# Ballona Wetlands Restoration: Community Iceplant Removal Project

Year 2 Annual Report

**July 2018**

Prepared for the California Coastal Commission, California Department of Fish and Wildlife, and National Fish and Wildlife Foundation

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## Annual Report (Year 2)

July 2018

*Coastal Development Permit No. 5-15-1427*

**Prepared by: The Bay Foundation**

**Prepared for:**

California Coastal Commission
California Department of Fish and Wildlife
National Fish and Wildlife Foundation

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# Table of Contents

# List of Figures

# List of Tables

# Project Summary

The Bay Foundation (TBF), in partnership with California Department of Fish and Wildlife (CDFW), Friends of Ballona Wetlands (FBW), and community volunteers are conducting a project to remove invasive vegetation while broadening public involvement and stewardship at the Ballona Wetlands Ecological Reserve (Reserve). This report serves as the second annual report of the "Ballona Wetlands Restoration: Community Iceplant Removal Project" prepared for the California Coastal Commission to meet the annual reporting requirements for Coastal Development Permit No. 5-15-1427. This report summarizes restoration activities and monitoring results from 1 September 2016 through 31 July 2018.

The project focused on the removal of *Carpobrotus spp*., or iceplant, from a targeted area within Area B of the Reserve. Removing iceplant and other non-native vegetation on site will help protect the remaining native flora that will be critical to the revegetation of the Reserve for the larger multi-year restoration effort. Iceplant is a creeping, mat-forming group of species that form dense monocultures, causing a reduction in biodiversity and competing directly with native wetland species. Its removal and the continued maintenance of the site through the removal of other invasive vegetation species will provide an increase in the health and condition of the wetland habitats at the Reserve in Area B – south of Culver and has allowed for community engagement in hands-on restoration efforts. Pre- and post-restoration monitoring will evaluate the success of the project over time and will provide recommendations for additional community-level restoration opportunities on-site and at other, similarly-impacted urban wetland systems throughout Southern California.

Two iceplant removal methods were implemented by project participants. The first method involved traditional hand-restoration through pulling out iceplant mats by the roots, shaking them to remove dirt and debris, and removing them from the site to be green-waste processed or composted. The second method involved covering iceplant monocultures with large black plastic tarps to eliminate radiant sunlight and leaving the desiccated iceplant in place as mulch. Tarping was only conducted during the first summer of Year 1 and all subsequent activities have been hand removal or clipping of seed heads.

During Year 1, TBF and community volunteers concentrated restoration efforts on removing invasive iceplant from the project site. Over 15 tons of iceplant (more than 200 cubic yards) were removed from the restoration area to a green waste dumpster for composting offsite. Initial iceplant removal efforts were followed by heavy winter rains. Many non-native species are highly adapted to respond quickly and grow much faster than their native competitors. Due to the high level of degradation of the Reserve, and the significant presence of non-native vegetation immediately adjacent to the project site, non-native vegetation growth occurred in some areas after the initial iceplant removal. Nativity of vegetation cover was highly variable and patchy, with both native and non-native vegetation growth in the project area. Non-native vegetation cover was predominantly annual grasses and herbaceous species, with very little iceplant regrowth. Native vegetation growth was predominantly saltgrass and alkali weed.

During Year 2, TBF and community volunteers concentrated restoration efforts on opportunistically hand removing invasive vegetation, mostly non-native annuals, from the Year 1 project footprint. During eight public restoration events, 66 volunteers contributed 165 hours of

service. Additionally, almost 100 students from the Girls Athletic Leadership School toured the area on 4 October 2017. Twelve additional non-public events for spot weeding were also opportunistically conducted by TBF staff and interns from LMU's Coastal Research Institute focused on removing radish, mustard, some iceplant, and five horn bassia. Overall Year 2 results indicated a significant reduction in non-native vegetation cover in most areas as compared to the baseline, and an increase in native vegetation cover. Significant expansion and new growth of native vegetation occurred, in some areas several times greater than pre-restoration cover, especially as evidenced by the mapping results, which are higher resolution and cover a larger area than the transect results alone. While both Year 2 mapping surveys were conducted after non-native vegetation removal events occurred, and thus may slightly underestimate 'ambient condition' non-native cover, they still indicate an increasing nativity of site vegetation over time. Similarly, they illustrate the effectiveness of maintenance activities led by TBF in the second implementation year, showing a consistent level of non-native cover and slight increase in native cover with a decrease in unvegetated areas.

Long-term restoration of the project site will likely require a continued period of ongoing maintenance and adaptive management efforts to remove non-native, invasive vegetation. Even though Year 2 saw a significant increase in the dominant cover of native vegetation, a large portion of the site (especially in areas that were tarped) remains unvegetated. Thus, supplemental native plant seeding is recommended for Year 3, with a focus on unvegetated areas. This native seed dispersal is the next phase of the project's Monitoring and Implementation Plan and is recommended as the next step due to its lack of soil disturbance. Ongoing communications with CDFW and their Native American consultant continue, per soil disturbance and cultural resource protocol implementation. Long-term monitoring will continue to inform adaptive management decisions.

Lastly, on 1 August 2018, the public permit conditions of CDP No. 5-15-1427 begin again, and the first public events for Year 3 are scheduled for 1 August and 8 August 2018. Please signup for future events via TBF's website, www.santamonicabay.org, click on "events".

## Restoration Activities

Restoration events began on 1 September 2016, in accordance with Coastal Commission permit conditions (CDP No. 5-15-1427). Desiccating iceplant through solarization required installing tarps over iceplant monocultures during the hot summer and early fall months; therefore, TBF prioritized installing tarps as part of initial restoration efforts in 2016. Two events per day were held during the first three restoration days to maximize tarp deployment time. All tarps were fully deployed by 8 September 2016. Additional restoration events focused on hand-removal of iceplant. Table 1 provides summary details of all restoration events held from 1 September through 31 July 2018 and includes statistics on the number of volunteers, number of hours, restoration activities, and site details. During Year 1, over 15 tons of iceplant (more than 200 cubic yards) were removed from the restoration area to a green waste dumpster for composting. Weight was calculated by the dumpster rental company before processing the invasive vegetation waste and cubic yard area was estimated by the total dumpster space used. During Year 2, 39 large tarps and 15 trash bags of non-native, invasive vegetation were removed from the same restoration area as Year 1 activities. Only small-scale hand restoration maintenance activities were conducted during Year 2, so the total weight removed, and effort reflect that focus. Figures 1 and 2 are photographs of restoration events.

Exact total acreages of both the hand-restored and tarped restoration areas were calculated using a Trimble Geo7x GPS and mapped using GIS (Figure 3). Hand restoration efforts alone resulted in a restoration area of 0.39 acres (1,585 $m^2$), and the total tarped restoration area was 0.36 acres (1,460 $m^2$) for a total current project footprint of 0.75 acres. Additionally, during both implementation years, hand restoration efforts occurred as part of ongoing site maintenance throughout the restoration footprint. The total aerial extent ("footprint") of the restoration area covers 0.75 acres (3,035 $m^2$) within the 3-acre permitted proposed restoration area.

Overall, restoration events were highly successful, with enthusiastic groups of engaged community members, local residents, and student participants. During Year 1, 181 volunteers contributed 525 hours of service across 12 restoration events. During Year 2, 66 volunteers contributed 165 hours of service across 8 public restoration events (Figure 1, Table 1). Additionally, almost 100 students from the Girls Athletic Leadership School toured the area on 4 October 2017 (Figure 2). Several large school groups (N=60, 36) participated in restoration activities, especially during the November 2017 events. Additional hours were contributed by several students and interns helping with scientific monitoring. At the start of each event, an informational safety and cultural resource speech was given that also included a brief history of the Reserve, and the importance of healthy wetlands. All participants signed-in and turned in a waiver to track participation over time. Year 2 event dates were restricted by permit conditions. Eleven additional non-public events for spot weeding were also opportunistically conducted by TBF staff and interns focused on removing radish, mustard, and five horn bassia.

One of the project goals was to increase community engagement, stewardship, and volunteer participation, and this goal was met successfully. Participants were engaged in many ways, including direct participation, a public project webpage, social media, word-of-mouth, and directly reaching out to schools and community members. All public restoration events (during the public time of the CDP permit) were open to sign-ups from the public, and everyone who offered help was met with a positive response. Santa Monica College, Loyola Marymount University, University of California Los Angeles, and

Heal the Bay all regularly had volunteer participation in Year 2. This project allowed well managed temporary public access in a restricted coastal habitat area of the Reserve that was previously inaccessible, encouraging educational and hands-on opportunities for learning in an urban wetland environment.

Figure 1. Volunteers and interns remove non-natives to help surrounding saltgrass on 13 October 2017.

Figure 2. GALS LA School visit the restoration site and tour Area B on 4 October 2017.

Table 1. Summary of restoration event statistics through 31 July 2018.

| Year | Event Date / Time | Site | # Volunteers | # Volunteer Hours | Restoration Method |
|---|---|---|---|---|---|
| Year 1 | 1 September 2016 | 1 | 9 | 27 | Tarping + Hand-restored |
| | 1 September 2016 | 1 | 9 | 27 | Tarping + Hand-restored |
| | 6 September 2016 | 2 | 11 | 25.5 | Tarping + Hand-restored |
| | 6 September 2016 | 2 | 13 | 39 | Tarping + Hand-restored |
| | 8 September 2016 | 3 | 9 | 19.5 | Tarping + Hand-restored |
| | 8 September 2016 | 1 & 3 | 8 | 24 | Hand-restored |
| | 13 September 2016 | 1 & 2 | 9 | 16.5 | Hand-restored |
| | 16 September 2016 | 1 & 2 | 5 | 15 | Hand-restored |
| | 20 October 2016 | 1 | 10 | 22.5 | Hand-restored |
| | 10 November 2016 | 1 | 2 | 6 | Hand-restored |
| | 15 November 2016 | 1 & 2 | 60 | 240 | Hand-restored |
| | 18 November 2016 | 1 | 36 | 63 | Hand-restored |
| | **Subtotal** | ---- | **181** | **525** | ---- |
| | | | | | |
| **Year 2** | 27 September 2017 | 1 & 3 | 5 | 12.5 | Hand-restored |
| | 13 October 2017 | 1 | 7 | 17.5 | Hand-restored |
| | 17 October 2017 | 1 | 2 | 5 | Hand-restored |
| | 25 October 2017 | 1 | 6 | 15 | Hand-restored |
| | 15 November 2017 | 2 | 13 | 32.5 | Hand-restored |
| | 27 February 2018 | 1 | 6 | 15 | Hand-restored |
| | 6 March 2018 | 1 | 1 | 2.5 | Hand-restored |
| | 13 March 2018 | 1 | 26 | 65 | Hand-restored |
| | **Subtotal** | ---- | **66** | **165** | ---- |

Table 2. Restoration events during non-public portion of permit with TBF staff and interns only.

| Event Date / Time | Site |
|---|---|
| 23 August 2017 | 1 & 3 |
| 20 March 2018 | 1 |
| 18 April 2018 | 1 |
| 24 April 2018 | 1 |
| 1 May 2018 | 1 |
| 8 May 2018 | 1 & 2 |
| 11 May 2018 | 1 & 2 |
| 17 May 2018 | 1 |
| 19 May 2018 | 1 |
| 11 July 2018 | 2 |
| 19 July 2018 | 1 & 2 |


Figure 3. Map of hand-restored and tarped restoration activity locations at the Ballona Reserve.

# Scientific Monitoring

A rigorous scientific monitoring plan informs adaptive management of restoration activities. Table 3 summarizes the biological monitoring sampling design. It lists five major parameters, the primary protocol(s) implemented for each parameter, and the frequency of implementation. Event statistics (e.g. volunteer hours) are reported above. Vegetation planting has not yet occurred for this project, as recruitment of vegetation was being monitored, though distributing native plant seeds in Year 3 is planned, based on the next phase of the revegetation plan in the Implementation and Monitoring Plan (TBF 2016). Additionally, cultural resource monitoring occurred, but since no items were found as part of this project implementation, there are no results presented.

Pre-restoration, or baseline, surveys were conducted in July and August 2016, prior to the initiation of restoration activities. The "during project" surveys were conducted during tarping and restoration events, and the post-restoration evaluation surveys were conducted in November 2016, May 2017, July 2017, October 2017, and May 2018. Additionally, site checks were conducted bi-weekly during tarping implementation (late summer 2016 only), and supplemental surveys (especially for birds and other wildlife) were often conducted in association with restoration events.

Table 3. Description of biological protocols implemented during pre-restoration baseline monitoring, implementation monitoring, post-restoration monitoring, and their minimum frequency of occurrence.

| Parameter | Protocol | Pre-Restoration (Baseline) | During Project | Post-Restoration (Evaluation) | Post-Restoration Frequency |
|---|---|---|---|---|---|
| Invasive Vegetation Cover | GPS and GIS; Transect / Quadrat Cover | ✓ | | ✓ | Semi-annually for two years |
| Seedling Density | Quadrat Density Counts | | | ✓ | Quarterly for two years |
| Avifauna (Bird) | Visual Surveys for Presence and Behavior | ✓ | ✓ | ✓ | Immediately post-restoration and annually for two years |
| Other Wildlife (Mammals and Herpetofauna) | Visual Surveys for Presence | ✓ | ✓ | ✓ | Immediately post-restoration and annually for two years |
| Photo-Point | Permanent Photo-Points | ✓ | ✓ | ✓ | Immediately post-restoration and quarterly for two years |

Summaries of the pre- and post-restoration monitoring methods and results are included below. Note that species lists are not meant to be exhaustive, they are just identifications of the variety of flora and fauna that were seen on project surveys and monitoring days.

## *Vegetation*

The composition and distribution of vegetation species across wetland habitats directly affects many ecosystem functions such as productivity, soil composition, and nitrogen and carbon exchange dynamics (Schwartz et al. 2000, Keer and Zedler 2002). Vegetation cover surveys were used to provide a wide range of information and data, including: summarizing the prevalence of native and non-native plant cover in each habitat, determining species cover, and species richness. Additionally, a seedling density survey was conducted on restored areas, with a focus on geospatially tagging new growth of iceplant within the restoration areas and identifying seedlings within fixed transect locations.

### Overall Summary of Vegetation Results

Overall results indicated a significant reduction in non-native vegetation cover in most areas and an increase in native vegetation cover. The initial non-native decrease was due primarily to the removal of 100% of the iceplant cover, followed by the subsequent return of several "weedy" non-native vegetation invaders. The estimates of non-native vegetation reduction are likely conservative, given that pre-restoration "baseline" surveys were conducted in the summer of 2016 after the annual non-native species would have died. Significant expansion and new growth of native vegetation occurred, in some areas several times greater than pre-restoration cover, especially as evidenced by the mapping results, which are higher resolution and cover a larger area than the transect results alone. While both Year 2 mapping surveys were conducted after non-native vegetation removal events occurred and thus may slightly underestimate 'ambient condition' non-native cover, they still indicate an increasing nativity of site vegetation over time. Similarly, mapping surveys illustrate the effectiveness of maintenance activities led by TBF in the second implementation year, showing a consistent level of non-native cover and slight increase in native cover with a decrease in unvegetated areas. Thus, ongoing maintenance is recommended for future years.

Adaptive management recommendation actions to improve the condition of the project area are included in a subsequent chapter of this report to address the non-native vegetation invasion and plans for revegetation in Year 3 to supplement the areas that remain unvegetated after two years. The following Figures 4-7 display a variety of representative locations within the restoration project footprint following iceplant removal with various combinations of native and non-native vegetation assemblages.

Figure 4. New native saltgrass (18 April 2018; top) intermixed with desiccated iceplant, and seeding native alkali weed (11 July 2018; bottom) in disturbed soils, both within the restoration area.

Figure 5. Mixed native and non-native vegetation assemblages (new growth) in restoration area (18 April 2018).

Figure 6. Mixed native and non-native vegetation assemblages (11 July 2018).

Figure 7. Predominantly non-native vegetation assemblage (18 May 2018).

### Vegetation Mapping Survey Methods

Vegetation mapping methods employed *A Manual of California Vegetation* (Sawyer et al. 2009) as the standard for classification and delineation of most native and many non-native vegetation alliances and associations based on the presence and relative cover of co-dominant species. An updated version of the Manual can also be found online at explorer.natureserve.org.

Vegetation mapping protocols are described in detail in SOP 3.5 Vegetation Mapping (TBF 2015a). This protocol outlines a synthesized vegetation stand delineation strategy based on a combination of aerial imagery, office digitization (commonly in ArcGIS), and *in situ* field verification. This method used a Trimble GPS unit and ArcGIS software to produce detailed, geospatially rectified vegetation maps, allowing for an analysis of vegetation alliance and association coverage. Post-restoration field surveys were conducted in May 2017, October 2017, and May 2018.

### Vegetation Mapping Survey Results

Vegetation mapping results displayed an increase in native cover over time (as evaluated by the dominant cover classification of each polygon), a decrease in non-native cover over time, with somewhat consistent non-native cover results between October 2017 and May 2018, and a decrease in unvegetated area over time. Native cover was predominantly made up of saltgrass and alkali weed. Non-native cover species varied by polygon. While these results show a significant change in the condition of the site from the baseline of iceplant monocultures and intermixed iceplant with other species, they should not be interpreted alone, and additional data over time will confirm trends.

Figure 8a is a map displaying baseline dominant vegetation type within pre-restoration GIS polygons classified as iceplant monocultures (approximately 49% of the total project area) or non-native vegetation (approximately 51% of the total project area). The non-native vegetation polygons were also predominantly iceplant, but some areas contained intermixed saltgrass, especially the western border adjacent to Culver Boulevard. The iceplant present in these intermixed areas was hand-pulled.

For post-restoration data, polygons displaying native vegetation classifications may also contain small patches of non-native vegetation; similarly, non-native vegetation classifications may also contain small patches of native vegetation. Additionally, new iceplant growth individual plants are indicated on the map as black triangles.

Figure 8b is a map displaying Year 1 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, or mixed nativity surveyed on 2 May 2017. Sites 1 and 2 both had some areas with new iceplant growth: 35 small individual plants sprouted in Site 1, and 5 small individual plants sprouted in Site 2. Desiccated iceplant "mulch" areas where no native or non-native vegetation re-growth has occurred yet accounted for approximately 14% of the total project area. Polygons dominated by non-native vegetation covered approximately 59% of the total project area, and polygons dominated by native or mixed vegetation assemblages covered approximately 28% of the total project area. The polygons did not account for bare ground or "mulch" areas that are intermixed with native or non-native vegetation.

Figure 8c is a map displaying Year 2 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in October 2017. Over 40% of the site was classified as native, with approximately the same amount of the site classified as unvegetated, spread across all Sites. The western edges of Sites 1 and 2 are starting to fill in with native vegetation, predominantly saltgrass. Site 3 remains primarily unvegetated and non-native, even after adaptive maintenance actions and restoration events took place. A large portion of the sites remain unvegetated during this survey.

Figure 8d is a map displaying Year 2 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in May 2018. During this survey, over 50% of the total restoration area was classified as native, with approximately 9% of the area as non-native and approximately 35% as unvegetated, a decline in unvegetated area from the October 2017 survey. Unvegetated area remains primarily in Sites 1 and 3, with patchy non-native in multiple places, but large areas of dominant native cover, a significant change from pre-restoration baseline conditions.

Mapping results differed from the transect-level data (below), likely due in part to the high-resolution data coverage of the mapping, and the smaller area surveyed in the transects, which may not capture all of the vegetation cover information in the same way. It is also important to note that the mapping data were collected both times in Year 2 after restoration events had occurred, and thus, may not represent the "ambient" conditions throughout the whole year, but they do illustrate the effectiveness of maintenance activities led by TBF in the second implementation year.

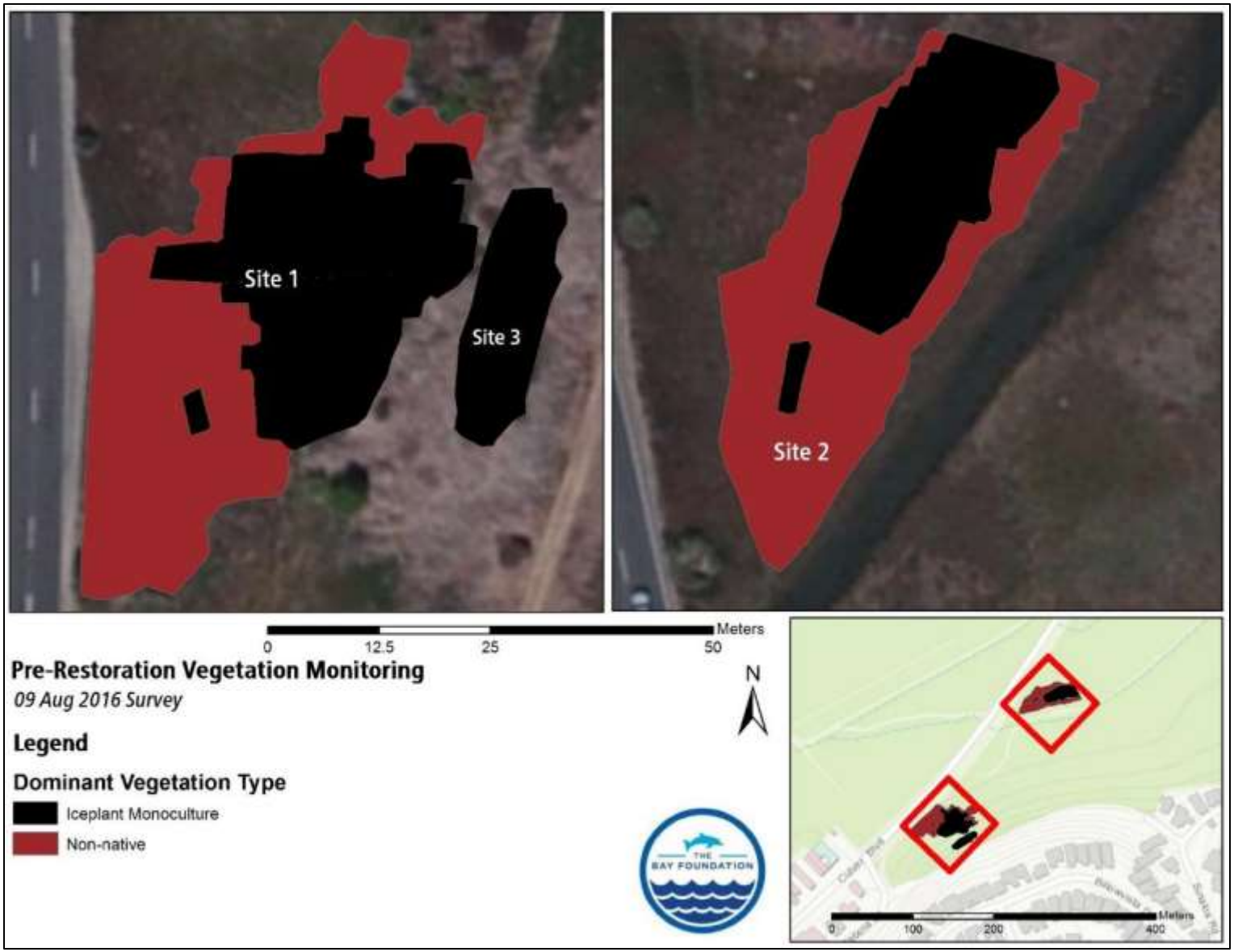



Figure 8a. Map displaying dominant vegetation type within GIS polygons during the 9 August 2016 baseline survey.

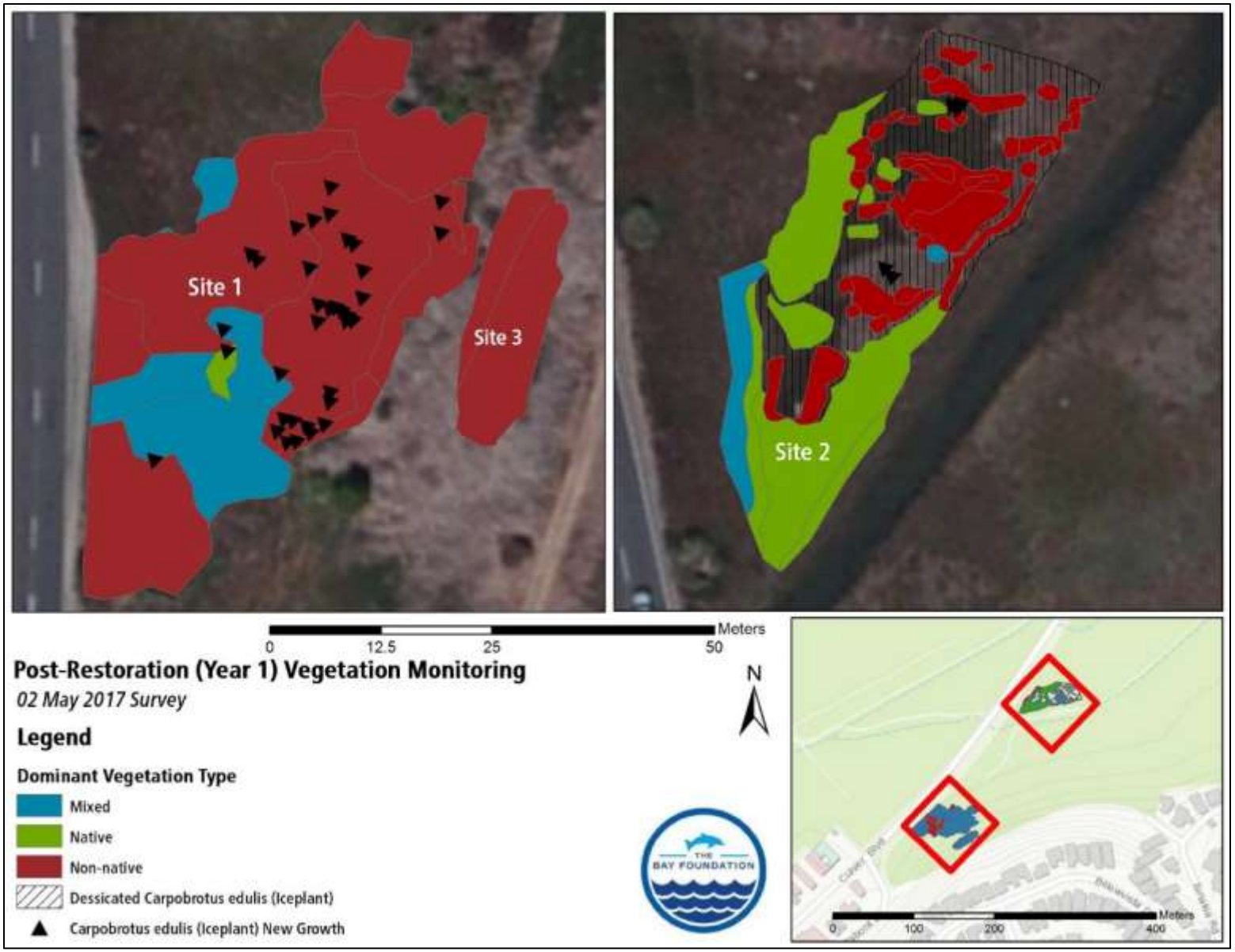



Figure 8b. Map displaying dominant vegetation type within GIS polygons during the 2 May 2017 survey.

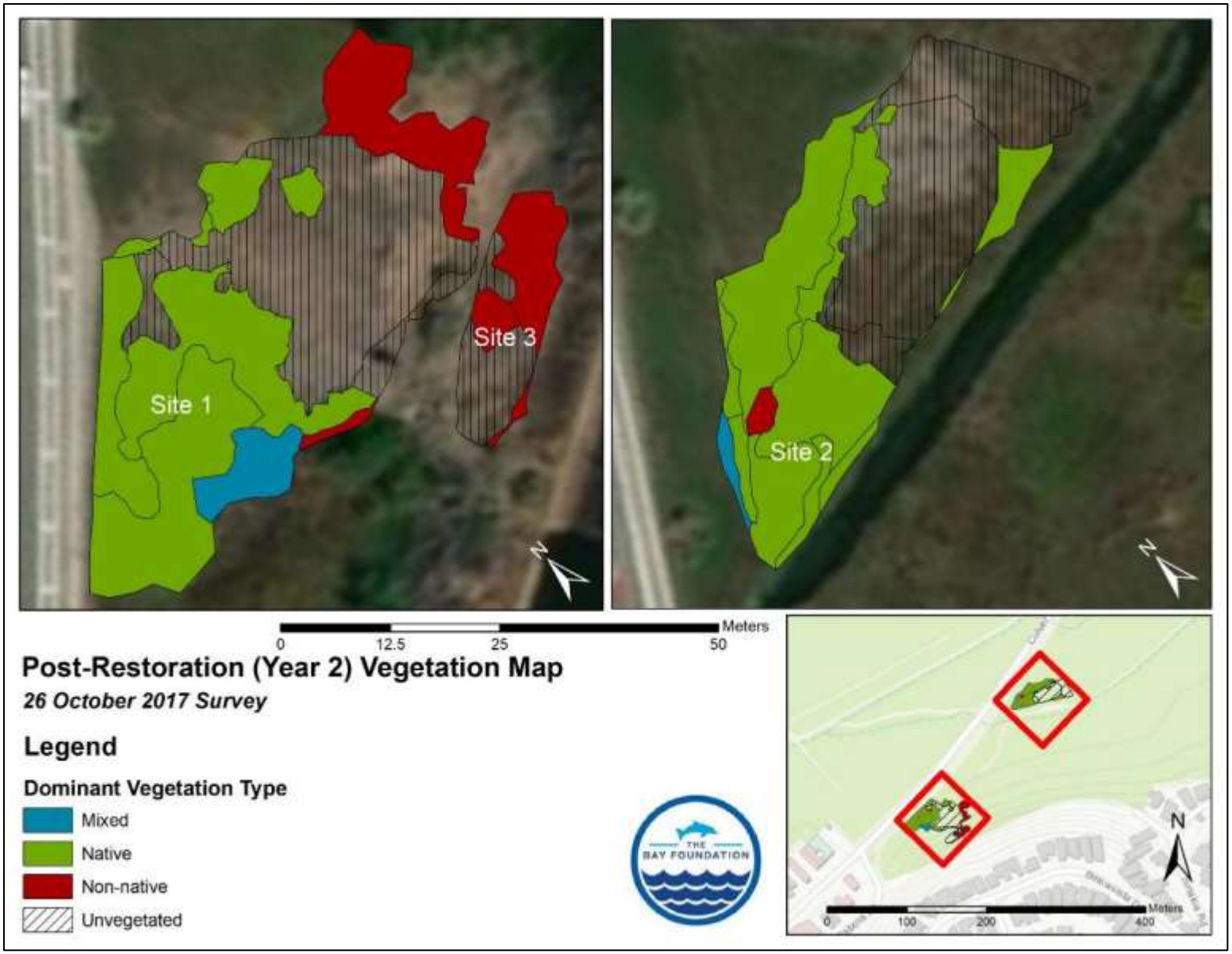



Figure 8c. Map displaying dominant vegetation type within GIS polygons during the 26 October 2017 survey.

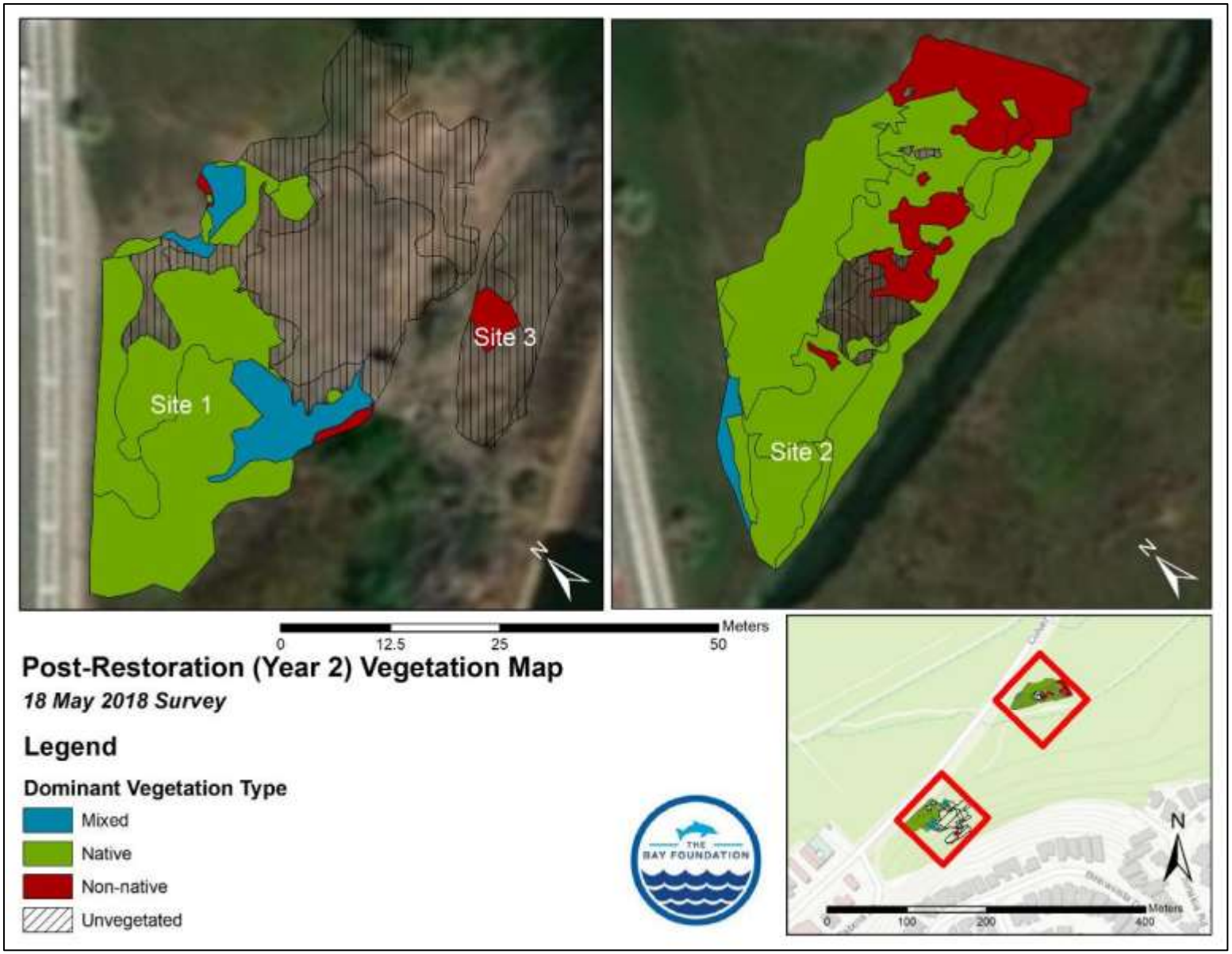



Figure 8d. Map displaying dominant vegetation type within GIS polygons during the 18 May 2018 survey.

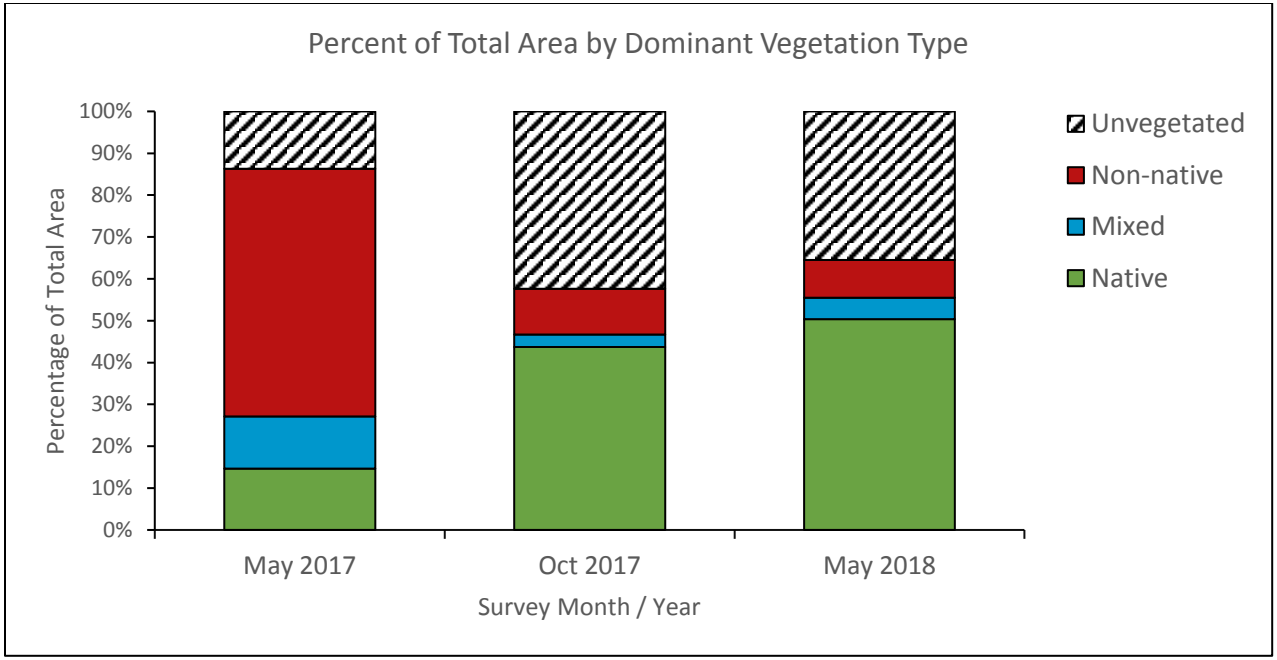



Figure 8e. Graph displaying percentage of dominant vegetation type over time.

### Vegetation Cover Survey Methods

The primary objective of transect- and quadrat-level cover surveys for this project was to assess the approximate cover of invasive, non-native vegetation over time. Transect- and quadrat-level plant cover data were collected on permanently identified 25-meter transects. Transects were randomly allocated within the "restoration" area and "control" area outside the restoration site. Both "Line-Intercept Transects" and "Cover Class Quadrats" were implemented.

The transect survey methods are described, along with field data sheets, in SOP 3.2 Vegetation Cover Surveys (TBF 2015b). Line-Intercept Transects documented every species observed directly below the transect tape where the vegetation crossed a minimum of 0.01 m. Line-intercept data were summed by species and divided by the total length of transect to determine percent cover for each transect and habitat. Cover Class Quadrat surveys were conducted using 1 $m^2$ PVC quadrats subdivided into 16 sub-quadrats. Ten quadrats were surveyed along each transect. Cover class species data were analyzed using the median of each Daubenmire cover category and averaged to determine percent cover within each transect with variability represented as standard deviation or error (TBF 2015b). Primary analyses were conducted to compare native versus non-native vegetation assemblages. Post-restoration field surveys were conducted in November 2016, immediately following restoration efforts, and again in May 2017, October 2017, and May 2018. An additional transect check for germinated seedlings was conducted in late December 2017, but due to the delayed onset of winter rains, none were identified at the time. Results are reported as live absolute cover percentages over time to best inform management actions and recommendations for the site.

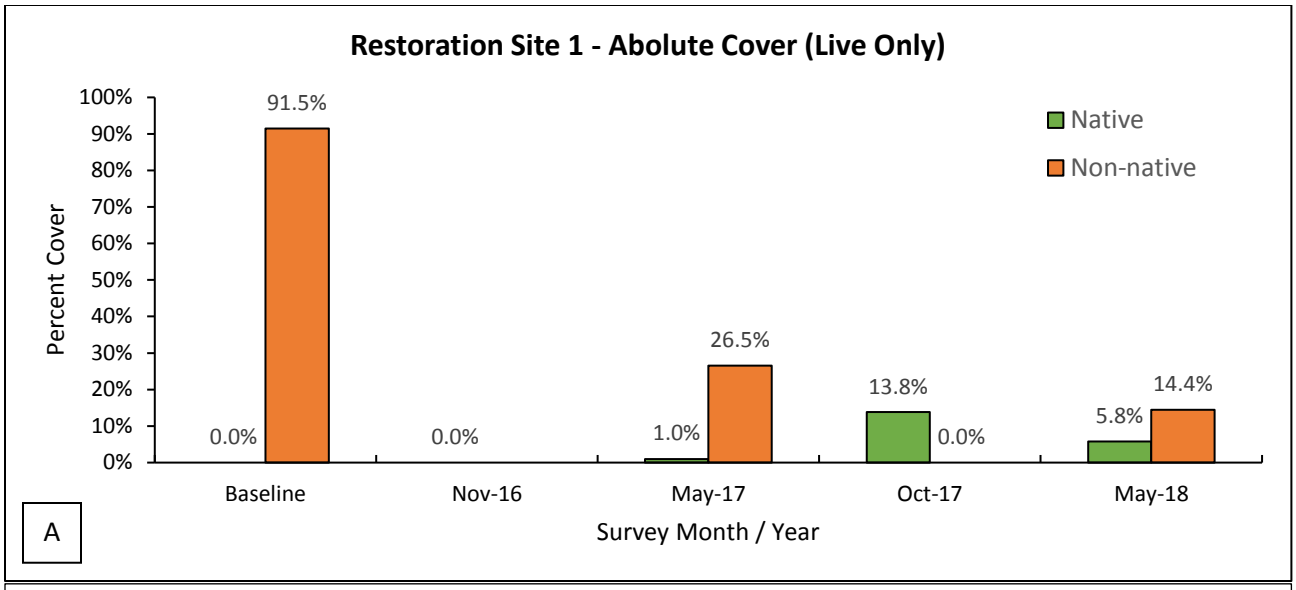
### Vegetation Cover Survey Results

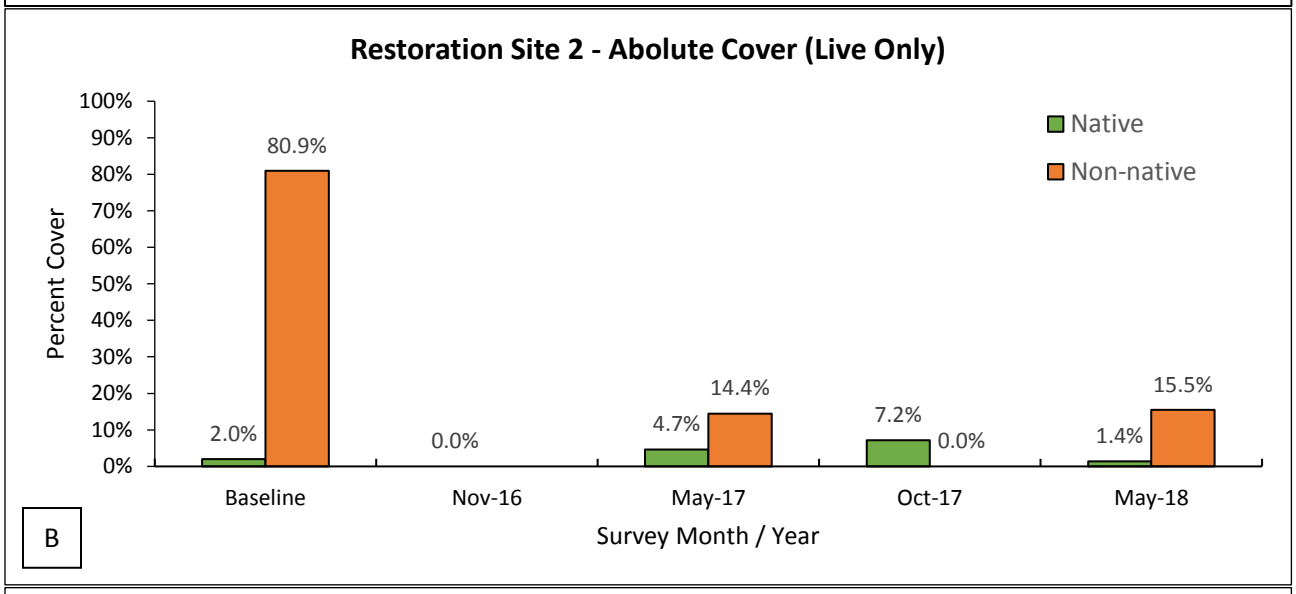
Site 1 transect results indicated a reduction in live non-native vegetation absolute cover from over 90%, pre-restoration, to 0% during the November 2016 survey, to less than 15% non-native cover, post-restoration on the most recent survey in May 2018 (Figure 9, A). This indicates a significant reduction in non-native vegetation cover, maintained across both monitoring years. Conversely, a fluctuating increase in native cover [saltgrass (*Distichlis spicata*)] from 0% (pre-restoration, baseline) to 5.8% cover in the most recent survey (May 2018) was identified, with a peak in October 2017 at 13.8%. The significant reduction in non-native cover was primarily due to the successful removal of iceplant from the project area. The less than 15% non-native cover was primarily new, annual "weedy" vegetation species, including: Geraldton carnation weed (*Euphorbia terracina*), non-native brome grasses, wild radish (*Raphanus sativus*), sweetclover (*Melilotus indicus*), and Bermuda buttercup (*Oxalis pes-caprae*), though other non-native species were present [e.g. sprouts of castor bean (*Ricinus communis*)]. Much of the remaining portions of the restoration area were covered in dead iceplant (acting as mulch) and did not exhibit vegetation growth at the time of the surveys. Photographs in Figure 10 illustrate the vegetation transition over time from a monoculture of iceplant (A), to dead iceplant immediately post-restoration (B), to a mix of a variety of native and non-native vegetation species (C-E). Figure 10 helps visualize the summary data as the saltgrass is highly discernable in October 2017, and then in May 2018, the most visible species is Geraldton carnation weed.

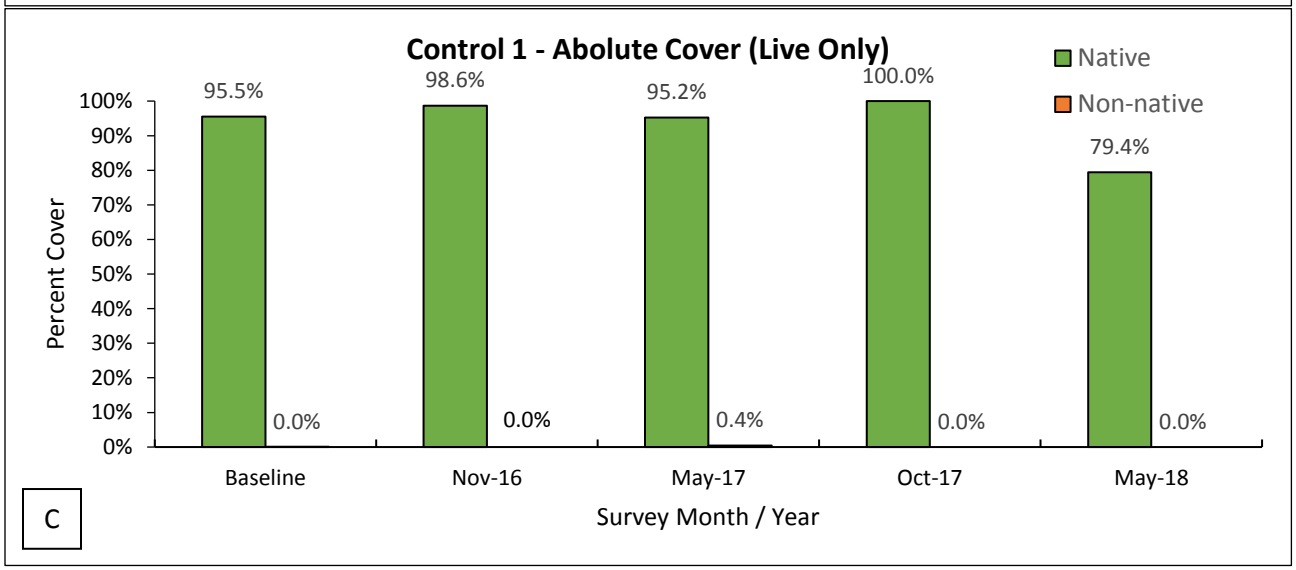
Similarly, Site 2 transect results indicated a shift from over 80% non-native cover to just over 15% non-native cover in the most recent survey (May 2018), again a significant reduction of non-native vegetation cover. Conversely, the native cover experienced patchiness and seasonal variability, with a

fluctuation between 0% and a high of 7.2% in the October 2017 survey, with a total of 1.4% in the most recent survey (May 2018) (Figure 9, B). This fluctuation was primarily due to expansion and then restriction of the area of saltgrass within the restoration area and some small patches of alkali weed (*Cressa truxillensis*). However, there were patches of native vegetation (again, primarily saltgrass) of over 25% cover in some of the Site 2 restoration areas, especially in October 2017 (Figure 11, quadrat photograph). The non-native vegetation cover at Site 2 varied but included non-native brome grasses and Bermuda buttercup.

Control results (transects surveyed outside of the restoration area and not altered during restorations) indicated some stability in the predominantly native areas, with live native cover ranging from a high of 98.6% dropping to a low of 79.4% native cover in May 2018, but still exhibiting resistance to invasion, with less than 1% non-native cover across all surveys (Figure 9, C). Conversely, control results in the predominantly non-native areas were highly fluctuating, indicated by a dramatic rise in non-native cover in May 2017, and a subsequent decline in October 2017, and again in May 2018. In May 2018, the non-native control area displayed approximately even non-native (44.0%) and native (41.8%) cover (Figure 9, D). These control transects are indicative of the variability of both native and non-native cover outside of the restoration project footprint area, but within the Reserve during the time period surveyed. Many of the areas adjacent to the project area had high non-native cover (e.g. Figure 12 taken immediately across Culver Boulevard from the project site).


Restoration Site 1 - Abolute Cover (Live Only)
Native
Non-native
Percent Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
91.5%
0.0%
0.0%
1.0%
26.5%
13.8%
0.0%
5.8%
14.4%
Baseline
Nov-16
May-17
Oct-17
May-18
Survey Month / Year
A


Restoration Site 2 - Abolute Cover (Live Only)
Native
Non-native
Percent Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
80.9%
2.0%
0.0%
4.7%
14.4%
7.2%
0.0%
1.4%
15.5%
Baseline
Nov-16
May-17
Oct-17
May-18
Survey Month / Year
B


Control 1 - Abolute Cover (Live Only)
Native
Non-native
Percent Cover
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
95.5%
0.0%
98.6%
0.0%
95.2%
0.4%
100.0%
0.0%
79.4%
0.0%
Baseline
Nov-16
May-17
Oct-17
May-18
Survey Month / Year
C

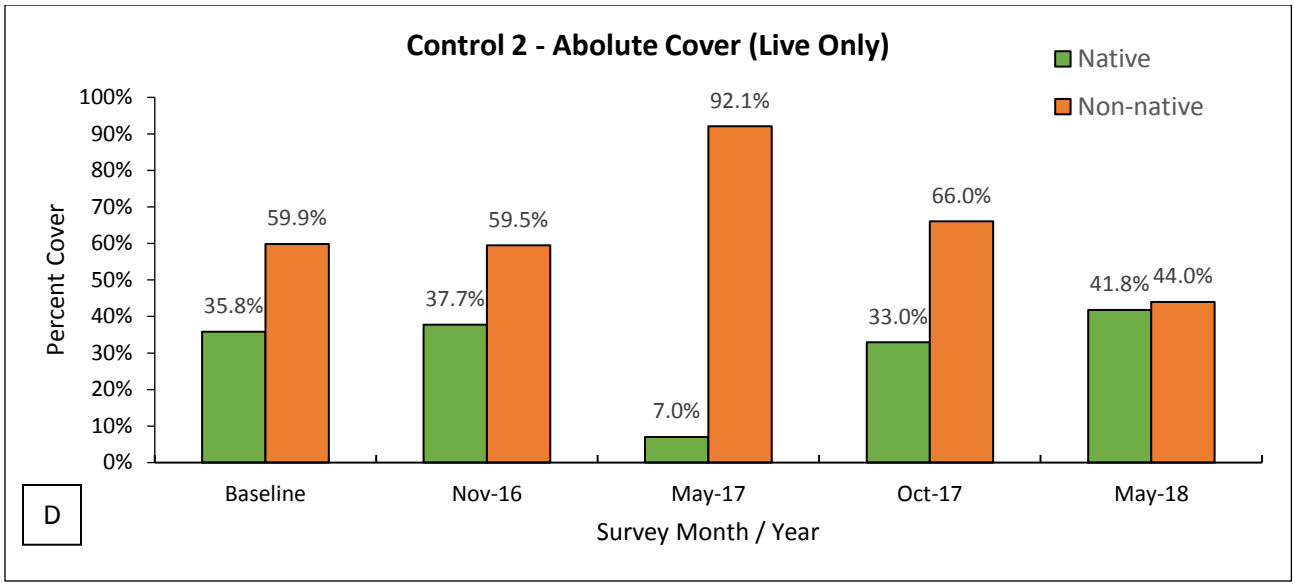



Figure 9. Vegetation data cover results from Site 1 (A), Site 2 (B), and the control area (outside the restoration footprint; C, D).

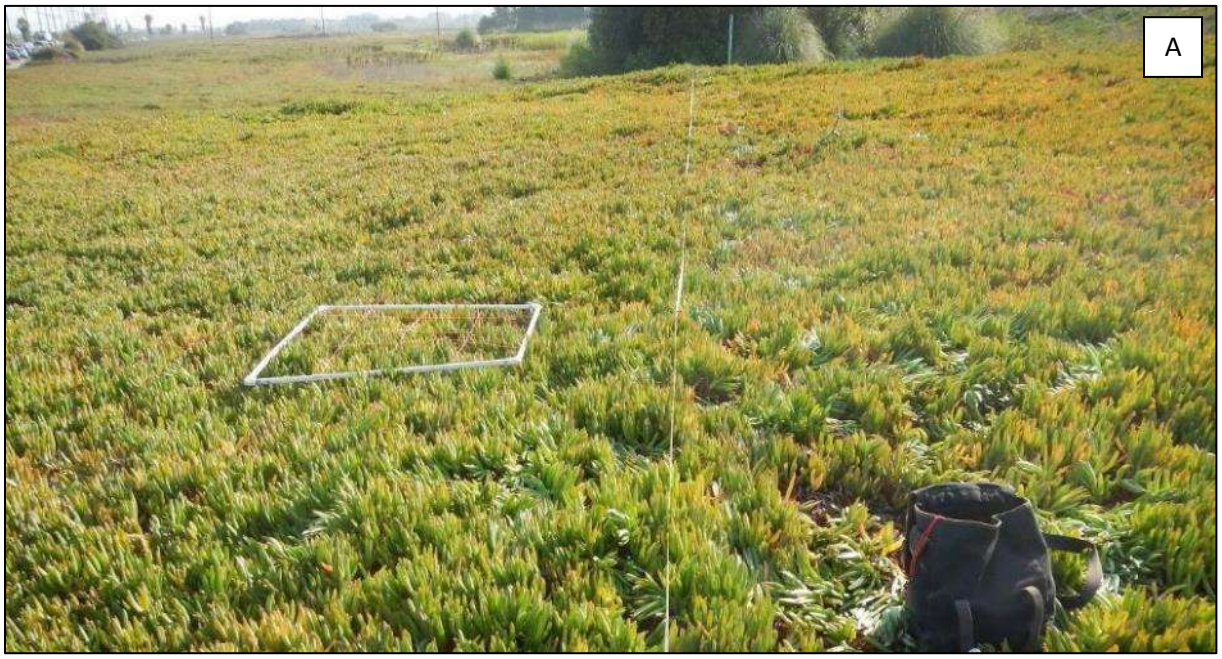



Figure 10. (Partial – see next two pages for details)


Figure 10. (Partial – see next page for details)


Figure 10. Photographs of Transect 5 pre-restoration on 23 August 2016 (A), immediately post-restoration on 29 November 2016 (B), and post-restoration on 1 May 2017 (C), 27 October 2017 (D; Year 2), and 1 May 2018 (E; Year 2).

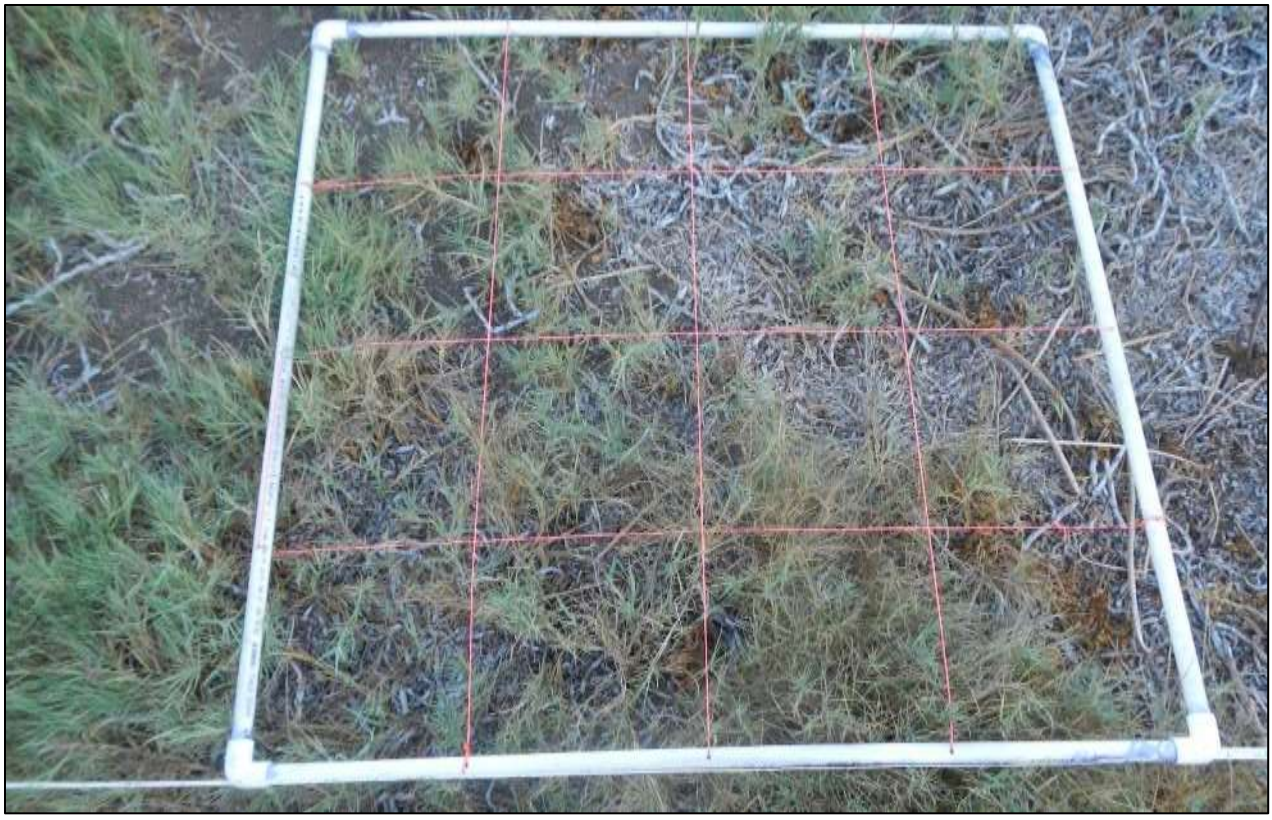


Figure 11. Photograph of saltgrass vegetation in a cover class quadrat at Site 2 (27 October 2017).


Figure 12. Photograph of non-native vegetation growth outside of project site across Culver Boulevard.

### *Avifauna and Other Wildlife*

No wildlife were harmed as part of this restoration project. There was no mortality under the tarps, and many species identified on or around the restoration area. It is important to note that the surveys conducted were not standardized for time or effort and are thus just displayed as presence data. The results should not be interpreted as full species lists of wildlife inhabiting the area; rather, they are just indicative examples of some of the species using the site.

#### Avifauna and Wildlife Survey Methods

The presence and distribution of avifauna within an ecosystem is often used as an index of habitat quality due to their diet and vulnerability to environmental conditions (Conway 2008). Avifauna data are useful to characterize representative avian assemblages and spatial distributions within a particular area. There are two primary purposes of avifauna and wildlife surveys for this project. First, it was to confirm a lack of breeding or nesting behavior for avifauna prior to the commencement of restoration activities to ensure no disturbance. Second, it was to provide a general understanding of the bird and wildlife community in the restoration area before and after restoration.

Bird survey methods are described in detail, along with field data sheets, in SOP 5.1 Bird Abundance-Activity (TBF 2015d). Bird surveys were performed by an ornithologist and entailed both observational visual and auditory bird surveys on 30 August 2016, 15 December 2016, 1 May 2017, and 13 July 2018. Observational data were also collected on wildlife presence during the implementation of other survey protocols and during restoration events; seven supplemental surveys were conducted during Year 2.

#### Avifauna and Wildlife Survey Results

No wildlife mortality was observed under the tarps during or after restoration. In fact, several reptiles (Western fence lizards, an alligator lizard, and a juvenile gopher snake) and several amphibians (Pacific tree frogs) were identified and moved during restoration events because they were on, under, or immediately adjacent to the tarps. They were moved to native salt marsh habitats immediately adjacent to the restoration area to avoid disturbance during events.

Avifauna were identified through ornithological surveys conducted by Cooper Ecological Monitoring, Inc. and as part of wildlife observation and monitoring days conducted by TBF and Friends of Ballona Wetlands. Table 4 includes a list of species identified as part of these monitoring surveys within the restoration area. It should be noted that this is not intended as a comprehensive or exhaustive list of species using the restoration area or adjacent habitats; several other species were visually observed by community members during restoration events. These results are intended to provide an overall understanding of some of the wildlife using the restoration area. No Belding's savannah sparrows were identified during the pre-restoration survey, and the ornithologist concluded that use of the pre-restoration area by this species during the project was very unlikely to occur.

Table 4 displays bird presence survey results. Many of the birds were identified immediately adjacent to the project area, rather than within the restoration footprint (e.g. "Cooper" columns of Table 4). This trend was exhibited during both the pre- and post-restoration surveys. The pre-restoration data column also includes species seen during restoration events within the project footprint area. Several raptor

species were observed hunting or foraging adjacent to or above the post-restoration project site, such as red-tailed hawk, red shouldered hawk, Cooper's hawk, and American kestrel. One osprey was observed hunting (flying) above the tide channel adjacent to Site 2. During the most recent bird survey on 13 July 2018, multiple individuals of several species were seen, including black phoebe, common yellowthroat, house finch, lesser goldfinch, and mourning dove. Snowy egrets were commonly identified in the tide channel adjacent to Site 2 (Figure 13).

During restoration events and post-monitoring surveys, a number of wildlife were seen and recorded such butterflies and moths (Table 5). Post-restoration wildlife identified included a variety of herpetofauna, mammals, and invertebrates, with some occasionally photographed such as the western pygmy blue (Figure 14) and the common buckeye (Figure 15). Western fence lizards and Pacific tree frogs were frequently observed, and alligator lizards were seen occasionally (Figure 16). Butterflies, moths, and other notable invertebrates were also recorded and included wandering skipper, cabbage white butterflies, several individuals of common buckeye butterflies, and others. California ground squirrel and Botta's pocket gopher burrows were also present throughout the restoration and adjacent areas and seen visually, while cottontail rabbits were frequently seen along the adjacent bluffs. Table 5 displays wildlife presents results.

Figure 13. Photographs of snowy egret adjacent to restoration Site 2 (left) and alligator lizard found in restoration area (right) (credit: R. Abbott, TBF).

Table 4. Bird species identified in and around the restoration project area.

| Common Name | Pre-restoration (and during) * | Post-restoration * | Cooper (5/1/17) ** | Cooper (7/13/18) ** |
|---|---|---|---|---|
| Allen's hummingbird | | | X | X |
| American crow | | | | X |
| American kestrel | | | | X |
| Anna's hummingbird | | | | X |
| Barn swallow | | | | |
| Black phoebe | X | X | | X |
| Bushtit | | X | X | |
| California towhee | | | X | |
| Common raven | | | X | |
| Common yellowthroat | | X | X | X |
| Cooper's hawk | | | | X |
| Great egret | | | | |
| House finch | | | X | X |
| House wren | | X | X | |
| Lesser Goldfinch | | | | X |
| Killdeer | | X | | |
| Marsh wren | | | | |
| Mourning dove | | X | X | X |
| Osprey | | X | | |
| Pigeon | | | | |
| Red tailed hawk | | | | |
| Red shouldered hawk | | | | |
| Savannah sparrow | | | | |
| Scrub jay | | | | |
| Song sparrow | | | X | X |
| Yellow warbler | | | X | |
| Warbling vireo | | | X | |
| Wilson's warbler | | | X | |

** Note: Pre-restoration (and during) survey efforts and post-restoration survey efforts are not equivalent.*

*** Note: Cooper Ecological ornithological surveys and observations were identified within approximately 50 feet of the project boundary.*

Table 5. Wildlife species identified within the project footprint area. Note: the pre-restoration column also includes wildlife found during restoration events (see December 2016 report for more details).

| Common Name | Pre-restoration (and during) | Post-restoration |
|---|---|---|
| Desert cottontail rabbit | | |
| CA ground squirrel | X | X |
| Western harvest mouse | | X |
| South Coast marsh vole | | |
| Botta's pocket gopher | | X |
| | | |
| Western fence lizard | X | X |
| Alligator lizard | X | X |
| Side-blotched lizard | | X |
| Gopher snake | X | X |
| Pacific tree frog | X | X |
| | | |
| Wandering skipper | X | X |
| Monarch butterfly | | X |
| Marine blue butterfly | | X |
| Cabbage white butterfly | X | X |
| Cloudless sulphur butterfly | | X |
| Common buckeye | | X |
| Fiery skipper | | X |
| Grey hairstreak | | |
| Western pygmy blue | | X |
| Unk. black moth | | X |
| Unk. brown moth | | X |

Figure 14. Western pygmy blue butterfly on pickleweed at edge of restoration area Site 2 (credit: R. Abbott, TBF, 26 October 2017).

Figure 15. Common buckeye in tarped iceplant restoration area (credit: R. Abbott, TBF, 18 April 2018).

### *Photo-point*

A series of geotagged photo-points were established to document change over time at the restoration site. The following photos provide a series of "after restoration" visual representations of tarped and hand-pulled restoration areas over time. Figure 16 shows an example photo-point over time of a close-up hand restoration site where iceplant was carefully removed around native saltgrass and alkali weed (note yellow flags for reference). Note the expansion of several of the patches of native alkali weed and saltgrass and the dead non-native mixed grasses (bottom). Figures 17 and 18 also document various points within the project area over time to provide visual examples of the post-restoration vegetation assemblages. Some of the non-natives are visually identifiable, especially in Year 1 (Figure 17), while in Year 2, especially in Site 2, the native saltgrass expansion is visible (bottom right corner; Figure 18).

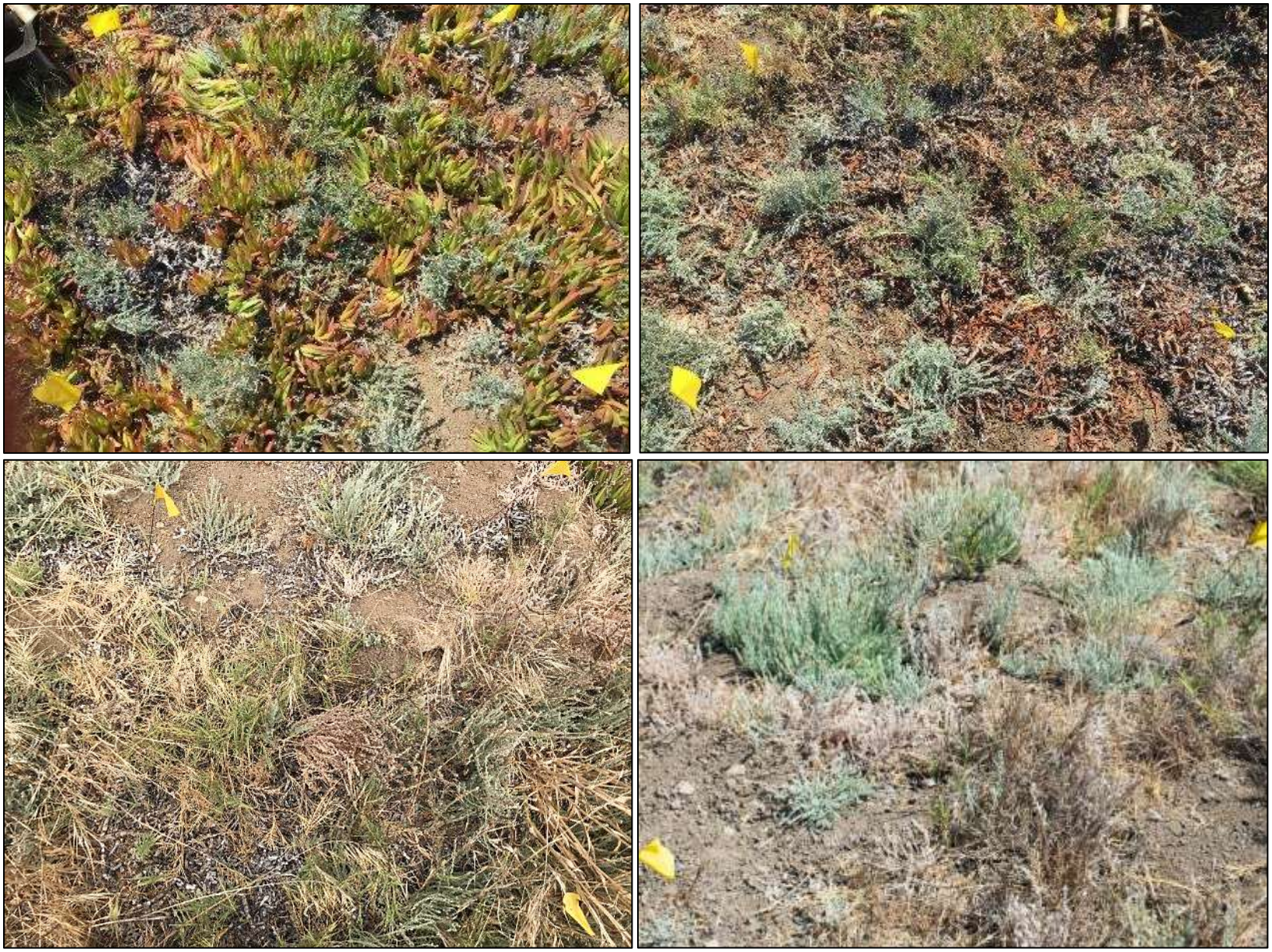


Figure 16. Photo point of pre-restoration square meter area of iceplant with intermixed native salt marsh species (top left), immediately post-restoration after hand-pulling iceplant (top right), post-restoration on 12 July 2017 (bottom left), and 31 July 2018 (bottom right).

## Site Photographs (Year 1)

Sites 1 & 3 (bearing 70°)

29 November 2016 | 25 April 2016 | 2 May 2017 | 12 July 2017

Sites 1 & 3 (bearing 300°)

29 November 2016 | 25 April 2016 | 2 May 2017 | 12 July 2017

Site 2 (bearing 270°)

29 November 2016 | 25 April 2016 | 2 May 2017 | 12 July 2017

Figure 17. Photo Point Series, Year 1

# Site Photographs (Year 2)

Sites 1 & 3 (bearing 70°)

12 August 2017 | 6 March 2018 | 18 May 2018 | 31 July 2018

Sites 1 & 3 (bearing 300°)

12 August 2017 | 27 February 2018 | 18 May 2018 | 31 July 2018

Site 2 (bearing 270°)

12 August 2017 | 16 November 2017 | 18 April 2018 | 31 July 2018

Figure 18. Photo Point Series, Year 2

# Permitting

TBF, in coordination with the California Department of Fish Wildlife (CDFW), obtained permits to implement the Ballona Wetlands Community Iceplant Removal Project. On 10 March 2016, the California Coastal Commission (CCC) approved Coastal Development Permit (CDP) No. 5-15-1427 for the removal of non-native *Carpobrotus spp*., or iceplant, from the targeted 3-acre area within the Ballona Wetlands Ecological Reserve, south of Culver Boulevard with several conditions. Only a portion of this iceplant removal has occurred as described in this report. Additionally, a CEQA exemption was filed and obtained by CDFW to implement this project.

Special conditions of CDP No. 5-15-1427 included:

1) Timing of operations prohibiting vegetation eradication and removal, hauling, annual maintenance and spot removal from 1 February through 30 August to avoid impact to avian species during breeding season;
2) Submittal of a plan to monitor and remove invasive non-native plants from the project area; and,
3) Disposal of materials outside the coastal zone.

On 14 July 2016, permit conditions were satisfied and the CDP permit was issued. Shortly after the first was drafted in December 2016 (not a requirement of the permitting process, but an extra report prepared by TBF), TBF contacted Commission staff in January 2017 seeking a permit amendment to allow tarping and solarization for three months versus two months (to facilitate a higher percentage of iceplant desiccation), and the ability for TBF staff to conduct as-needed smaller spot removal events to pull weeds year-round. In April 2017, TBF (on behalf of CDFW) requested a permit amendment (CDP No. 5-15-1427-A1) to adjust the timing restriction condition of the underlying permit to allow year-round weed pulling to facilitate better management of invasive plant growth in the project area. Objections were made against the requested permit amendment which resulted in the amendment request becoming "material" and needing to go before a public Commission meeting for approval. Monitoring of the site continued; however, the "material" permit amendment process prevented TBF from being able to conduct spot-removal of weedy vegetation that came up following heavy winter rains in Year 1, thus negatively impacting the restoration process.

On 27 June 2017, a revocation request was submitted to the Commission by Ballona Wetlands Land Trust (BWLT). The revocation request (No. 5-15-1427-REV) resulted in an additional agenda item to be presented and reviewed during the 11 August 2017 Commission hearing. On 27 July 2017, TBF participated in a meeting organized by BWLT to discuss the project with a larger group of stakeholders to understand and address ongoing concerns with the project.

At the CCC hearing on 11 August 2017, BWLT withdrew their revocation request No. 5-15-1427-REV, and CCC approved the amendment request by CDFW and TBF (No. 5-15-1427-A1), including an extension of project activities (spot removal by hand-pulling invasives) to be year-round for maintenance, and an extension of potential tarping deployment time, if needed. The permit amendment was issued on 12 September 2017. All reports for this project are made publicly available on TBF's website: www.santamonicabay.org. The annual reporting time period is August through July of the following year. Coordination and communications are ongoing with CDFW and Commission staff.

# Challenges

Restoration activities in a heavily degraded urban environment continued to pose challenges in Year 2, and while challenges for the second year varied in part from the first year of implementation, non-native weed maintenance continued to remain an ongoing challenge. Urban wetlands, like many other urban environments, experience significant impacts from non-native vegetation seed dispersal and growth, as well as encroachment from adjacent patches of non-native plants. The restoration site is immediately adjacent to a roadway, so it is possible that road transport and non-native seed dispersal via adjacent mechanisms may need to continue to be controlled until the larger Ballona Wetlands Ecological Reserve restoration project is implemented, in whatever final vision is chosen by the lead agencies (CDFW and the Army Corps of Engineers). Additionally, native vegetation recruitment remained patchy and with some seasonal variation. After the culmination of Year 2 activities and scientific monitoring, this challenge should be met in Year 3 with an adaptive management plan that includes dispersing native seeds in the restoration area, and results should be monitored carefully. This method of revegetation was recommended as preferential by CDFW's Native American consultants. Long-term restoration of the project site will likely require a period of ongoing effort to remove non-native, invasive vegetation (e.g. Table 6), and continued monitoring will inform necessary adaptive management decisions (see subsection below).

A second challenge faced by the project was recruitment of community volunteers and participants. While the project was limited in scope to by the permit conditions in Year 2 (see below), and the choice to keep maintenance efforts focused within the current project footprint, new volunteer recruits would provide additional support for the project, including during weekday events. This support has been provided in part by schools and through Loyola Marymount University's Coastal Research Institute internship students but may be supplemented through more and additional forms of new communication, including alternate online volunteer venues.

An additional challenge during the end of Year 1 of this project involved concerns about the permit amendment (expansion of restoration event timing) that were expressed by a stakeholder group to the Coastal Commission; therefore, management actions to remove non-native vegetation through restoration events were not able to occur in the target months for removal of several non-native annuals. The revocation request against the project permit required a wait of several months until the Commission convened a local hearing in Los Angeles. During the August 2017 Commission meeting, the revocation request was subsequently withdrawn, and the permit amendment was approved by the Commissioners, but the lack of an expedient approval could have potentially impacted the restoration area. Given this challenge, it is possible that future years may require additional maintenance to overcome the non-native vegetation re-seeding that occurred before the approval of the amendment.

These challenges continue to add to the difficulty of restoring an urban wetland in the middle of Los Angeles; however, information provided by this project will serve to inform future efforts both at this site and other wetlands throughout southern California.

# Adaptive Management Strategies

Monitoring combined with adaptive management actions can help address restoration challenges. Since the amendment was approved by the Coastal Commission, weed management within the restrictive permit conditions was subsequently expanded during the second implementation year. Weed succession refers to the growth of other weed species following the removal of one type of vegetation and is further discussed below after two years of data on plant regrowth. Unfortunately, many non-native species are highly adapted to respond quickly and grow much faster than their native competitors. While iceplant removal efforts were largely a success, with only scattered minimal re-growth present in a few areas, many other non-natives (including both perennials and annuals) continued to invade the site. However, the high level of invasion that was seen in Year 1 of a few key species shifted in Year 2 and was less present. It's unclear if that trend is a result of less precipitation in Year 2 or adaptive management actions, but a strong continued maintenance regime is recommended. Community restoration events will continue to be held that strategically target non-native vegetation growth on-site using species-specific removal strategies as described further below. Volunteer participants during Year 3 restoration events will be given a thorough briefing on non-native plants being targeted during the event and will be guided by TBF staff on removal techniques.

Table 6 provides a list of invasive species, with subsequent descriptions by species of the adaptive management efforts undertaken in Year 2, anecdotal results based on recurrence, and recommendations by species for Year 3. TBF will continue focus on removing the dominant invaders in Year 3 as part of ongoing long-term maintenance of the site. Perhaps equally as important is the recommendation to continue with the next phase of revegetation as part of the Implementation and Management Plan, focused on native seed dispersal within restoration areas through hand seeding. This native seeding phase is further discussed in a subsection below 'Ongoing Maintenance'.

## Ongoing Maintenance

Year 2 maintenance required less effort than the first implementation year, perhaps due in part to non-native removal from the prior year or less winter precipitation, or both. Trends indicated fewer perennials such as iceplant (only a few small sprouts reoccurring within the project area in Year 2) and castor bean (again, only a couple of sprouts after removal of sprouts and seed heads in fall 2017). The primary target species shifted from annual sweetclover to Geraldton carnation weed and Bermuda buttercup in Year 2 (Table 6). Geraldton carnation weed is encroaching from areas outside but immediately adjacent to the restoration area, so an extension of the restoration area would allow for better adaptive management of this invasive species. Site 2 had some new growth of Australian saltbush, but not in the same areas that were tarped in Year 1, so it may have a presence in the seed bank and should be tracked over time. For additional details by species, see individual subsections below and Table 6.

Year 3 restoration activities will focus on strategically controlling non-native vegetation within the Year 1 restoration footprint, seeding native plant species into the Year 1 footprint during the wet season, and continued hand restoration maintenance of weeds into the larger project area (still within the same permitted 3-acre area). This new hand restoration will allow for the perimeter control of several key

invaders and may help reduce the impact of some of the non-native invaders into the restoration project footprint. Removal of non-natives will continue to be targeted by flowering period for each individual species for maximum effectiveness (prior to seeding; Table 7). The following subsections provide details for the dominant vegetation invaders present within the restoration project area and suggested control methods. Table 6 and Table 7 summarize maintenance information by species. All removed non-native plant material will be disposed of offsite.

Table 6. Summary of weed maintenance adaptive management strategies by species (non-natives).

| Scientific Name | Common Name | Growth Type | Year 2 Summary | Future Recommendations for Year 3 |
|---|---|---|---|---|
| *Bromus spp.* | Brome grasses | Annual | Present throughout; maintained through seed clipping and pulling | Weed-wacker before seeding or hand removal by roots before seeding |
| *Carpobrotus spp.* | Iceplant | Perennial | Very little regrowth in Year 2; hand removed several individual sprouts | Hand removal by roots; solarization of monocultures (not proposed for Year 3) |
| *Euphorbia terracina* | Geraldton carnation weed | Perennial | More invasive in Year 2 – invading from perimeter; hand removed and clipped | Hand removal by roots |
| *Glebionis coronarium* | Crown daisy | Annual | Not present in Year 2 within site; present around periphery | Hand removal by roots or weed-wrench before seeding; expand perimeter maintenance |
| *Lysimachia arvensis* | Scarlet pimpernel | Annual | Very little presence in Year 2; hand removed | Hand removal by roots or weed-wrench before seeding |
| *Melilotus indicus* | Sweetclover | Annual | Less invasive than Year 1; hand removed | Weed-wacker (or clipping) before seeding or hand removal by roots before seeding |
| *Oxalis pes-caprae* | Bermuda buttercup | Perennial | High presence in Year 2; hand removed | Hand removal by roots or weed-wrench before seeding; make sure to remove bulbs |
| *Raphanus sativus* | Wild radish | Annual | Present in Year 2, especially around periphery and Site 3; hand removed and cut flowering tops | Weed-wacker (or clipping) before seeding or hand removal by roots before seeding |
| *Ricinus communis* | Castor bean | Perennial | Very little regrowth after initial seed clipping and sprout pulling in fall 2017 | Bag seeds; hand removal by roots or weed-wrench before seeding; expand perimeter maintenance |
| *Sonchus oleraceus* | Common sowthistle | Annual | Present in low amounts throughout; hand removed | Hand removal by roots or weed-wrench before seeding |
| *Atriplex semibaccata* | Australian saltbush | Perennial | Present in low amounts at Site 2; hand removed | Hand removal by roots |
| *Cortaderia selloana* | Pampas grass | Perennial | Not targeted during Year 1 and Year 2 | Clipping and bagging of seed heads from plants within project area; manual removal of plants when feasible |

Table 7. Summary flowering period for invasive vegetation by month and species.

| | Bloom Period | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Name | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Brome grasses | | | | | | | | | | | | |
| Iceplant | | | | | | | | | | | | |
| Geraldton carnation weed | | | | | | | | | | | | |
| Crown daisy | | | | | | | | | | | | |
| Scarlet pimpernel | | | | | | | | | | | | |
| Sweetclover | | | | | | | | | | | | |
| Bermuda buttercup | | | | | | | | | | | | |
| Wild radish | | | | | | | | | | | | |
| Castor bean | | | | | | | | | | | | |
| Common sowthistle | | | | | | | | | | | | |
| Pampas grass | | | | | | | | | | | | |
| Australian saltbush | | | | | | | | | | | | |

### *Perennial Non-native Species*

#### ***Carpobrotus spp.***

Iceplant was not present in significant amounts in Year 2, and the couple of individual plants that re-sprouted were easily removed. For future years, all iceplant sprouts present in the project area can be removed by hand and disposed of offsite. For additional details about iceplant, see the rest of this report and other information on the project webpage.

#### ***Euphorbia terracina***

Geraldton carnation weed (*Euphorbia terracina*) was present in higher amounts during Year 2 than Year 1, and appears to be seriously encroaching from the perimeter, especially at Site 1. Geraldton weed is a perennial (or biennial) herb that is not native to California and has the potential to spread rapidly (Cal-IPC). Like many other members of the spurge family, it produces toxic sap and has allelopathic properties that reduce germination of native plants (Cal-IPC). Although chemical methods have shown success in controlling this plant, this project is limited to manual removal methods only; therefore, this invasive plant species will continue to be removed by hand, bagging plants which have gone to seed, and carefully minimizing soil disturbance around the area (Dorsey et al. 2010). Geraldton carnation weed seeds can exist in the seed bank for three to five years, so continued maintenance of removing this invasive before it goes to seed will be necessary to establish control (Randall and Brooks 2000). Additional recommendations for this species include expanding the perimeter maintenance activities.

#### ***Oxalis pes-caprae***

Bermuda buttercup (*Oxalis pes-caprae*) was present in higher amounts in Year 2 at Site 1. Unfortunately, soil disturbance was not allowed at the key time of removal for this species (which has underground bulbs), so it may return in Year 3 and should be removed with the bulbs included. The buttercup is a low-growing perennial herb (family Oxalidaceae) found along the coast of California (Cal-

IPC). This buttercup does not produce seeds, but it has been shown to be difficult to control because of its ability to form many persistent bulbs and is often described as an "agricultural weed" (Cal-IPC). A loose basal rosette of leaves up to about 14 inches (35 cm) tall grows from the bulb and flowers bloom from November through April (UCIPM). While herbicides are commonly used to control this species (Stringer and Heath 2011), it can be removed by hand.

***Cortaderia selloana***

Pampas grass (*Cortaderia selloana*) is a large perennial grass found sporadically around the periphery of the project site. A few large stands exist within the permitted project site (not within the Year 1 footprint), and while Year 1 and Year 2 restoration activities targeted primarily iceplant followed by non-native annuals, Year 3 activities will include at a minimum, clipping the seed heads from pampas grass plants located in the extended project footprint and removing juvenile plants completely. Each flower (plume) from the pampas grass plant can produce up to 100,000 seeds that are widely dispersed by wind; thus, management of the spread of seeds within the project footprint will benefit not only the site but other portions of the Reserve.

***Ricinus communis***

Castor bean (*Ricinus communis*) did not appear to have large amounts of re-growth after efforts were made in fall 2017 to bag and remove all seed heads and to pull sprouts (approximately 400). Only a couple of individual sprouts were seen in spring 2018. Castor bean is a perennial shrub, sometimes tree-like, that can grow three to 15 feet tall. Castor bean grows quickly in mild climates and has escaped cultivation to become a noxious weed in southern and central California (Bossard et al. 2000). Castor bean displaces native plant species by growing rapidly and shading out native seeds and seedlings. Additionally, the seeds of castor bean are highly toxic to humans and wildlife such as rabbits, cats, dogs, and gophers (Robbins et al. 1941). As this plant spreads via seeds, seed heads from individual plants should be bagged prior to pulling plants by hand and removing the bulk of the root system. A weed wrench can be used to remove larger castor bean plants. Additional recommendations for this species include expanding the perimeter maintenance activities.

***Atriplex semibaccata***

Australian saltbush (*Atriplex semibaccata*) is a spreading, shrubby perennial and is invasive in coastal grasslands and scrub, and the higher ground of salt marshes. It is a prostrate ground cover plant that has an extensive flowering period. A small area of Australian saltbush was tarped in Year 1, and subsequently manually removed during community restoration events during Year 1 and Year 2 from within the project footprint at Site 2. It will continue to be managed during Year 3 restoration activities using hand removal techniques.

## *Annual Non-native Species*

### ***Bromus spp.***

*Bromus spp*. includes a variety of non-native annual brome grasses such as ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), and foxtail brome (*Bromus madritensis*), exhibiting similar graminoid growth patterns and reproducing by seed (Cal-IPC). These species had patchy presence throughout the restoration areas and should continue to be cut or pulled before seeds form. These species are characteristic of disturbed habitats and are common "weedy" grasses. In California, they contribute to altered patterns of wildfire, altered microhabitat characteristics, and altered nutrient cycling and competition for soil nutrients and light (Cal-IPC). Seeds of brome grasses can cling to people and are easily spread. Care should be taken not to transport the seeds from other areas onto the project area. For Year 3, these non-natives should continue to be removed prior to seeding by hand removal. Some recommendations for removal include using a weed-wacker to cut off the tops (flowering heads prior to seeding) of these grasses in areas dominated by these species for maximum cost-effectiveness.

### ***Glebionis coronaria***

Crown daisy (*Glebionis coronaria*) was not identified in the restoration areas during Year 2 but has been identified on the periphery adjacent to the restoration sites, especially along the base of the bluff. Crown daisy is a flowering annual, commonly found in coastal California, and can invade a variety of habitats. This common ornamental plant escapes gardens settings and easily invades disturbed areas (Cal-IPC). The seeds of this species sprout quickly after rain and can grow up to five feet tall. Dense stands can crowd out native vegetation and dead plant mass if not removed can also prevent native plants from recolonizing (Tuttle et al. 2011). Crown daisy can be removed by hand or weed wrench. For Year 3, the adjacent crown daisy should be assessed, and additional recommendations for this species include expanding the perimeter maintenance activities.

### ***Lysimachia arvensis***

Scarlet pimpernel (*Lysimachia arvensis*) is a small annual (can be biennial) non-native broadleaf herb that was present in Site 1 and 3 as small scattered individual plants in Year 2. The species is commonly found in man-made and disturbed habitats and is tolerant of wetland habitats. If consumed, it can be toxic to livestock and humans (UCIPM). Mature plants can grow up to approximately 1.3 feet with upright or prostrate stems. Small salmon-orange colored flowers are produced from March through July (UCIPM), and it reproduces by seed. This species can be removed by hand or weed wrench. Year 3 recommendations include removing reoccurring individual sprouts.

### ***Melilotus indicus***

Sweetclover (*Melilotus indicus*) was present in much smaller amounts during Year 2, when compared to the maintenance efforts of Year 1. This non-native annual (can be biennial) herb that blooms from April through October, can grow up to approximately two feet in height, and is fairly tolerant of saline soils (Calflora). This plant is often poisonous to mammals and can have a persistent seed bank of up to 20 years (Florabase). Plants should be hand removed before seeds are formed. If using a weed-wacker, the plant needs to be cut below the lowest branch axil to prevent resprouting. For Year 3, continued

maintenance of any regrowth should occur, and additional recommendations for this species include expanding the perimeter maintenance activities.

***Raphanus sativus***

Wild radish (*Raphanus sativus*) was present in Year 2 in smaller amounts than Year 1 but was a significant presence around the periphery of the restoration area. Radish is an herbaceous annual that frequently invades disturbed areas, including roadsides, and can also be found in wetland areas (Holloran et al. 2004). Wild radish can grow up to 3 feet or taller and reproduce only by seed. Seeds can remain viable for long periods of time and can germinate in spring on fall depending on weather. Wild radish is present in all restoration sites and has likely gone to seed by the time TBF is allowed to conduct post-restoration maintenance. Wild radish plants with seeds present will be bagged and removed from the site. Removal can occur manually by hand or weed wrench. Plants should be hand removed before seeds are formed. Additional recommendations for this species during Year 3 include expanding the perimeter maintenance activities.

***Sonchus oleraceus***

Common sowthistle (*Sonchus oleraceus*) was present in small amounts in various places throughout the restoration area in Year 2. Sowthistle is a common annual (can be biennial) broadleaf plant that is frequently found in disturbed soils. It has hollow stems, releases a milky sap when cut open, and can reach over 4 feet in height. The yellow flowers mature into fluffy white seed heads, and this species reproduces by wind-dispersed seed. A single plant can produce up to 8,000 seeds (Florabase). Seed is able to germinate all year round over a broad range of temperatures and light availability (Cal-IPC). This species has been known to be resistant to herbicides and manual removal techniques are recommended. Populations can be removed by hand or by weed wrench. Cutting is often ineffective, as flowers can continue to be produced from cut stems. Recommendations for Year 3 include continued hand removal and maintenance.

## Revegetation of the Project Area

The first step of revegetation of the restoration project allowed for a passive evaluation of natural native vegetation recruitment based on the existing seed bank without soil disturbance (recommended by CDFW and their Native American consultant). This scientific evaluation occurred for a period of two years after iceplant removal. While some areas such as the western half of Site 2 have experienced significant recruitment of native species like saltgrass and alkali weed, the majority of the restoration areas still have patchy or very low levels of native cover and would benefit from additional adaptive management to encourage native plant recruitment. Therefore, in Year 3, seeds will be collected from healthy patches of native vegetation from throughout the Reserve, following guidelines developed by CDFW to avoid impacts to existing native vegetation areas. Reserve collection will allow for preservation of local genetic diversity within site. These seeds will be dispersed at the optimal time in Year 3 based on the weather conditions during the wet season and will not require any soil disturbance.

Subsequent monitoring after the wet season in Year 3 will allow for an evaluation of the success of this revegetation technique, and at that time options will be discussed for supplemental techniques that may include additional seed dispersal or container plants. Targeted infill plantings with native species in the restored areas may be conducted in future years, based on the success of the natural recruitment protocol and hand-seeding protocol implementation. Small, native (1 gallon or smaller) container stock may continue to be considered if the previous revegetation protocols are insufficient to achieve native vegetation recruitment.

The plant palette for both seed collection and planting reflects hardy, salt-tolerant species which can also withstand seasonal reduced hydrology. Vegetation seeded or planted on site will consist of native plants present in the Reserve. The planting plan will be developed in coordination with CDFW and their Native American consultants. The palette may include (but not be limited to) the following native species and will vary based on the recruitment success of the micro-habitats within the project area. Table 8 displays the summary flowering period for each of the native vegetation species by month obtained through Calflora and additional species-specific literature sources. Note the narrower flowering window of some of the native species as compared to the non-natives (Table 7; e.g. castor bean, sowthistle).

> **Marsh habitat species**: *Salicornia pacifica, Distichlis spicata, Frankenia salina, Cressa truxillensis, Distichlis littoralis*, and *Juncus mexicanus* (in or adjacent to brackish areas)
>
> **Transition habitat / upland edge species**: *Heliotropium curassavicum, Atriplex lentiformis, Distichlis spicata, Acmispon glaber, Encelia californica, Lupinus chamissonis, Ericameria ericoides, Salvia mellifera, Camissoniopsis spp, Salvia leucophylla*, and *Elymus triticoides*.

Table 8. Summary flowering period for native vegetation by month and species.

| | Bloom Period | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| *Salicornia pacifica* | | | | | | | | ■ | ■ | ■ | ■ | |
| *Distichlis spicata* | | | | | | | | | ■ | ■ | ■ | |
| *Frankenia salina* | | | | | | | | | ■ | ■ | | |
| *Cressa truxillensis* | | | | | | | ■ | ■ | | | | |
| *Juncus mexicanus* | | | ■ | ■ | ■ | | | | | | | |
| *Distichlis littoralis* | | | | | | ■ | ■ | ■ | ■ | | | |
| *Heliotropium curassavicum* | | | | | ■ | ■ | | | | | | |
| *Atriplex lentiformis* | | | | | | ■ | ■ | | | | | |
| *Acmispon glaber* | | | | ■ | ■ | ■ | ■ | ■ | | | | |
| *Encelia californica* | | | ■ | ■ | ■ | ■ | | | | | | |
| *Lupinus chamissonis* | | | | ■ | ■ | ■ | | | | | | |
| *Ericameria ericoides* | | | | | | | | | ■ | ■ | ■ | |
| *Camissoniopsis spp.* | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| *Salvia mellifera* | | | | ■ | ■ | ■ | ■ | | | | | |
| *Salvia leucophylla* | | | | ■ | ■ | ■ | ■ | | | | | |
| *Elymus triticoides* | | | | | | ■ | ■ | | | | | |

Figure 19. Photographs of seeding alkali weed (left) and flowering pickleweed (right; credit: H. Lyford, LMU, 26 July 2018).

# Conclusions

Iceplant is a ground-hugging succulent that can grow deep, nearly impenetrable mats several feet thick which dominate resources along a range of soil moisture and nutrient conditions. Iceplant provides little protection or useable habitat for native birds and wildlife. Additionally, its shallow, fibrous root network consumes large quantities of available water year-round, further impeding the growth of native species with the largest impact occurring during times of drought. Most significantly, the highly competitive characteristics of iceplant for available nutrients, water, light, and space allows it to suppress the growth of native seedlings and often results in the growth of large, monospecific stands providing minimal habitat value. Iceplant also alters soil conditions, making the influx of native vegetation species difficult.

The importance of iceplant removal at a site like the Ballona Reserve should not be understated. It is an invasive species that has increased in area on the Reserve by approximately 20% over the last several decades, covering approximately 30 acres of the Reserve (before the implementation of this project). While this project was focused on a relatively small area, it serves to inform future hand-restoration efforts both at the Reserve and throughout southern California. Both restoration methods (i.e. tarping and hand-pulling iceplant) were successful at removing iceplant in Year 1 and engaging the local community and school groups to varying degrees. Additional efforts to continue to engage the public are made available through the project webpage, periodic newsletters, and engagement through social media. Allowing students and the community to actively participate in improving the health of the Reserve will encourage stronger stakeholder involvement in the larger restoration process for the whole Reserve and broaden the hands-on educational opportunities for Los Angeles.

While the initial results of the tarping and hand-pull restoration efforts successfully removed iceplant with very little regrowth exhibited, based on the challenges described above, there has been an influx of additional non-native species. Many of the annual non-native species died out in the late spring / early summer months, and as expected, ongoing and long-term monitoring and maintenance will be needed due to the high level of degradation of the Reserve and the lack of tidal influence to the salt marsh, which would encourage more native vegetation growth. Continued adaptive management will allow for non-native vegetation removal in future years, as restoration efforts continue, as well as informing a long-term understanding of invasive plant succession within the restoration area. Saltgrass and alkali weed are definitively expanding within the restoration area, especially along the western portions of each of Site 1 and 2. As saltgrass is the preferred habitat for rare species such as the wandering skipper, the iceplant removal efforts are likely to help support this species and others in future years. During Year 2, anecdotal notes included a much higher presence of wandering skipper in the restoration area than prior to restoration (D. Cooper, pers. obs.).

While the initial efforts specifically targeted to iceplant removal were successful, with minimal re-growth of iceplant, additional restoration events are needed to continue to remove other non-native invaders in the future. Additional recommendations include expanding the perimeter to restrict encroachment of non-natives into the project area. Lastly, but of equal importance is the implementation of the next phase of revegetation, which includes native seed dispersal. The successes or challenges of this phase will also be carefully monitored.

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