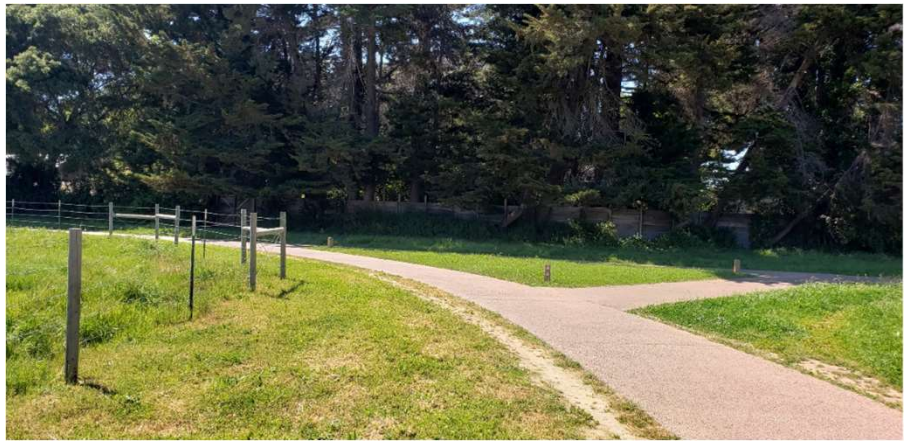
PP15 1 2019

PP15 2 2019

PP15 3 2019

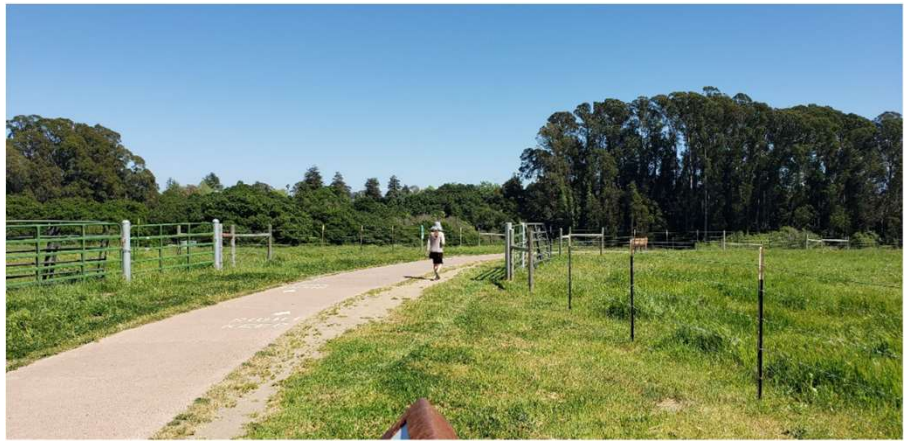
PP15 4 2019

PP16 1 2019



PP16 2 2019

PP16 3 2019



PP16 4 2019

PP17 1 2019

PP17 2 2019

PP17 3 2019

PP17 4 2019

Summary of Soil Sample Data, December 2018
(26 samples; 13 samples at 0-2" depth and 13 samples at 3-6" depth)

	Area A (10 samples)			Area B (4 samples)			Area C (6 samples)			Area D (6 samples)			Mean (all samples)
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	
ORGANIC MATTER													
Available N (ppm)	12	20	13	9	13	12	11	15	12	10	21	14	**13**
NUTRIENTS													
Phosphorus (P) – Olsen	3	7	4	10	19	15	4	8	6	3	5	4	**7**
Potassium (K) (ppm)	42	436	161	237	392	332	166	353	238	74	180	107	**209**
Magnesium (Mg) (ppm)	109	209	157	115	143	130	77	128	109	75	103	87	**120**
Calcium (Ca) (ppm)	587	786	743	532	622	591	553	769	643	459	620	536	**628**
Manganese (Mn) (ppm)	16	35	24	12	19	15	18	24	21	15	22	19	**20**
Iron (Fe) (ppm)	72	253	145	75	108	93	68	184	105	86	146	109	**113**
Boron (B) (ppm)	.08	.16	.11	.07	.09	.08	.08	.13	.10	.07	.10	.09	**0.10**
Nitrogen NO3-N (ppm)	1	6	3	1	3	2	1	7	2	1	10	4	**2.75**
OTHER PROPERTIES													
Ph	4.4	5.0	4.7	4.6	5.3	4.9	4.5	5.5	4.9	4.4	5.2	4.8	**4.8**
Cation Exchange Capacity (meq/100g)	4.2	6.8	5.1	4.5	5.1	4.8	4.1	5.5	4.6	3.0	4.3	3.6	**4.5**
LEGEND[1]		**Very Low**											
		Low											
		Medium											
		Optimum											
		High											

1- levels based on soil test ratings, Waypoint Analytical, 2019

Summary of Soil Sample Data, 2013 (Sue Bainbridge Study)				Change from 2013 to 2018
	All Sites (56 samples)			
	Minimum	Maximum	Mean	
ORGANIC MATTER				
Available N (ppm)	59	115	86.5	Decrease from mean of 86.5 (optimum) to mean of 13 (very low)
NUTRIENTS				
Phosphorus (P) – Olsen	3	38	13.2	Decrease from mean of 13.2 (medium) to mean of 7 (very low)
Potassium (K) (ppm)	88	467	201.5	Small increase from mean of 201.5 (optimum) to mean of 209 (optimum)
Magnesium (Mg) (ppm)	91	682	137	Small decrease from mean of 137 (optimum) to mean of 120 (optimum)
Calcium (Ca) (ppm)	440	2899	622.3	Small change from mean of 622.3 (medium) to mean of 628 (medium)
Manganese (Mn) (ppm)	N/A	N/A	N/A	
Iron (Fe) (ppm)	N/A	N/A	N/A	
Nitrogen NO3-N (ppm)	3	87	19.3	Decrease from mean of 19.3 to mean of 2.75
Boron (B) (ppm)	N/A	N/A	N/A	
OTHER PROPERTIES				
Ph	4.4	6.2	5.0	Decrease from mean of 5.0 to mean of 4.8 (strongly acidic)
Cation Exchange Capacity (meq/100g)	5.5	23.5	8.5	Decrease from mean of 8.5 to mean of 4.5
LEGEND[1]	**Very Low**			
	Low			
	Medium			
	Optimum			
	High			

1- levels based on soil test ratings, Waypoint Analytical, 2019

Appendix D Arana Gulch Creek Riparian Woodland and Wetland Management Area and Hagemann Gulch Riparian Woodland Management Area

D-1: Arana Creek Revegetation Areas: Revegetation Monitoring Results: CNPS and CDFG Combined Vegetation Rapid Assessment and Releve Field Forms

CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (Circle One) (Revised Sept 10, 2009)

For Office Use:	Final database #:	Final vegetation type name:	Alliance Year 5 Monitor Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo:	Date:	Name(s) of surveyors (circle recorder):
Area A		12/19	K Lyons

GPS wypt #: _____ GPS name: _____ Datum: _____ or NAD83. Bearing, left axis at SW pt_____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ Zone: 10 / 11 (circle one) Error: ±_____ ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance _____(meters) & bearing _____(degrees)

Elevation: ft / m Camera Name/Photograph #'s:

Stand Size (acres): (<1,) 1-5, >5 | Plot Size (m^2): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius____ft / m

Exposure, Actual °: W NE NW SE SW Flat Variable /All | Steepness, Actual °: _____ 0° 1-5° 5-25° > 25°

Topography: Macro: top (upper) mid lower bottom | Micro: convex flat concave undulating

Geology code: _____ Soil Texture code: _____ | Upland or Wetland/(Riparian) (circle one)

% Surface cover

H20:____ BA Stems:____ Litter: ____ Bedrock:____ (Incl. outcrops) Boulder:____ (>60cm diam) Stone:____ (25-60cm) Cobble: _____ (7.5-25cm) Gravel:____ (2mm-7.5cm) Fines:_____ (Incl sand, mud) =100%

% Current year bioturbation _____ Past bioturbation present? Y / N | % Hoof punch _____

Site history, stand age, comments:

Slope adjacent to trail & toe of Arana Creek

Type/ Level of disturbance codes: ____/___ ____/___ ____/___ ____/___ ____/___ "Other"

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH: T1 (<1" dbh), (T2) (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: (S1) seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: (H1) (<12" plant ht.), H2 (>12" ht.) % Non-Vasc cover: _____ Total % Vasc Veg cover: _____

% Cover -Overstory Tree Conifer/Hardwood: ____/____ Low-Medium Tree: 30 Shrub: 85 Herbaceous: 10

Height Class - Overstory Conifer/Hardwood: ____/____ Low-Medium Tree: _____ Shrub: _____ Herbaceous: _____

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
% cover intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	C	Strata	Species	% cover	C
T	Salix lasiolepis	30					
S	Rubus armeniacus	60					
S	Toxicodendron diversiloba	20					
S	Genista monspessulana	5					
H	grasses + Forbs	10					

Unusual species: _____

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances: _____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb ____ Shrub ____ Tree ____ Other identification or mapping information:

CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (Circle One) (Revised Sept 10, 2009)

For Office Use:	Final database #:	Final vegetation type name:	Alliance Year 5 Monitoring Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo:	Date:	Name(s) of surveyors (circle recorder):
Area C		12/19	K. Lyons

GPS wypt #: ____ GPS name: ____ Datum: ____ or NAD83. Bearing, left axis at SW pt____ (degrees) of Long / Short side

UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ Zone: 10 / 11 (circle one) Error: ±____ ft / m / pdop

GPS within stand? Yes / No If No, cite from waypoint to stand, distance ____(meters) & bearing ____(degrees)

Elevation: ft / m Camera Name/Photograph #'s:

Stand Size (acres): (<1,) 1-5, >5 | Plot Size (m^2): 10 / 100 / 400 / 1000 | Plot Shape ___ x___ ft / m or Circle Radius___ft / m

Exposure, Actual °: ____ NE (NW) SE SW Flat Variable /All | Steepness, Actual °: ____ (0°) 1-5° 5-25° > 25°

Topography: Macro: top upper mid lower bottom | Micro: convex flat concave undulating

Geology code: _____ Soil Texture code: _____ | (Upland) or Wetland/Riparian (circle one)

% Surface cover

H20:____ BA Stems:____ Litter: ____ Bedrock:____ (Incl. outcrops) Boulder:____ (>60cm diam) Stone:____ (25-60cm) Cobble: ____ (7.5-25cm) Gravel:____ (2mm-7.5cm) Fines:____ (Incl sand, mud) =100%

% Current year bioturbation _____ Past bioturbation present? Y / N | % Hoof punch _____

Site history, stand age, comments:

Revegetation area NW of Arana Creek causeway

Type/ Level of disturbance codes: ____/___ ____/___ ____/___ ____/___ ____/___ "Other"

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : T1 (<1" dbh), (T2) (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), (S3) mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: (H1) (<12" plant ht.). H2 (>12" ht.) **% Non-Vasc cover:** _____ **Total % Vasc Veg cover:**_____

% Cover -Overstory Tree Conifer/Hardwood: ____/____ **Low-Medium Tree:** 7 **Shrub:** 35 **Herbaceous:** 70

Height Class - Overstory Conifer/Hardwood: ____/____ **Low-Medium Tree:** ____ **Shrub:** ____ **Herbaceous:** ____

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T= Overstory tree, U= Understory Tree, S = Shrub, H= Herb, N= Non-vascular.
% cover intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	C	Strata	Species	% cover	C
T	Cupressus macrocarpa	5					
T	Quercus agrifolia	2					
S	Rosa californica	20					
S	Artemisia douglasiana	15					
H	grasses & Forbs	70					

Unusual species: _____

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances: _____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb ___ Shrub ___ Tree ___ Other identification or mapping information: