Ballona Wetlands Restoration: Community Iceplant Removal Project

Year 4 Annual Report

July 2020

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

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Community Iceplant Removal Project
Annual Report (Year 4)

31 July 2020

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Prepared by: The Bay Foundation

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Report 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 fourth 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 2020.

The project focused on the removal of *Carpobrotus spp*., or iceplant, from a targeted area within Area B of the Reserve and maintaining the area to benefit native vegetation. 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 Boulevard and has allowed for community engagement in hands-on restoration efforts. Pre- and post-restoration monitoring will evaluate the progress 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, clipping of seed heads, or weed whacking.

During Year 4, the project restoration footprint expanded to cover a total of 1.55 acres across all years. This is an increase of 0.40 acres from Year 3. Twelve public restoration events were held in Year 4, with 102 volunteers contributing 204 hours of service to the project (Figure 1). For all years combined, 457 volunteers have contributed 1,218 hours across 41 community restoration events. Sixteen non-public restoration and site maintenance events were also opportunistically conducted in Year 4 by TBF staff, project partners, and interns focused on removing non-native vegetation such as iceplant, radish (*Raphanus sativus*), and Geraldton carnation weed (*Euphorbia terracina*). Several of these restoration and site maintenance events took place within the public portion of the permit, but were not open to the public, as they were targeted events with project partners, CDFW, and FBW (Figure 2). Over the course of four implementation years, an estimated total of over 32 tons of iceplant were removed from site, with removal of numerous other non-native invasive plants species.

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 4 saw a significant increase in the dominant cover of native vegetation compared to pre-restoration, some portions of the site (especially in areas that previously had the densest and deepest ice plant cover) remain unvegetated or with patchy non-native invasive plants exhibiting seasonal variations. In Year 4, the eastern portion of the project site (part of Site 1-B and most of Site 1-C) was dominated by native vegetation, primarily saltgrass (*Distichlis spicata*); the western portion of the project site, including the hillside had patchy and intermixed bare ground, native plants, and non-native plants, which varied in cover seasonally. TBF continues to follow guidance and protocol recommendations developed by CDFW and their Native American consultant. Long-term monitoring will continue to inform adaptive management decisions.

Year 4 saw several substantial new challenges. One of the most significant was the series of illegal incursions on-site of vehicles which repeatedly impacted the restoration project area and progress, especially on project Sites 3-A, 3-B, 1-A, and 1-B (the hillside and below). Additional details can be found in the "Challenges" chapter further in the report. Additionally, beginning in December 2019, a novel coronavirus outbreak began in Wuhan, People's Republic of China (SARS-CoV-2), which caused a disease known as COVID-19. Over the subsequent months, the virus and its associated disease spread globally and turned into a worldwide pandemic. Beginning in March 2020, the State of California and Los Angeles County Department of Public Health issued a "stay-at-home" order with specific restrictions on all activities.

Implementation of activities in the time of COVID-19 requires extensive preparation to prioritize human health, reduce safety risks, and follow regulatory restrictions. This included cancelling or postponing all on-site activities from 20 March through 21 April 2020 in accordance with state and local guidance by the Center for Disease Control and Prevention and the Los Angeles County Department of Public Health. During this time, TBF and partners coordinated to adapt to challenges by drafting safety guidelines to follow in the field, such as social distancing and face coverings. When activities resumed, on 22 April 2020, they were limited to staff and some interns only. One Community Restoration Event had to be cancelled on 10 March 2020 (the public permit conditions for public events ended 15 March). Additional details can be found in the "Challenges" chapter further in the report.

On 1 August 2020, the public permit conditions of CDP No. 5-15-1427 will begin again. TBF has developed strategies and practices to eventually resume public events in a safe manner. The scheduling of future events will be informed by and in accordance with public health agencies, such as the Center for Disease Control and Prevention, and by local authorities, such as Los Angeles County Department of Public Health. Updates on the status of future events may be found on TBF's website, www.santamonicabay.org, click on "events".

Figure 1. Restoration event with community members hand removing iceplant on 13 February 2020 (top), and a photograph of the area dominated by native vegetation approximately 4 months later on 24 June 2020 (bottom).

Figure 2. Photos taken before (top) and after (bottom) site maintenance day, where TBF and CDFW weed wacked radish on the hillside (22 April 2020).

Restoration Activities

Restoration events for this project 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. Tables 1 and 2 provides summary details of all restoration activities from 1 September 2019 through 31 July 2020. Table 1 includes statistics on the number of volunteers, number of hours, restoration activities, and site details for all community restoration events, whereas Table 2 displays restoration activity dates with TBF staff, project partners, and interns only.

Over the duration of 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 reflects that focus. During Year 3, an estimated nine tons of iceplant were hand-pulled during restoration events. An additional 119 bags (72-gallon bags) of other non-native and invasive vegetation, such as radish, mustard (*Brassica* spp.), and castor bean (*Ricinus communis*), were also removed. Over the course of Year 4, nearly eight and a half tons of iceplant were removed during community restoration events. An additional 33 bags (72-gallon) of other non-natives, such as mustard, radish, castor bean, and Geraldton carnation weed were also removed during Year 4. Estimations for Year 3 and 4 were calculated by multiplying the total number of bags removed by the average weight of 10 full bags. Over the course of four implementation years, an estimated total of over 32 tons of iceplant have been removed from site. Figures 3-6 are photographs of restoration activities.

Exact total acreages of both the hand-restored and tarped restoration areas were calculated using a Trimble Geo7x GPS and mapped using GIS (Figure 7). Initial restoration efforts in Year 1 included hand restoration in an area of 0.39 acres (1,585 m^2), and tarped restoration area in an area of 0.36 acres (1,460 m^2) for a total project footprint of 0.75 acres. During Year 2, the restoration area of 0.75 acres was maintained, primarily removing invasive annual weeds. During Years 1 and 2, hand restoration efforts occurred as part of ongoing site maintenance throughout the restoration footprint. In Year 3, project expansion began by strategically targeting buffer perimeters to the Year 1 and 2 restoration footprint and then expanding to remove iceplant by hand in an area directly north of Site 1 (now designated as Site 1-A). This expansion area consisted of mixed iceplant and saltgrass (*Distichlis spicata*) as the dominant species and was designated in the project map as Site 1-B (Figure 7). The total aerial extent ("footprint") of the restoration area at the end of Year 3 covered 1.15 acres (4,654 m^2) within the 3-acre permitted restoration area. During Year 4, ongoing site maintenance occurred throughout the previous project footprint of all prior years, and restoration activities continued to expand north of Site 1-B in very similar habitat (e.g., iceplant and saltgrass mix). The Year 4 area (designated as Site 1-C) expanded the project by 0.40 acres (1,620 m^2) for a total of 1.55 acres across all years (6,270 m^2).

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 (Table 1). During Year 2, 66 volunteers contributed 165 hours of service across eight public restoration events. During Year 3, 108 volunteers contributed 324 hours across nine community restoration events. In Year 4, 102 volunteers contributed 204 hours across 12 restoration events (Figures 3-6, Table 1). For all years combined, 457 volunteers contributed 1,218 hours across 41 community restoration events.

At the start of each event, an informational safety and cultural resource speech and introduction 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. Additional hours were contributed by several students and interns helping with scientific monitoring, as well as events focused on transferring biomass from restoration events to a green waste dumpster off-site.

Implementation of restoration activities in the time of COVID-19 requires extensive preparation to prioritize human health, reduce safety risks, and follow state and local guidance. This included cancelling or postponing all on-site activities from 20 March through 21 April 2020, including a public restoration event on 20 March 2020. During this time, TBF and partners coordinated to adapt to challenges by drafting safety guidelines to follow in the field, such as social distancing and face coverings. When activities resumed on 22 April 2020, they were limited to staff and some interns only. One community restoration event had to be cancelled on 10 March 2020 (the permit conditions for public events ended 15 March). On 1 August 2020, the public permit conditions of CDP No. 5-15-1427-A1 begin again. TBF developed strategies and practices to resume public events in a safer manner in line with local guidance, once restrictions are lifted (see also “Challenges” chapter of the report). The scheduling of future events will be informed by and in accordance with public health agencies, such as the Center for Disease Control and Prevention, and by local authorities, such as Los Angeles County Department of Public Health.

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, and University of California Los Angeles all regularly had volunteer participation in Year 4. 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. Considering COVID-19, TBF continues to also explore virtual outreach opportunities to engage the community.

In addition to community events, sixteen non-public restoration and site maintenance events were also opportunistically conducted by TBF staff, project partners, and interns, focused on the removal of non-native vegetation such as iceplant, radish, and Geraldton carnation weed. Site maintenance events were conducted throughout the project area, allowing for the removal of targeted invasive vegetation over

time. Several of these restoration and site maintenance events took place within the public portion of the permit, but were not open to the public, as they were targeted events. Activities that occurred during these non-public restoration and site maintenance days included weeding, weed whacking, biomass pile removal, collecting and redistributing native plant seed, and emergency erosion control related to several large vehicles which illegally impacted the site (more details on impacts can be found in the “Challenges” section later in this report).

Figure 3. Volunteers remove invasive iceplant during a restoration event on 23 October 2019.

Figure 4. Volunteers and staff pulling invasive iceplant (top). Photographs of a portion of the restoration area before (bottom left) and after (bottom right) restoration activities on 15 January 2020.

Figure 5. Volunteers and staff pulling invasive iceplant (top). Photographs of a portion of the restoration area before (bottom left) and after (bottom right) restoration activities on 4 March 2020.

Table 1. Summary of community restoration event statistics through March 2020.

Year	Event Date / Time	Site	# Volunteers	# Volunteer Hours	Restoration Method
Year 1	1 September 2016	1-A	9	27	Tarping + Hand-restored
	1 September 2016	1-A	9	27	Tarping + Hand-restored
	6 September 2016	2-A	11	25.5	Tarping + Hand-restored
	6 September 2016	2-A	13	39	Tarping + Hand-restored
	8 September 2016	3	9	19.5	Tarping + Hand-restored
	8 September 2016	1-A; 3	8	24	Hand-restored
	13 September 2016	1-A; 2-A	9	16.5	Hand-restored
	16 September 2016	1-A; 2-A	5	15	Hand-restored
	20 October 2016	1-A	10	22.5	Hand-restored
	10 November 2016	1-A	2	6	Hand-restored
	15 November 2016	1-A; 2-A	60	240	Hand-restored
	18 November 2016	1-A	36	63	Hand-restored
	Subtotal	**----**	**181**	**525**	**----**
Year 2	27 September 2017	1-A; 3	5	12.5	Hand-restored
	13 October 2017	1-A	7	17.5	Hand-restored
	17 October 2017	1-A	2	5	Hand-restored
	25 October 2017	1-A	6	15	Hand-restored
	15 November 2017	2-A	13	32.5	Hand-restored
	27 February 2018	1-A	6	15	Hand-restored
	6 March 2018	1-A	1	2.5	Hand-restored
	13 March 2018	1-A	26	65	Hand-restored
	Subtotal	**----**	**66**	**165**	**----**
Year 3	19 September 2018	1-B	15	45	Hand-restored
	22 September 2018	1-B	36	108	Hand-restored
	27 September 2018	2-A; 1-B	1	3	Hand-restored
	4 October 2018	1-B	3	9	Hand-restored
	24 October 2018	3; 1-B	11	33	Hand-restored
	14 November 2018	1-B	15	45	Hand-restored
	30 January 2019	1-A; 3-A	4	12	Hand-restored
	27 February 2019	1-A	14	42	Hand-restored
	13 March 2019	1-A	9	27	Hand-restored
	Subtotal	**----**	**108**	**324**	**----**
Year 4	14 September 2019	1-A	5	10	Hand-restored
	9 October 2019	1-B	5	10	Hand-restored
	23 October 2019	1-B	19	38	Hand-restored
	13 November 2019	1-C	26	52	Hand-restored
	11 December 2019	1-C	3	6	Hand-restored
	8 January 2020	1-C	2	4	Hand-restored

Year	Event Date / Time	Site	# Volunteers	# Volunteer Hours	Restoration Method
	15 January 2020	1-C	6	12	Hand-restored
	29 January 2020	1-C	13	26	Hand-restored
	4 February 2020	1-C	0	0	Hand-restored
	13 February 2020	1-C	5	10	Hand-restored
	19 February 2020	1-C	13	26	Hand-restored
	4 March 2020	1-C	5	10	Hand-restored
	Subtotal	----	**102**	**204**	----
	Four Year Total	----	**457**	**1,218**	----

Table 2. Restoration events during non-public portion of permit with staff and interns only. The asterisk indicates a targeted event with TBF staff, interns, and / or project partners. Table continues on next page. Note: targeted events were not allowed in Year 1 due to permit restrictions.

Year	Event Date / Time	Site
2	23 August 2017	1-A; 3-A
	20 March 2018	1-A
	18 April 2018	1-A
	24 April 2018	1-A
	1 May 2018	1-A
	8 May 2018	1-A; 2-A
	11 May 2018	1-A; 2-A
	17 May 2018	1-A
	19 May 2018	1-A
	11 July 2018	2-A
	19 July 2018	1-A; 2-A
3	1 August 2018	1-A
	8 August 2018	1-A; 1-B
	29 August 2018	1-B
	* 8 February 2019	3-B
	26 April 2019	1-A; 3-B
	22 May 2019	1-A
	11 June 2019	1-A; 3-A; 3-B
	12 June 2019	1-A; 3-A; 3-B
	21 June 2019	1-A; 3-A; 3-B
	24 July 2019	3-A; 3-B
4	23 August 2019	1-A
	13 September 2019	1-A
	18 September 2019	1-A
	20 September 2019	1-A
	10 October 2019	1-A; 1-B

Year	Event Date / Time	Site
4	26 November 2019	3-B
	* 23 January 2020	1-A; 1-B
	* 20 February 2020	1-A; 1-B
	19 March 2020	1-B; 3-A; 3-B
	* 22 April 2020	1-B; 3-A; 3-B
	5 June 2020	1-A; 3-A; 3-B
	16 June 2020	1-C
	* 24 June 2020	1-B; 1-C
	17 July 2020	1-C
	22 July 2020	1-A, 3-A, 3-B
	30 July 2020	1-A

Figure 6. FBW interns helping pull invasive species while monitoring on 5 June 2020.

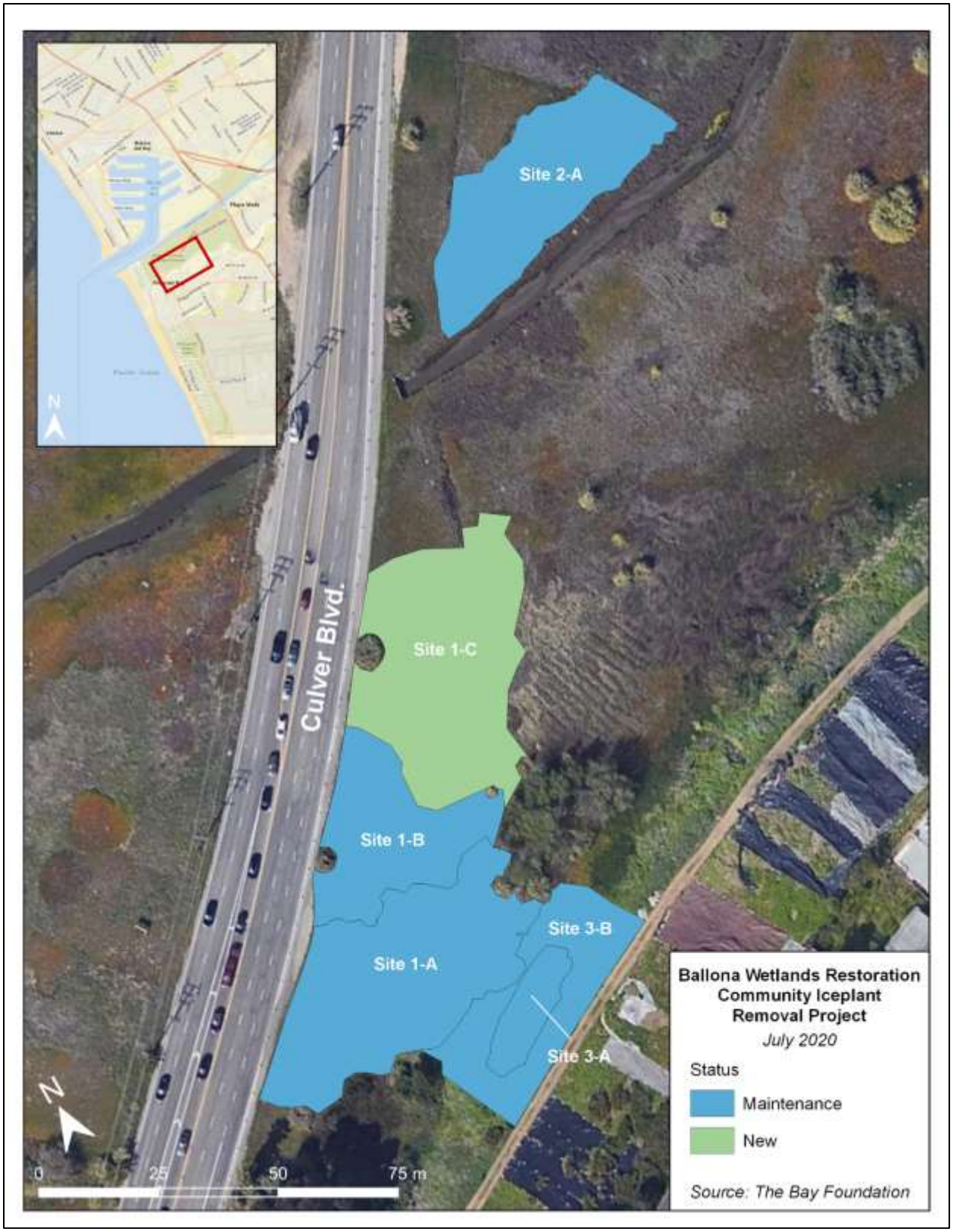


Figure 7. Map of restoration site showing new restoration for Year 4, August 2019 to July 2020 (light green) and maintenance areas from previous years (light blue).

Revegetation Activities and Next Steps

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 Sites 1-B and 1-C) have experienced significant recruitment of native species like saltgrass and alkali weed (*Cressa truxillensis*), some of the restoration areas still have patchy or low levels of native cover and would benefit from additional adaptive management to encourage native plant recruitment.

During Year 3, TBF coordinated with CDFW to develop plans for revegetation efforts in portions of Site 1-A and Site 3-A / 3-B, which had higher proportions of bare ground. Revegetation Protocol 2 and Protocol 3, as detailed in the project Implementation and Monitoring Plan, were used in targeted areas of the initial restoration area with a goal of increasing native plant recruitment (TBF 2016). A coastal upland scrub seed mix was established in partnership with CDFW and a Native American consultant and distributed on the hillside of Site 3-A and portions of Site 3-B on 8 February 2019. Additionally, TBF installed saltgrass rhizome cuttings in a small portion of Site 1-A in late February into early March. For additional details on Year 3 revegetation activities, refer to the Year 3 Report (Johnston et al. 2019). Revegetation activities were reevaluated in Year 4 after the growth season for the annual species.

As a part of Year 4 revegetation activities, Loyola Marymount University's (LMU) Coastal Research Institute (CRI) initiated a research project to evaluate the potential of plant-microbe interactions on native plant species such as saltgrass and alkali weed to potentially enhance plant growth and germination. The project evaluated scarification methods, an assessment of optimal growth conditions, mesocosm revegetation experiments, and isolated microbes from soil and roots to augment naturally present bacteria for field inoculations during revegetation. Preliminary findings determined that moderate-grit sandpaper scarification increased alkali weed germination from 16% to 92% and whole rhizome transplants of saltgrass increased survival.

In addition to obtaining experimental data, the research involved conducting a literature review to determine suitable inoculants for use in the restoration area. The review spanned inoculant types, as well as analyzed commercially available microbial inoculants. Preliminary data from the review revealed that other restoration projects have incorporated plant microbe interactions into revegetation and restoration projects, as well as suggestions for commercial inoculants. This project is ongoing as of July 2020, but was severely impacted from COVID-19, which halted access to the experiments at LMU.

Additionally during Year 4, plans were initiated to continue revegetation activities, including container stock planting, but beginning in July 2019, a series of illegal vehicle incursions and subsequent sediment dumping on site caused significant damage to the hillside area (Sites 3-A and 3-B) and portions of the lower restoration area (Site 1-A and a small portion of Site 1-B). Subsequent to these impacts, the Coastal Commission asked TBF to refrain from project activities within these areas for a duration of time while they entered into discussions with the alleged violator. Additional details on the impacted areas and activities can be found in the "Challenges" section of this report.

Once COVID-19 restrictions lessened, TBF resumed non-public staff maintenance weeding activities in these areas (beginning end of April 2020), and weeding activities (e.g., hand removal, weed-whacking) continued through the time of release of this report (31 July 2020). Seed was opportunistically collected from native vegetation outside the project area and redistributed on site following protocols developed by CDFW, including alkali weed and saltgrass. Additionally, seed began to be collected during Year 4 to be grown out for future container stock outplanting in Year 5, including several dune shrub species. TBF plans to implement container stock planting and seeding in the impacted areas during Year 5, and will pursue these activities as soon as the Commission completes resolution of the violation, including issuing a new Coastal Development Permit for removal of the illegal sediment piles.

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. 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. Plant lists were developed in coordination with CDFW and their Native American consultant. Table 3 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 9; 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 3. 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 8. Photographs of flowering salt heliotrope (*Heliotropium curassavicum*) (left; 2 June 2020) and white sage (*Salvia apiana*) (right; 22 July 2020).

Scientific Monitoring

A rigorous scientific monitoring plan informs adaptive management of restoration activities. Table 4 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) and revegetation efforts are reported above. Additionally, cultural resource monitoring occurred during all restoration events and activities, 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 accordance with the post-restoration frequency listed in Table 4 from the project Implementation and Monitoring Plan. 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. Figure 9 shows photographs from a scientific monitoring activity.

Table 4. 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 or statistically relevant, they are just documentation of the variety of flora and fauna that were identified 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. Restoration efforts expanded in Year 4 (see maps and restoration activity information above); thus, the results presented below combine both prior efforts and new restoration activities.

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 and would not have been captured in the cover data. Significant expansion and new growth of native vegetation occurred, in some areas several times greater than pre-restoration cover. Mapping results encompass the most area for cover assessment and displayed a similar trend.

Sites 3-A, 3-B, and parts of Sites 1-A and 1-B experienced severe illegal disturbances in Year 4, including multiple vehicle and construction truck incursions, dumping of sediment on site (Site 3-B), and impacts associated with those two disturbances. For additional details on the disturbances, see the "Challenges" chapter of this report. Erosion control mats were broken, new native seedlings were trampled or uprooted, and soil was severely disturbed. These impacts negatively affected vegetation cover, especially in Sites 3-A and 3-B.

Mapping surveys illustrate the effectiveness of maintenance activities, showing a decrease in non-native vegetation cover followed by a recorded increase when the new sites were added to the whole project area. Overall, non-native cover decreased from pre-restoration, and native cover increased, though the specific pattern varied by site and season, especially regarding annual species. During Year 4, TBF began expanding restoration efforts along the perimeter of the Year 3 project footprint. Site identification was updated in Figure 7 to reflect this expansion. Site 1, Site 2, and Site 3 from the Year 1 and Year 2 Monitoring Reports correspond to Site 1-A, Site 2-A, and Site 3-A in the Year 4 Monitoring Report, respectively. Site 1-B and 3-B identified project implementation areas during Year 3. Site 3-C is considered expansion area and new restoration during Year 4. Site 2-A showed an increase in non-native cover in the middle polygons of the most recent (June 2019) survey. This is likely due to a focus on maintenance in the other sites within the project. Ongoing maintenance is recommended throughout all Sites (1-A, 1-B, 1-C, 2-A, 3-A, and 3-B) for future years.

Adaptive management recommendation actions are included in other chapters of this report to address non-native vegetation invasion and additional plans for revegetation in Year 5 to further supplement the

project areas. The following Figures 10a-10c 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 9. TBF staff and project partners conducting monitoring on 24 June 2020.

Figure 10a. Mixed native and non-native plant assemblages (2 June 2020, top; 16 July 2020, bottom), although both photographs are dominated by native saltgrass.

Figure 10b. Predominantly non-native vegetation assemblage prior to weed whacking with CDFW on 17 April 2020.

Figure 10c. Vegetation assemblages consisting primarily of mixed native saltgrass and pickleweed (*Salicornia pacifica*) (24 June 2020).

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 semi-annually in May 2017, October 2017, May 2018, November 2018, June 2019, November 2019, and June 2020.

Vegetation Mapping Survey Results

Vegetation mapping results displayed an increase in native cover compared to pre-restoration conditions (as evaluated by the dominant cover classification of each polygon). Results also displayed a decrease in non-native cover compared to pre-restoration, but a higher non-native cover than Year 2, which is accounted for in part by adding newly restored areas (all sites were combined for the mapping analyses). Additionally, a decrease in unvegetated area was documented since October 2017, which identified the highest cover of unvegetated area. Native cover was predominantly made up of saltgrass in the Year 4 surveys, with other species present. Non-native cover and 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 will allow for longer-term trends to be analyzed in future reports.

Figure 11a is a map displaying baseline (pre-restoration) dominant vegetation type 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 (e.g., Figure 11b). New iceplant growth was mapped in the survey following initial restoration efforts. While current site observations find occasional iceplant sprouts, these iceplant spouts are pulled immediately, and not present during monitoring efforts. Figures 11b – 11h display post-restoration data and are summarized individually below.

Figure 11b 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-A and 2-A both had some areas with new iceplant growth: 35 small individual plants sprouted in Site 1-A, and 5 small individual plants sprouted in Site 2-A. Desiccated iceplant “mulch” areas where no native or non-native

vegetation re-growth had 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 11c 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-A and 2-A are starting to fill in with native vegetation, predominantly saltgrass. Site 3-A 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 11d 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-A and 3-A, with patchy non-native in multiple places, but large areas of dominant native cover, a significant change from pre-restoration baseline conditions.

Figure 11e is a map displaying Year 3 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in November 2018. During this survey, 43.5% of the total restoration area was classified as native, with 23.3% of the area as dominated by non-native vegetation and 25.9% identified as mixed nativity. The largest polygons dominated by non-native cover were in Sites 3-A and 3-B. Approximately 11% was unvegetated, the lowest in mapping analyses to-date. Native polygons were dominated by saltgrass and alkali weed. Common non-native species identified included non-native grasses, particularly brome species, wild radish, and mustard. A small patch of Geraldton carnation weed (*Euphorbia terracina*) continues to be managed in Site 3-A. Site 1-B shows dominant native vegetation cover, primarily saltgrass, in the month following restoration activities removing iceplant in that area.

Figure 11f is a map displaying Year 3 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in June 2019. Predominantly native cover was found on just over 32% of the site, which was more than double the initial May 2017 pre-restoration baseline survey (14.6%). Native cover on this survey was dominated by annual Canadian horseweed. Non-native cover was removed from Sites 3-A and 3-B in February 2019 and replaced with biodegradable erosion control matting and hand-broadcast seeding of native plants. While seedlings of several native plants successfully sprouted (see photographs throughout report), they did not achieve a high enough cover to consider the assessment polygons as dominated by native cover. They are identified in map Figure 11f as predominantly 'unvegetated', although that does not imply that the native seedlings were not present. Mapping results from Site 2-A identified dominant native and mixed-native cover around the periphery, with the interior of the site invaded by non-native brome grasses,

wild radish, and annual yellow sweetclover. The majority of non-native invasive vegetation were observed to be annual species. Site 1-B continued to show dominant native cover, expansion of saltgrass, similar to post-restoration conditions immediately following the removal of iceplant in Fall 2018.

Figure 11g is a map displaying Year 4 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in November 2019. Predominantly native cover was identified on over 50% of the site, as compared to the initial May 2017 pre-restoration baseline survey of 14.6%. Non-native cover was approximately 20% of the total area (portions of Sites 2-A and 3-B), with a large unvegetated region. Site 1-B and much of Site 1-C were dominated by natives, predominantly saltgrass with some alkali weed, pickleweed (*Salicornia pacifica*), alkali heath (*Frankenia salina*), and other mixed species.

Figure 11h is a map displaying Year 4 post-restoration dominant vegetation type within GIS polygons classified as native, non-native, mixed nativity, or unvegetated surveyed in June 2020. Predominantly native cover was identified in Site 1-C, with mixed nativity in Sites 1-B and 1-A. Site 2-A was dominated by non-native vegetation in the center of the polygons, with native cover around the periphery. Total area dominated by natives made up 40.8% of the restoration area, with non-native at 38.4% and bare ground at only 2.6%, the lowest of any survey to-date. Non-natives were primarily annual weedy grasses, Geraldton carnation weed, radish, and several others (see also Adaptive Management chapter below for details). Targeted restoration events for several of these species and areas occurred after mapping data were collected.

Figure 12 summarizes mapping results over all surveys and proportion of native, non-native, and unvegetated areas. The graph illustrates seasonal variation, with spring surveys (e.g., June 2020) having higher proportions of non-native annual weedy plant species present. Additionally, the bars represent comprehensive proportions of native and non-native species, including new restoration areas in Year 3 and Year 4 surveys. Native cover has increased over time from the baseline survey conditions, with seasonal variation. Mapping results differed from the transect-level data (below), due in part to the variation in specific protocols and method implementation. Both sets of results are presented in this report to provide more comprehensive data analyses. It is also important to note that both the mapping data and cover data represent distinct points in time, and thus, may not represent the “ambient” conditions throughout the whole year, given seasonal variation of plant cover, especially in annual species. Additional years of data will continue to inform long-term trends.

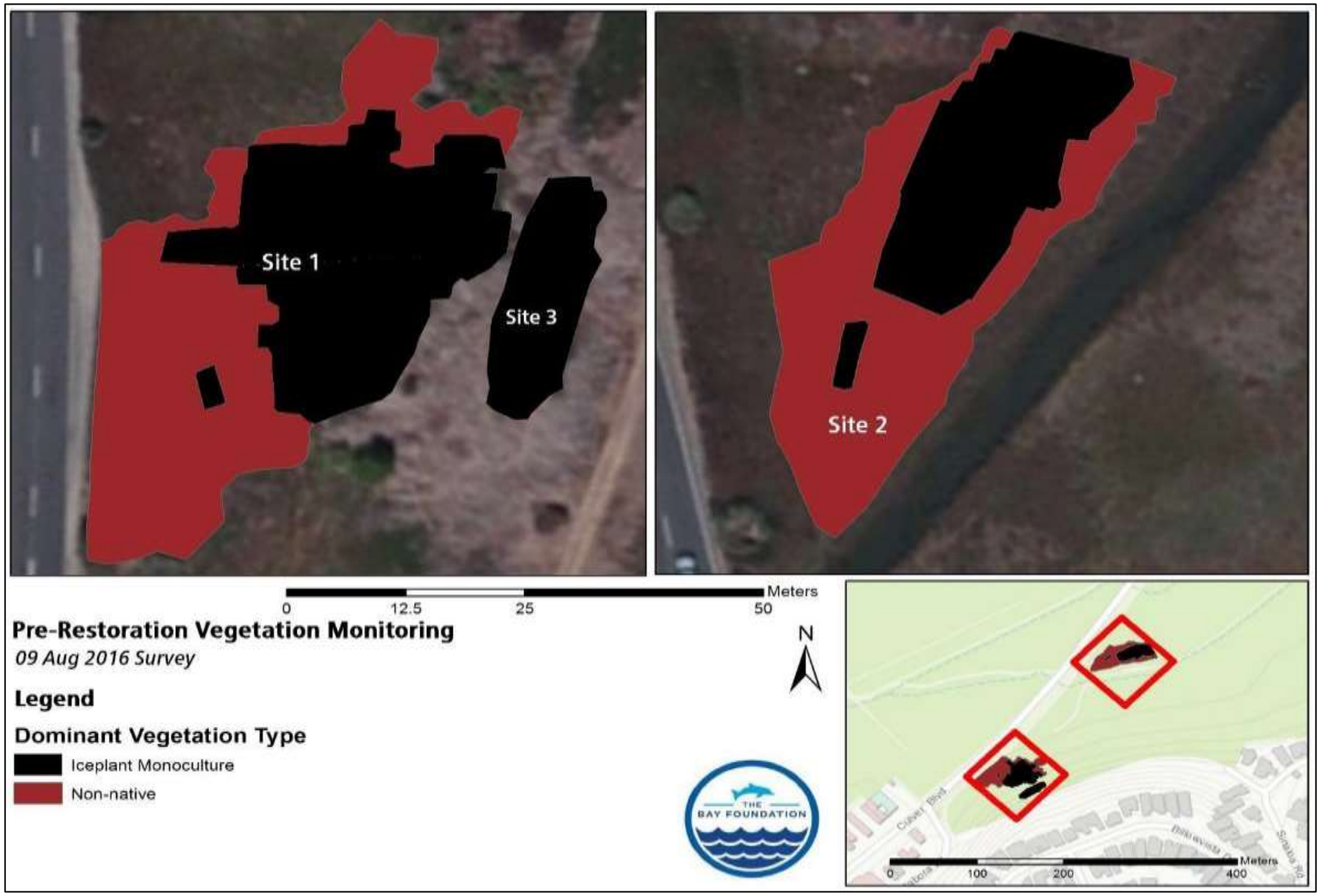


Figure 11a. Map displaying dominant vegetation type within GIS polygons during the 9 August 2016 baseline survey.

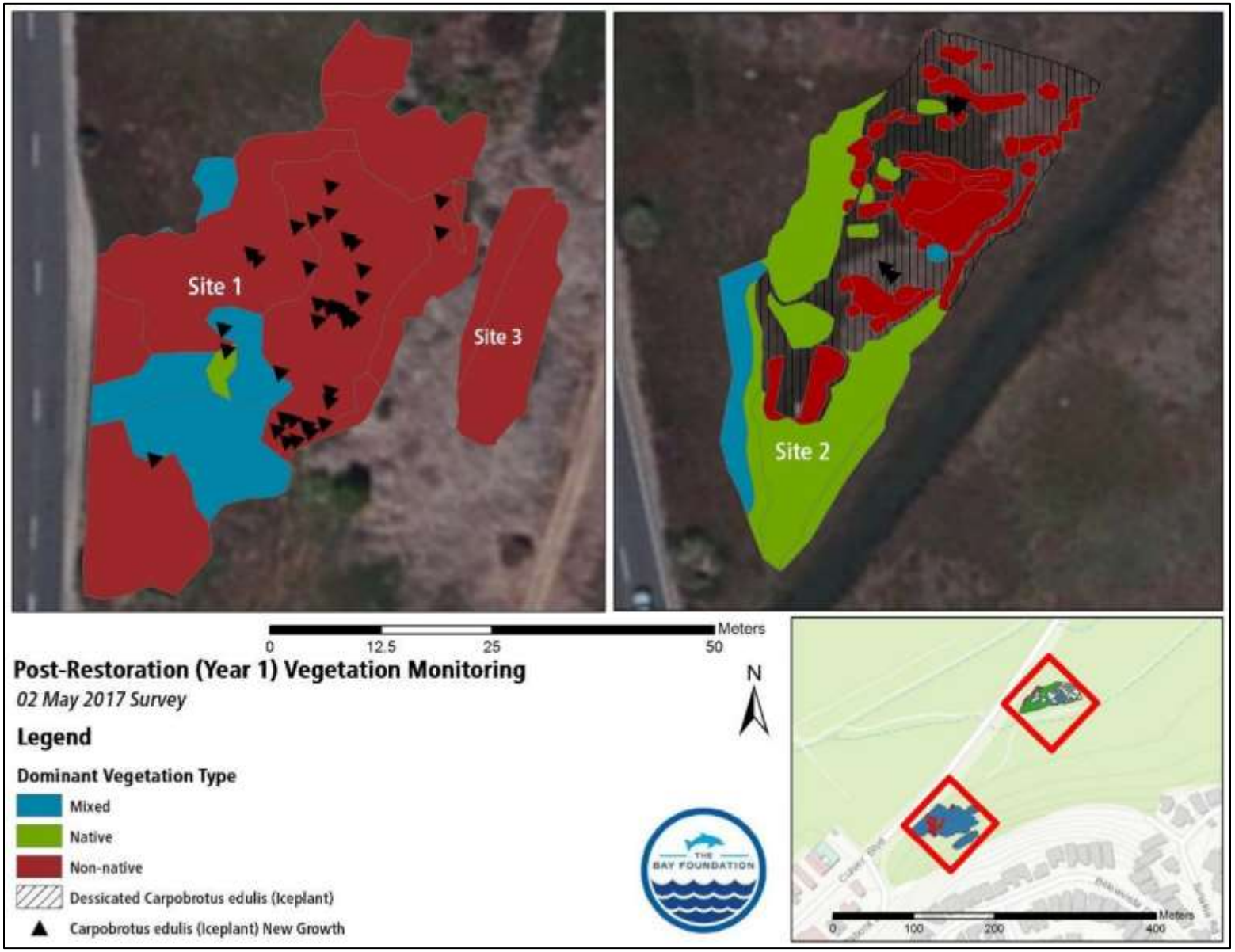


Figure 11b. Map displaying dominant vegetation type within GIS polygons during the 2 May 2017 survey.

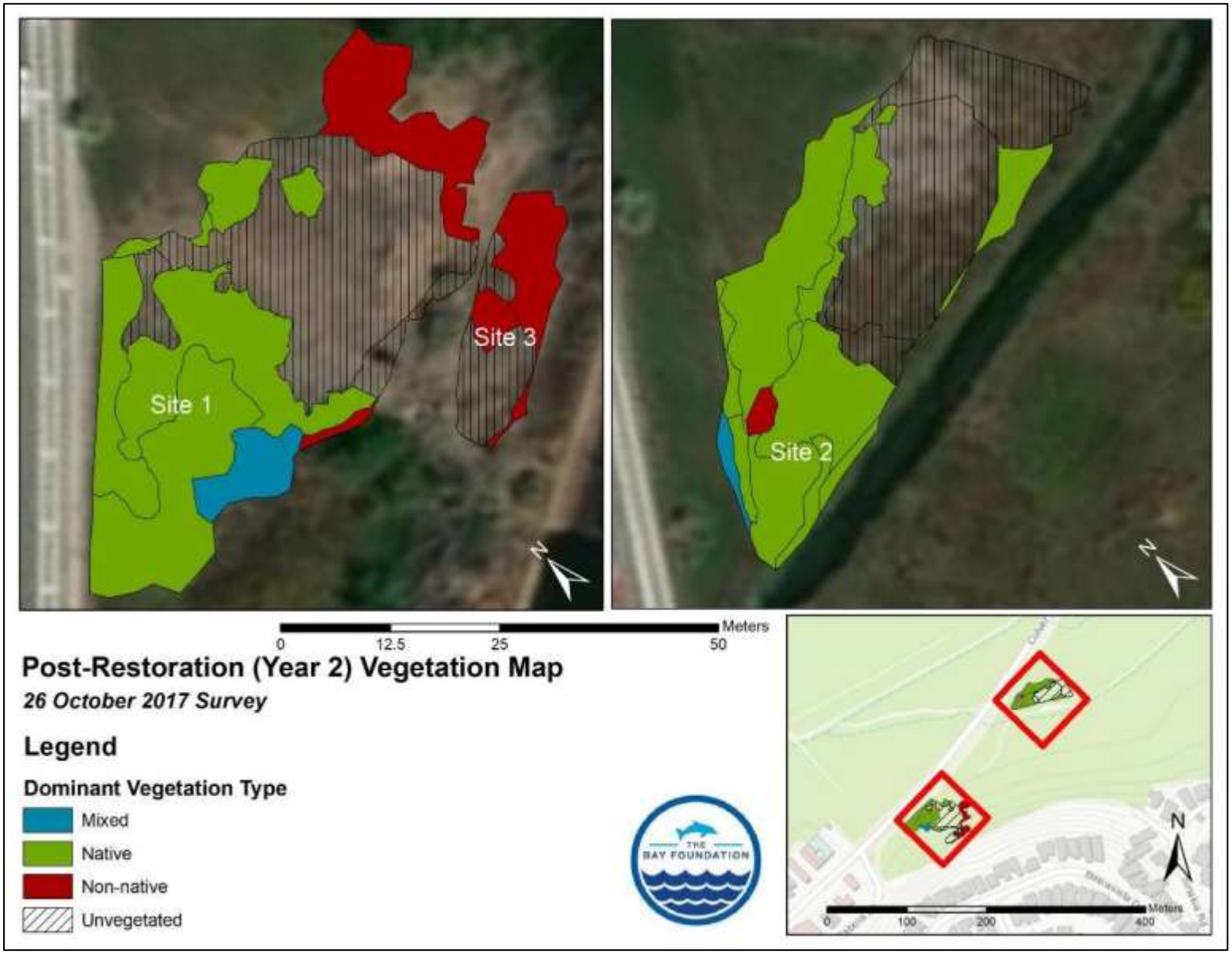


Figure 11c. Map displaying dominant vegetation type within GIS polygons during the 26 October 2017 survey.

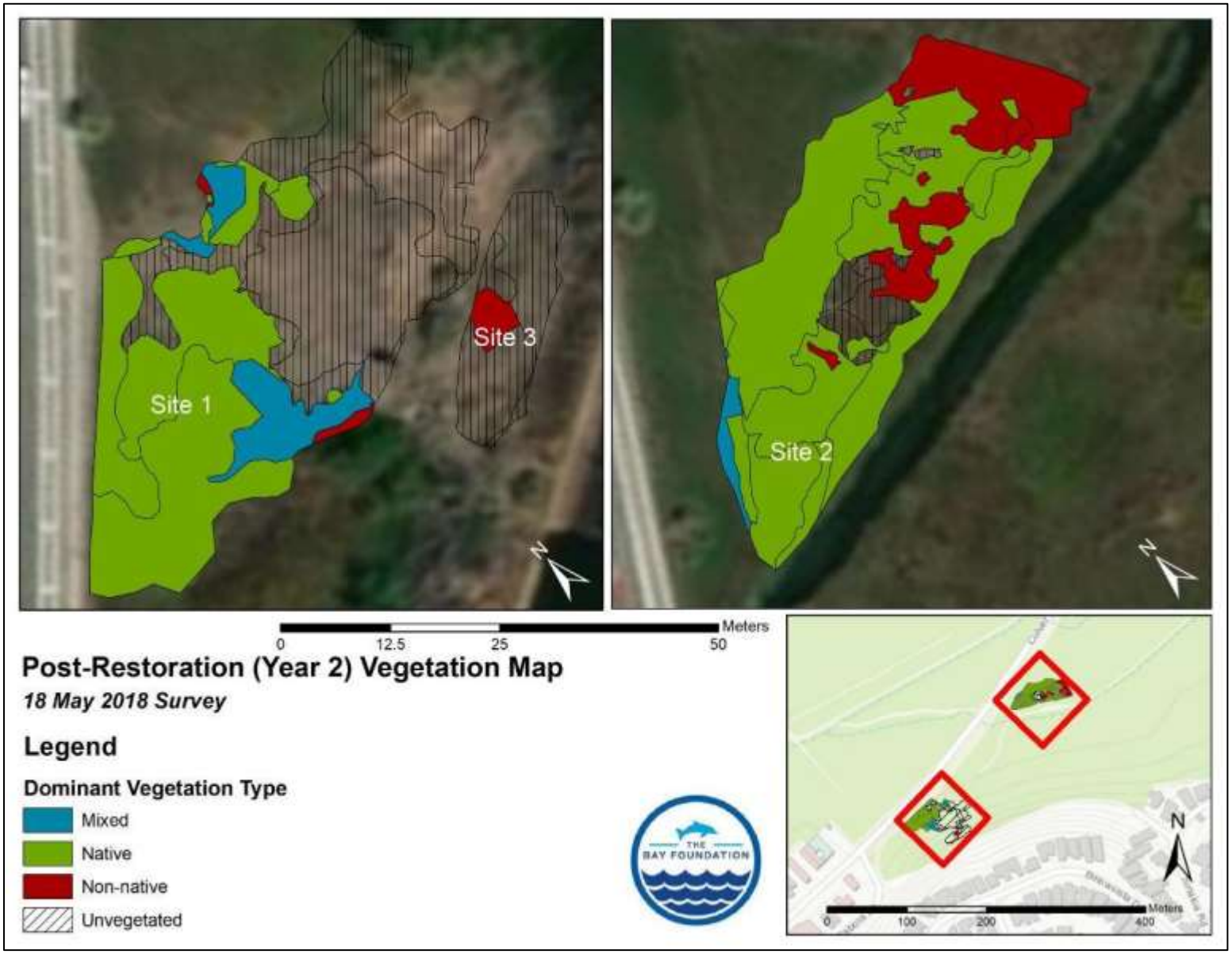


Figure 11d. Map displaying dominant vegetation type within GIS polygons during the 18 May 2019 survey.

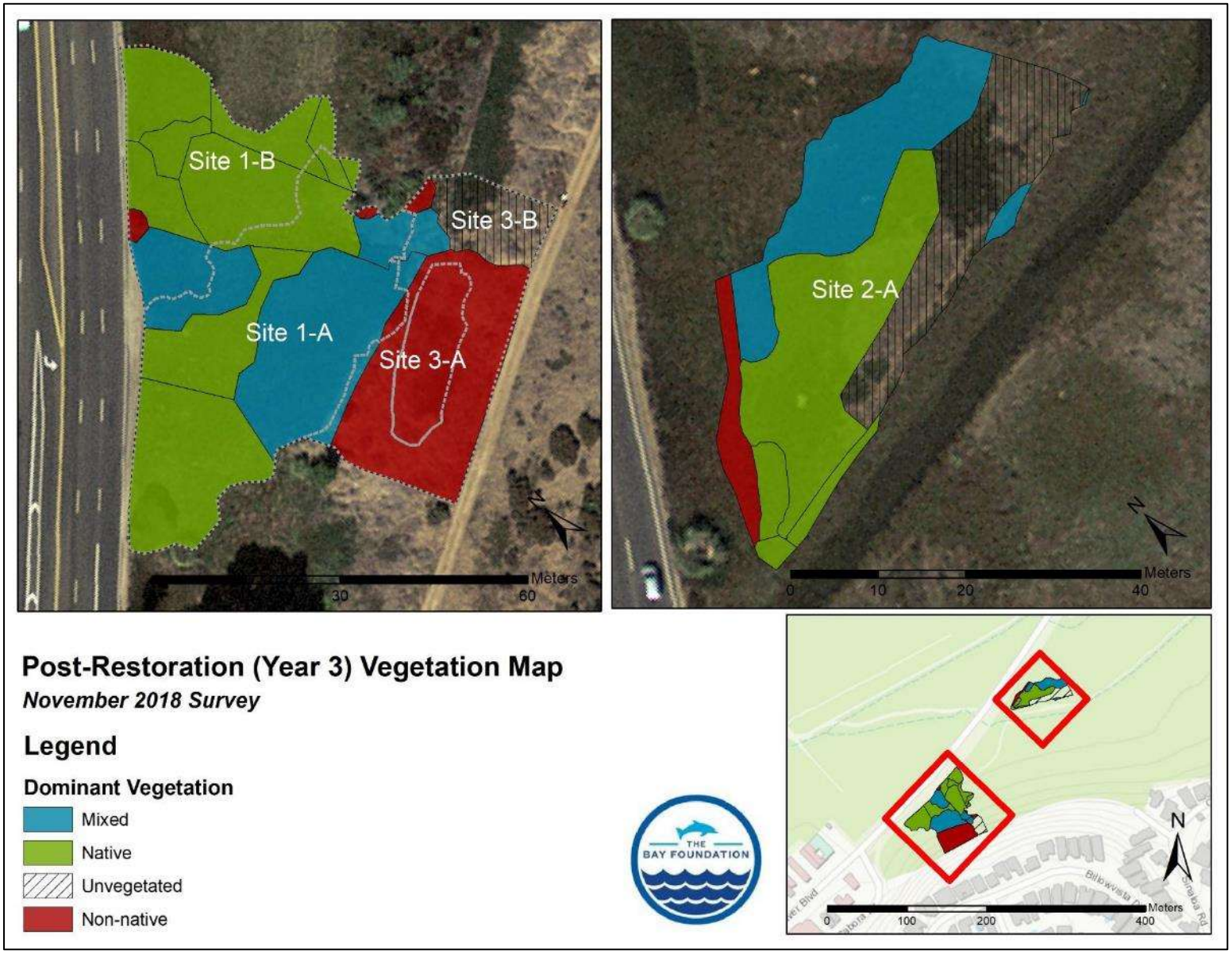


Figure 11e. Map displaying dominant vegetation type within GIS polygons during the 18 November 2018 survey.

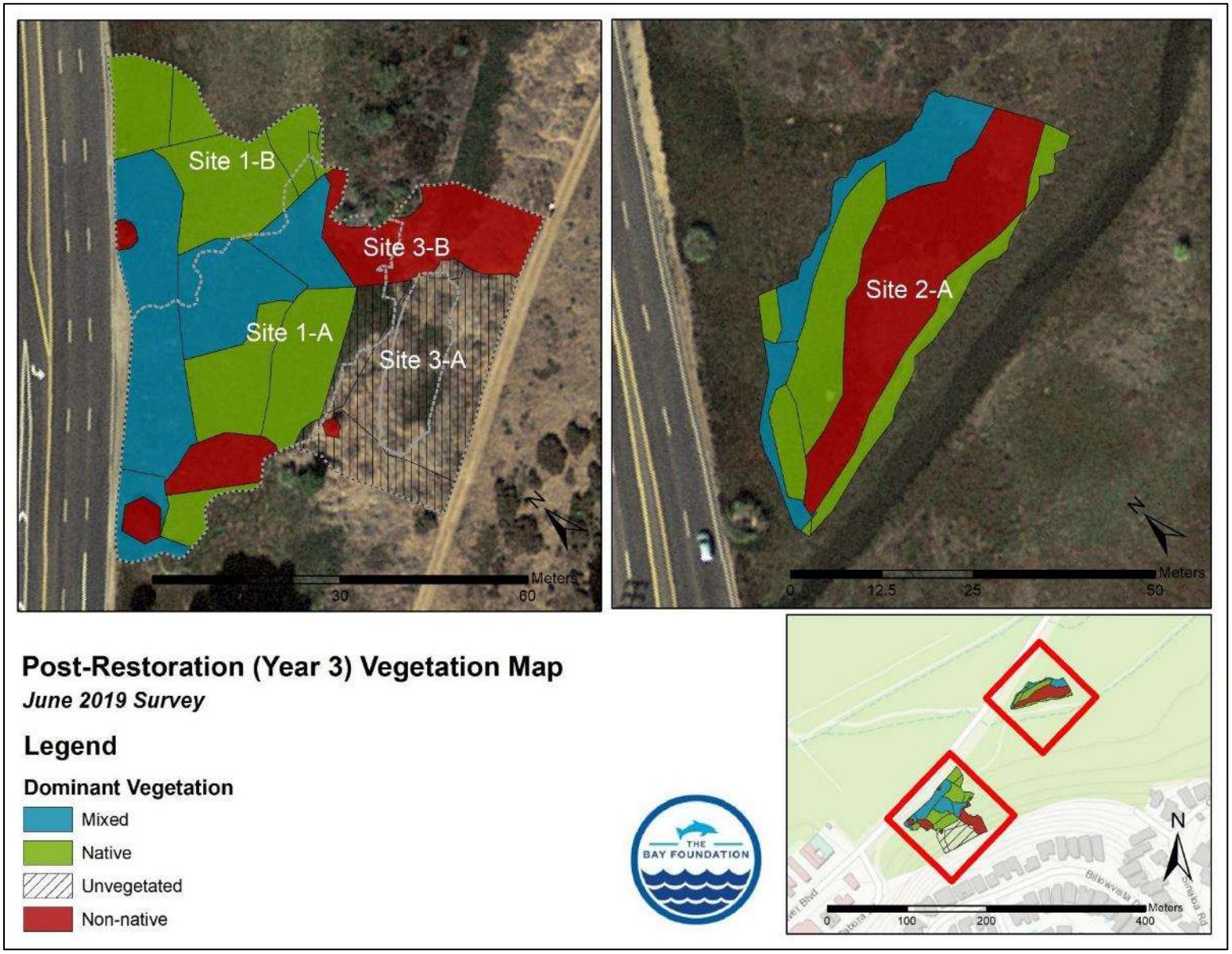


Figure 11f. Map displaying dominant vegetation type within GIS polygons during the 11 June 2019 survey.

Figure 11g. Map displaying dominant vegetation type within GIS polygons during the Fall 2019 survey on 21 November 2019.

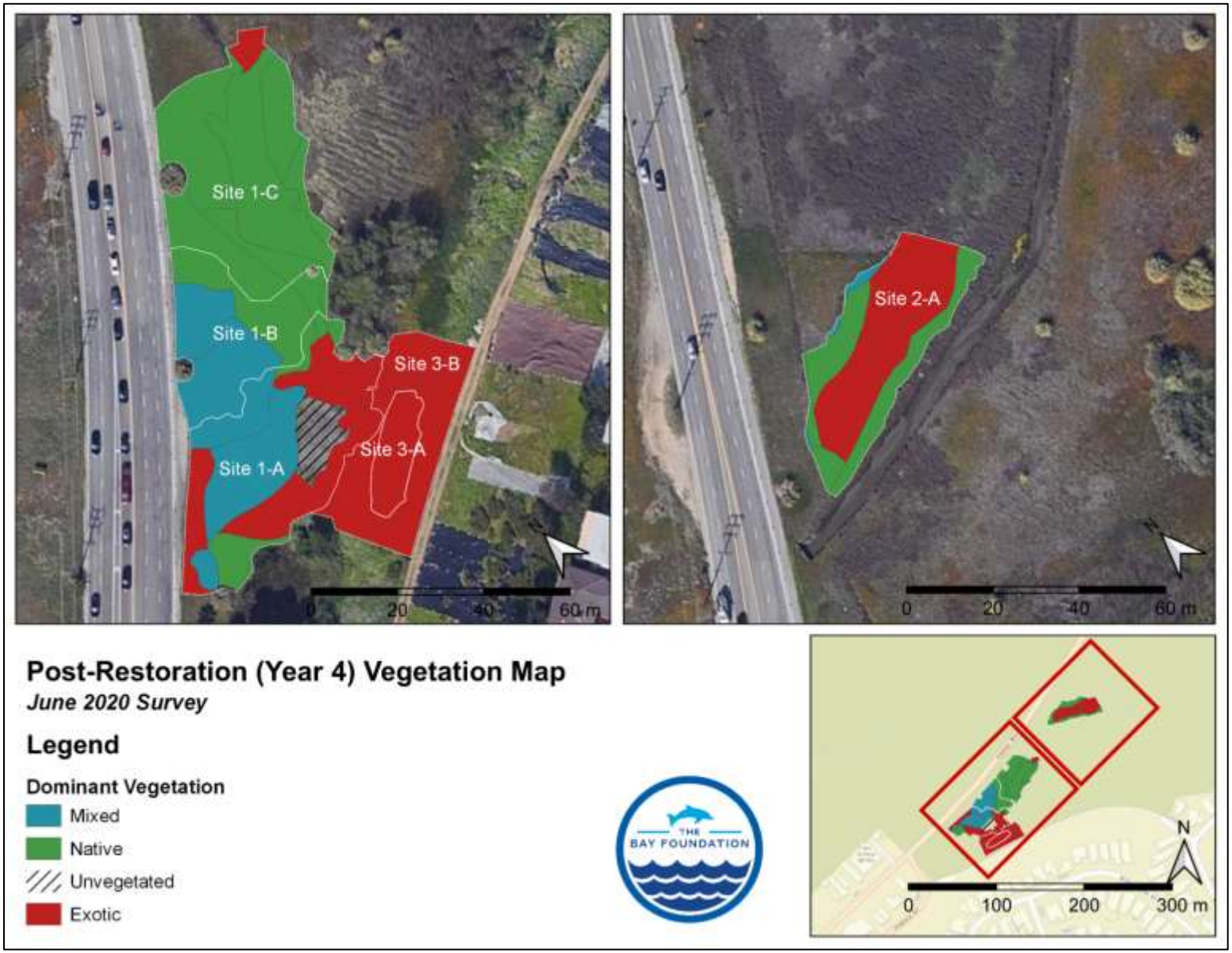


Figure 11h. Map displaying dominant vegetation type within GIS polygons during the Summer 2020 survey on 10-11 June 2020.

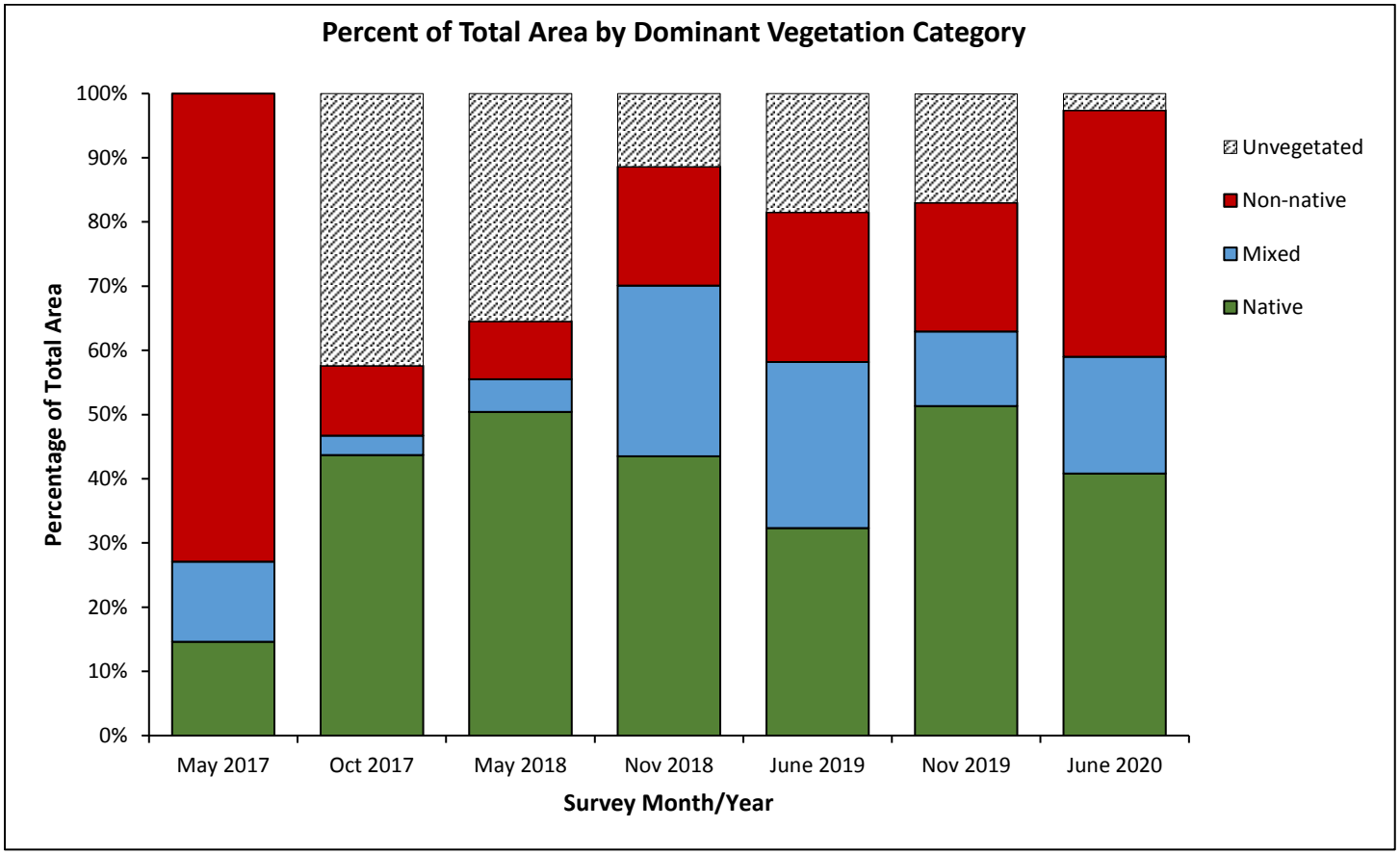


Figure 12. Graph displaying percentage of dominant vegetation type over time.

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. Baseline vegetation data was collected in August 2016. Post-restoration field surveys were conducted in November 2016, immediately following restoration efforts, and again in May 2017, October 2017, May 2018, November 2018, May/June 2019, November 2019, and June 2020. Additional transects were added in 2018 and 2019 to capture baseline and post-restoration conditions in two different expansion areas of restoration activities (i.e., Site 1-B and 1-C). 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-A transect results indicated a reduction in live non-native vegetation absolute cover from over 90%, pre-restoration, to 0.2% in November 2019 and 35.0% in June 2020 post-restoration (Figure 13). This indicates a significant reduction in non-native vegetation cover, maintained across all four monitoring years along representative transects. Conversely, a fluctuating increase in native cover from 0% (pre-restoration, baseline) to 3.1% cover in the most recent survey (June 2020) was identified at Site 1-A. Native cover at Site 1-A has included expansion of saltgrass and in Year 3, the presence of native annual Canadian horseweed, and patchy alkali weed. However, bare ground and some weedy annual non-natives continue to dominate this site, and revegetation efforts are recommended for Year 5.

The substantial reduction in non-native cover was primarily due to the successful removal of iceplant from the project area and subsequent weeding and maintenance events. The remaining non-native cover was primarily annual "weedy" vegetation species, including: Geraldton carnation weed (*Euphorbia terracina*), non-native brome grasses (*Brome spp.*), wild radish (*Raphanus sativus*), annual yellow sweetclover (*Melilotus indicus*), and Bermuda buttercup (*Oxalis pes-caprae*), though other non-native species were present. 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 Figures 16a through 16e illustrate the vegetation transition over time in Site 1-A from a monoculture of iceplant (A, top), to dead iceplant immediately post-restoration (A, bottom), to a mix of a variety of native and non-native vegetation species (B-E). In Figure 16c, saltgrass is discernable in

October 2017, and then in May 2018, the most visible species is Geraldton carnation weed. Year 3 post-restoration observations show minimal non-native species with the area dominated by the native annual species, Canadian horseweed (Figure 16d). Year 4 was predominantly bare ground in the November 2019 survey, and had small patches of Canadian horseweed in the June 2020 survey (Figure 16e).

Similarly, Site 2-A transect results indicated a shift from over 80% non-native cover, pre-restoration, to 25.9% in November 2019 and 45.9% in the most recent survey (June 2020), again a substantial reduction of non-native vegetation cover. Transect results in Site 2-A are also likely conservative, as a portion of one of the transects is in unrestored area (not yet part of the project footprint). Conversely, the native cover experienced patchiness and seasonal variability, with a fluctuation between 0% (November 2016) to 35.8% in the most recent survey (June 2020) (Figure 13). However, there were patches of native vegetation (again, primarily saltgrass) of over 25% cover in some of the Site 2-A restoration areas, especially in October 2017 and in Year 4. During Year 4, the non-native vegetation cover at Site 2-A was dominated by annual species including brome species, wild radish, and patches of Australian saltbush (*Atriplex semibaccata*).

Restoration Site 1-B was newly restored in Year 3. This area identified 40.7% non-native vegetation cover in the baseline survey with 57.9% native cover. Native cover was predominantly saltgrass, and non-native cover was predominantly iceplant. The post-restoration surveys showed a dramatic increase in native vegetation dominated by saltgrass and decrease in non-native vegetation (Figure 14). During Year 4, non-native vegetation cover ranged from 0% in November 2019 to 16.5% in the most recent survey (June 2020). Conversely, during Year 4 native vegetation cover ranged from 86.8% in November 2019 to 73.1% in the most recent survey (June 2020). Site 1-B has had consistently high native vegetation cover since restoration activities occurred, dominated by saltgrass, but including several other natives such as small patches of alkali health (*Frankenia salina*) and alkali weed. The non-natives present in this area included small patches of common sowthistle (*Sonchus oleraceus*) and individual brome grasses (Figures 17a and 17b). Restoration Site 1-C was newly restored in Year 4 and was dominated by native saltgrass.

Control results (transects not altered during restorations) indicated some stability in the predominantly native areas, with live native cover ranging from a high of 100.0% dropping to a low of 79.4% native cover in May 2018, but then rising again in Year 3 (Figure 15). In Year 4, there was a reduction in native cover from 100% to 87.3% in the most recent survey (June 2020). Additionally, the control results identified resistance to invasion, with less than 1% non-native cover across all surveys. Conversely, control results in the predominantly non-native areas were highly fluctuating, with a range of 44% (May 2018) to approximately 91% (May 2017). In the Year 4 surveys, non-native cover ranged from 36.4 to 21.4%. 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 restoration activities to date and within the project area have high non-native cover (e.g., Figure 18 taken in non-restored area).

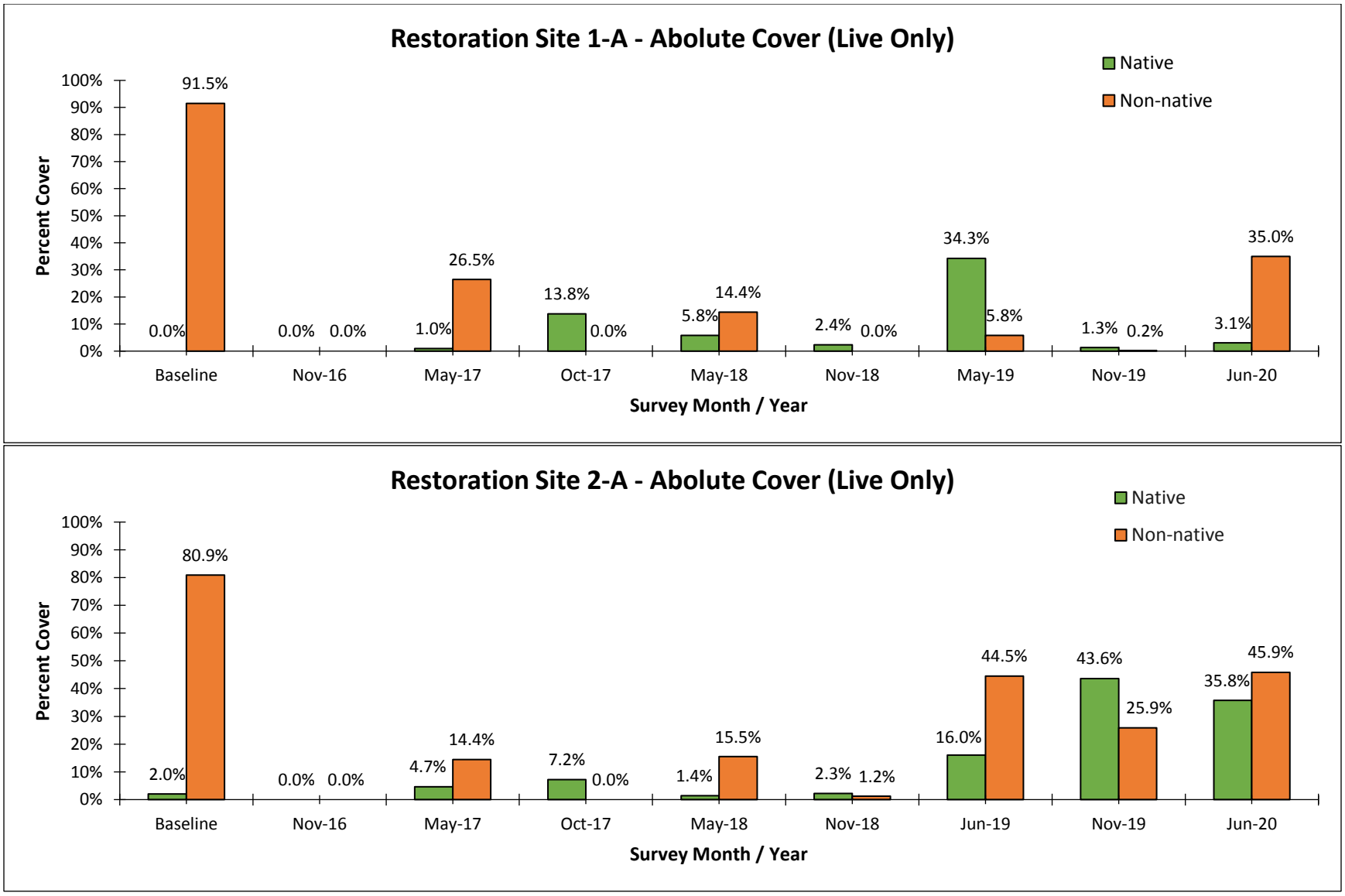


Figure 13. Vegetation data cover results from Site 1-A (top) and Site 2-A (bottom) absolute vegetation cover (live only).

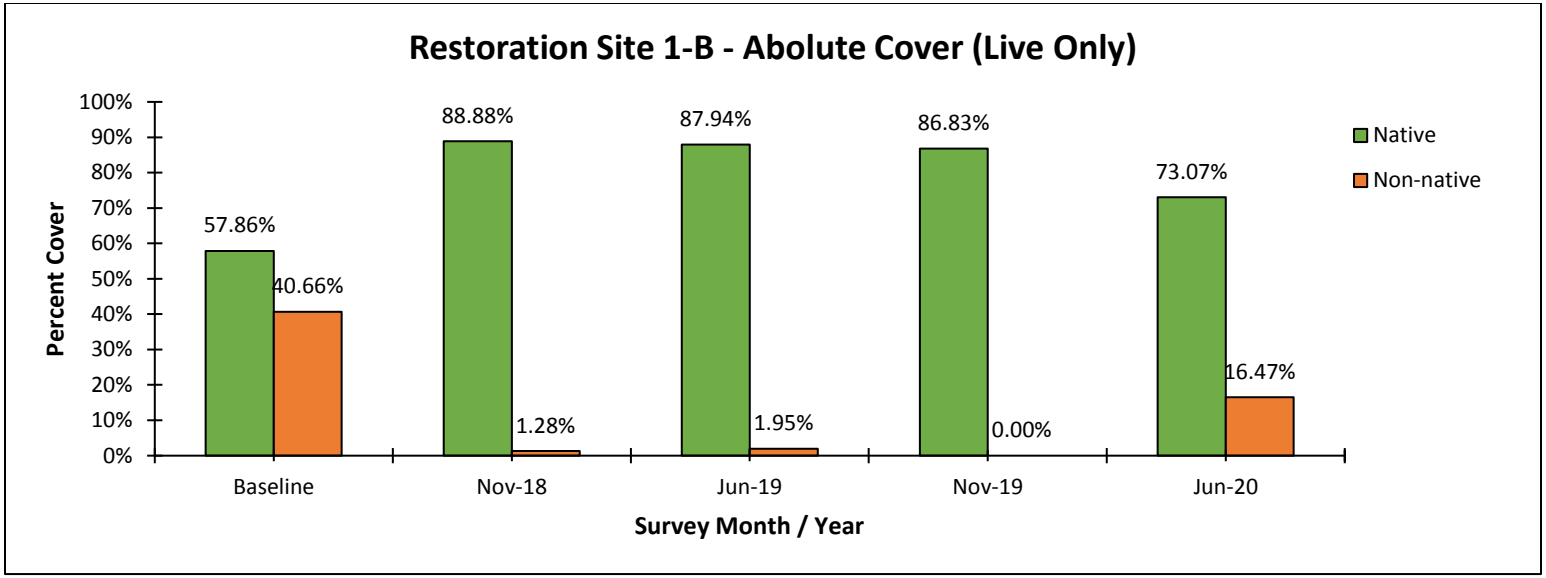
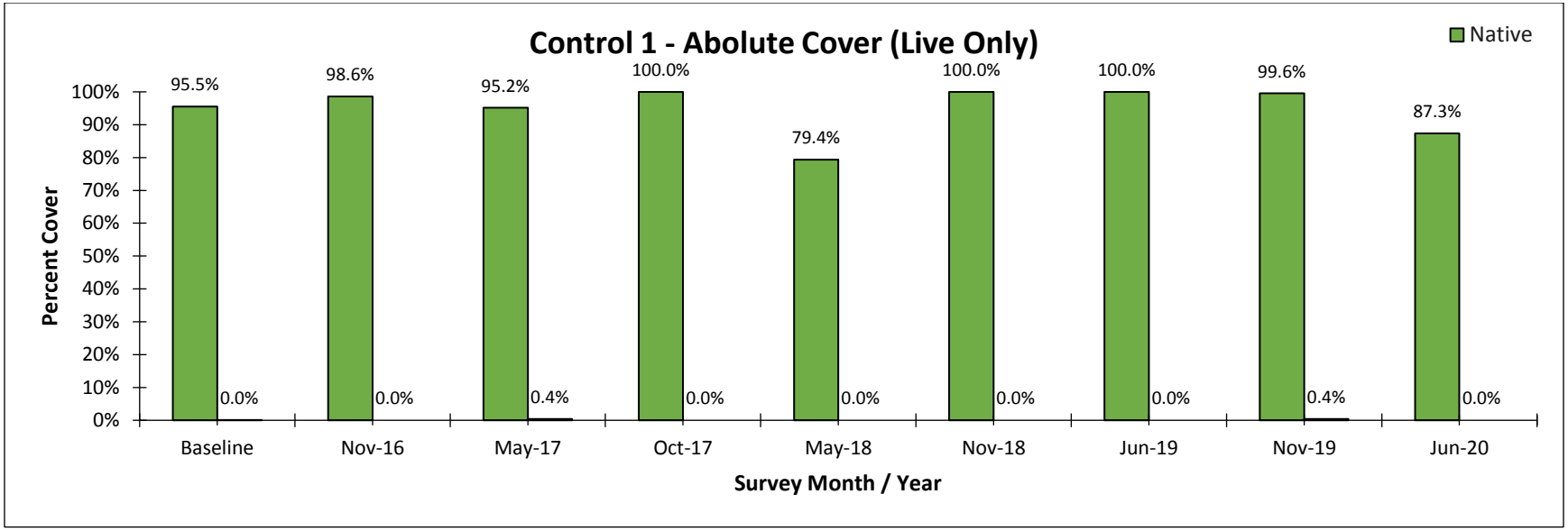


Figure 14. Vegetation data cover results from Site 1-B, newly restored in Year 3 (June 2018-July 2020).



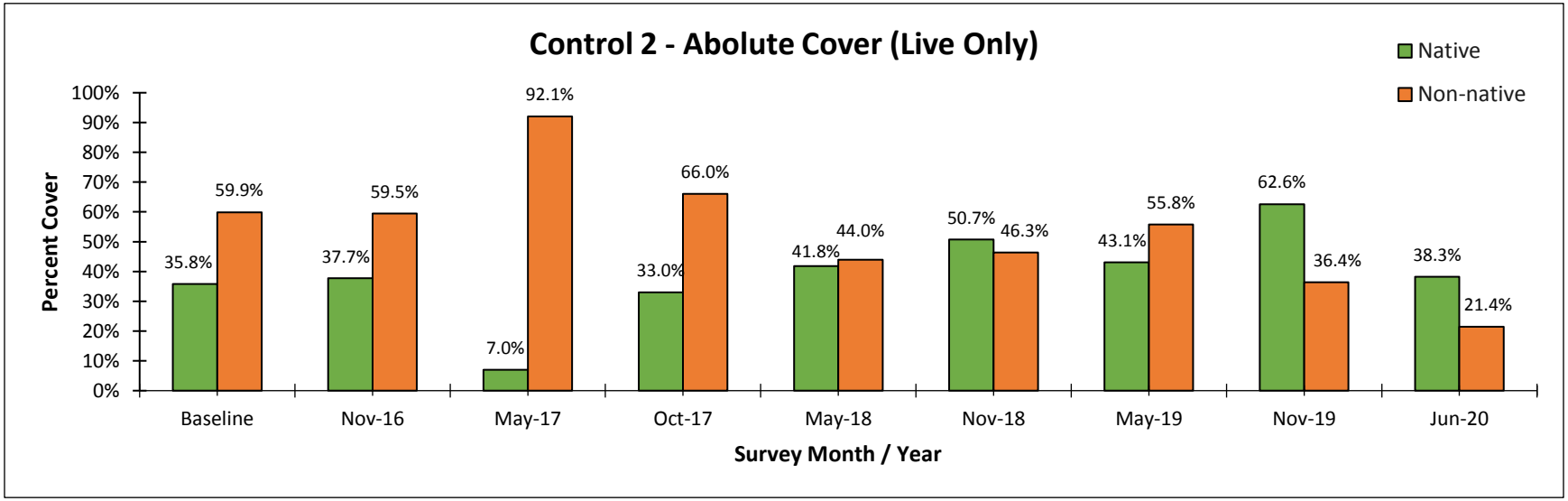


Figure 15. Vegetation data cover results from Control Site 1 (top) and Control Site 2 (bottom) absolute vegetation cover (live only).

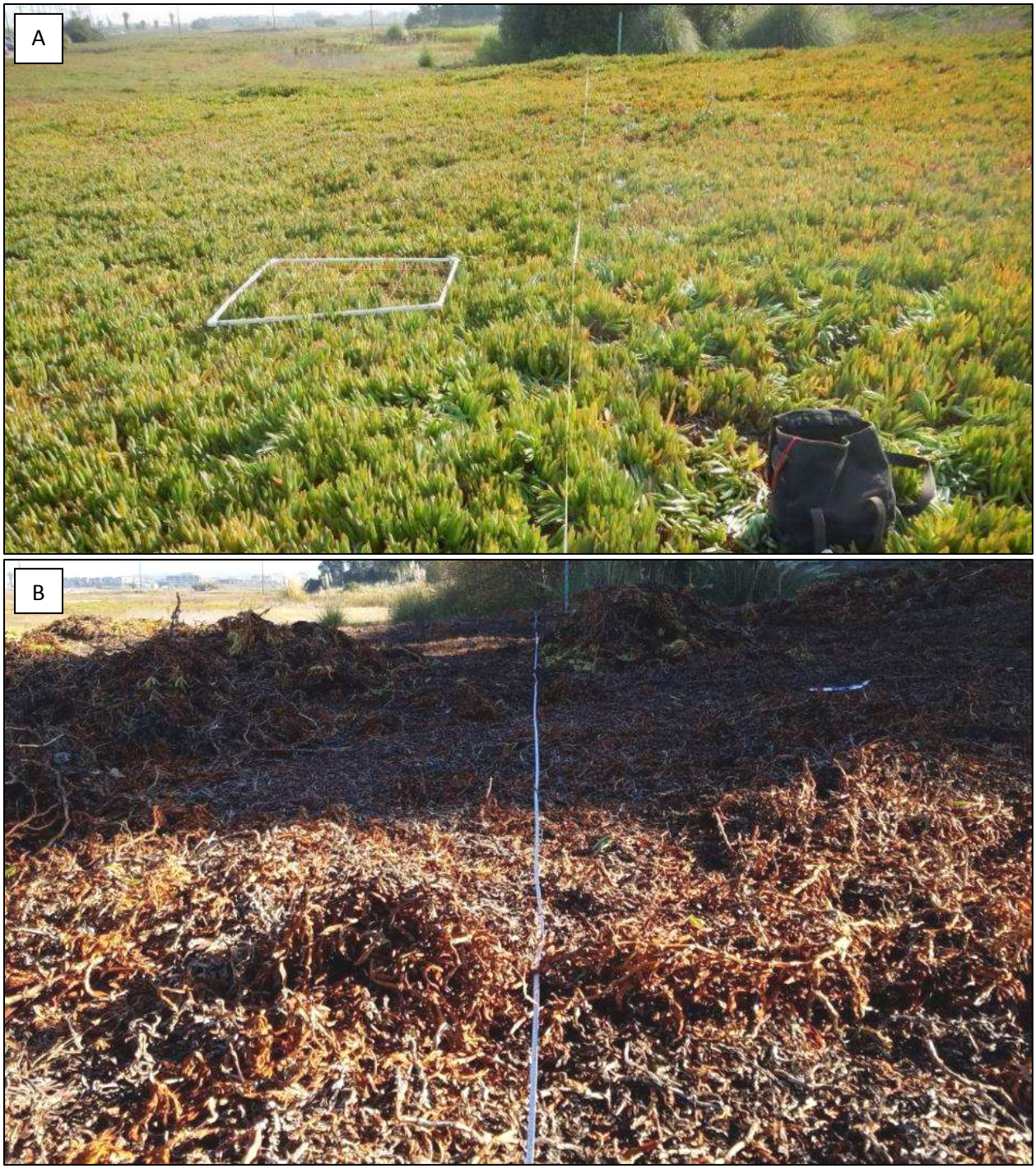


Figure 16a. Photographs of Transect 5 pre-restoration on 23 August 2016 (A, top) and immediately post-restoration on 29 November 2016 (B, bottom).

Figure 16b. Photographs of Transect 5 post-restoration on 1 May 2017 (C).

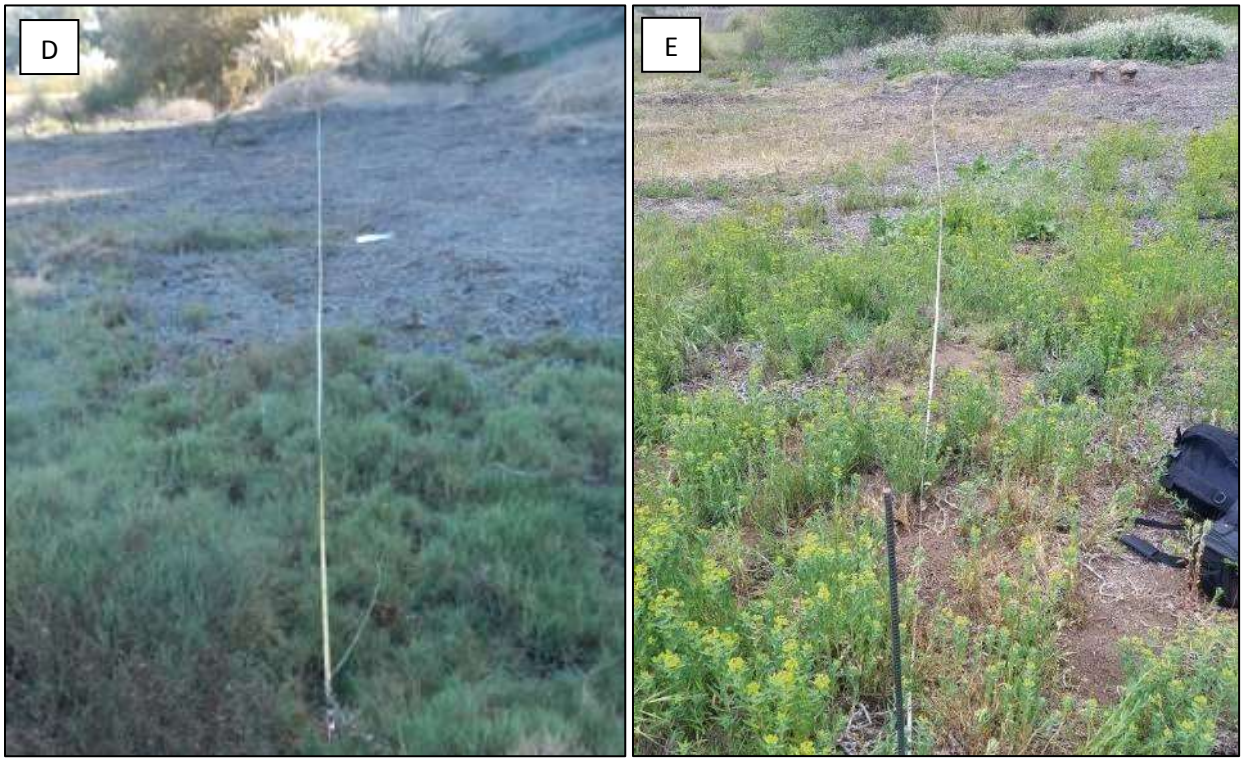


Figure 16c. Photographs of Transect 5, Year 2 post-restoration, on 7 October 2017 (D), and 1 May 2018 (E). Note: photograph (D) was taken at a slightly different starting location, hence the saltgrass patch present in (D) and not after. Subsequent photo start points were corrected.

Figure 16d. Photographs of Transect 5, Year 3, post-restoration on 28 November 2018 (F), and 24 July 2019 (G).

Figure 16e. Photograph of Transect 5, Year 4, post-restoration on 16 July 2020 (H).

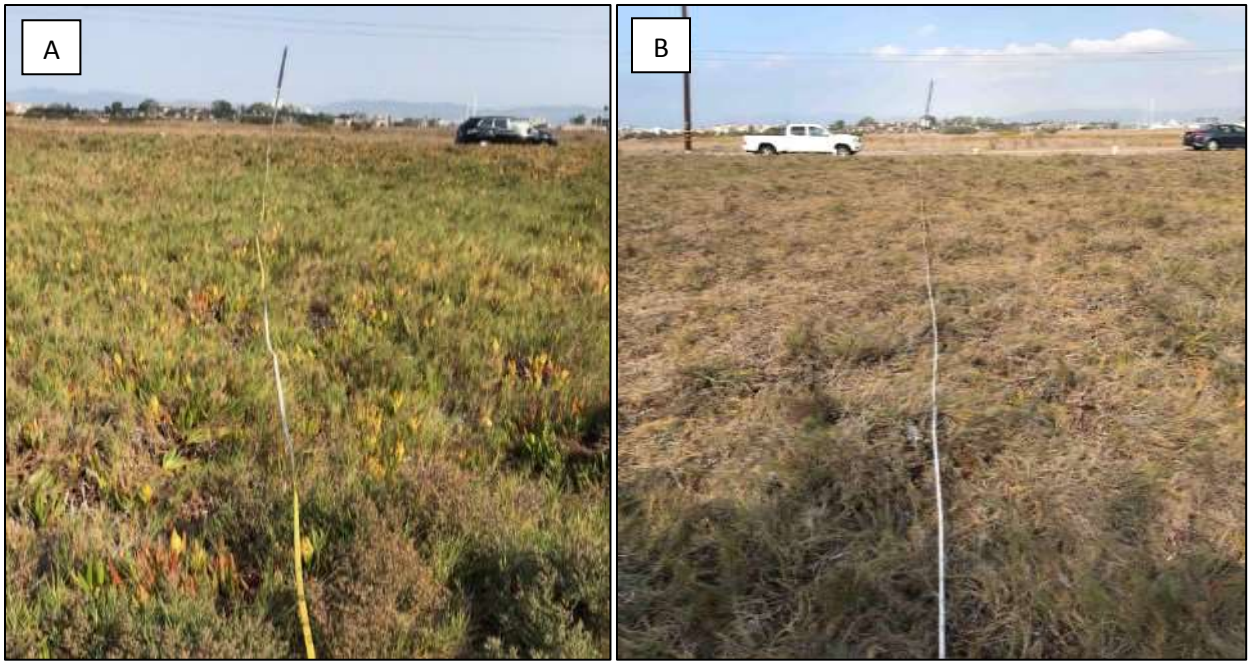


Figure 17a. Photograph of beginning of Transect 7 at baseline conditions (pre-restoration) on 9 August 2018 (A) and within weeks of post-restoration on 28 November 2018 (B).

Figure 17b. Photograph of beginning of Transect 7 post-restoration on 5 June 2019 (C) and 21 July 2020 (D).

Figure 18. Photo of vegetation transect in non-restored area of project site on 16 July 2020 showing predominantly iceplant, curly dox, and non-native grasses, with intermixed saltgrass.

Precipitation

The total rainfall for the wet weather months (October through May of the following year) was 16.32 inches during Year 1, 3.79 inches in Year 2, 16.94 inches in Year 3, and 13.03 inches in Year 4, as measured by the Los Angeles International Airport (LAX) rain gauge. Year 2 had noticeably less precipitation than Years 1, 3, and 4. Precipitation is particularly important to monitoring during revegetation efforts and can be meaningful when analyzing vegetation monitoring data. Figure 19 shows the total rainfall for wet weather months throughout the duration of the project.

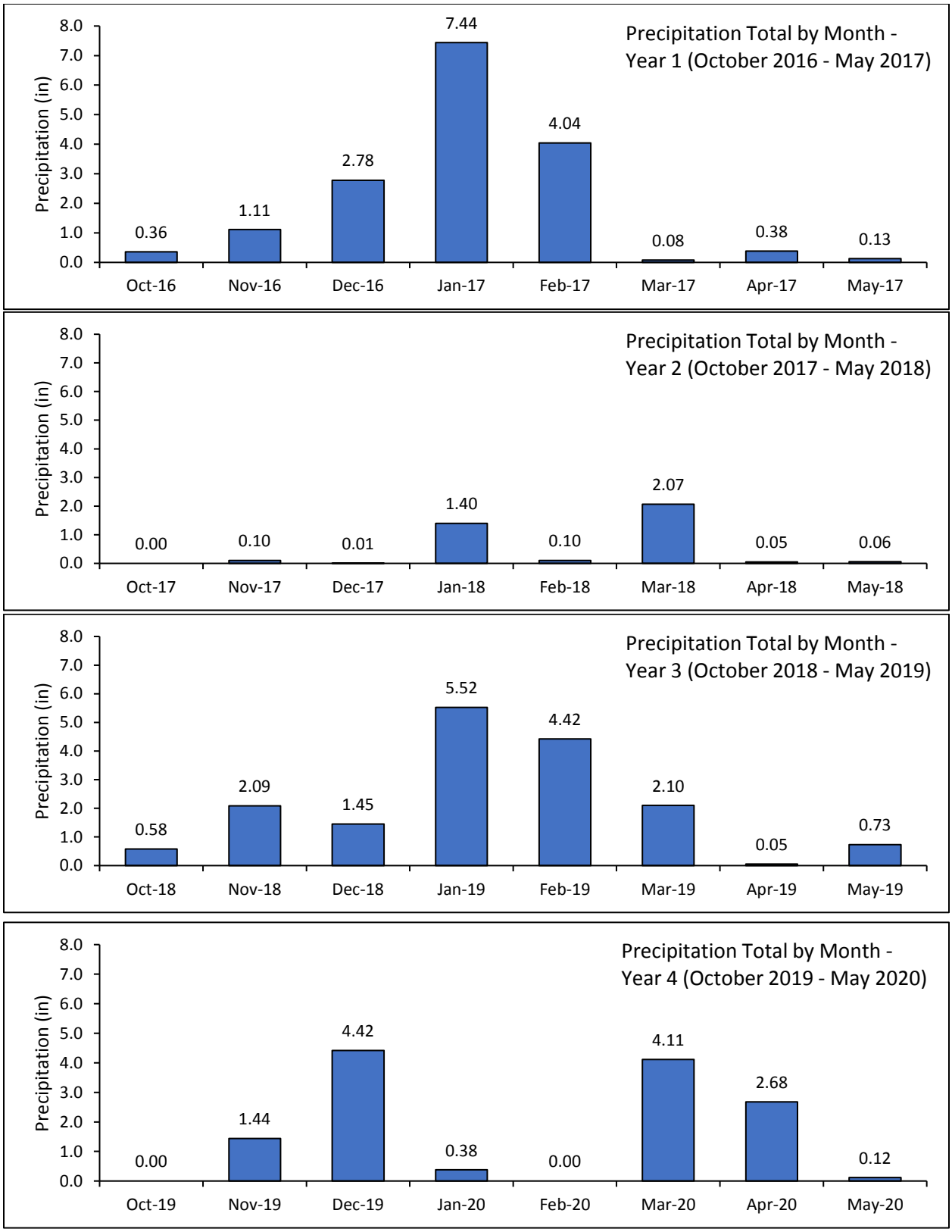


Figure 19. Monthly precipitation totals (inches) for wet weather months (October - May). Daily precipitation data were downloaded from AccuWeather Premium and recorded at the LAX rain gauge.

Avifauna and Other Wildlife

No wildlife was 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 on monitoring days. Species lists are not intended to be analyzed for statistical relevance.

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, 1 December 2017, 13 July 2018, 12 February 2019, 11 April 2019, 30 July 2019, and 31 October 2019. Observational bird and wildlife data were also collected during the implementation of other survey protocols and during restoration events; seven supplemental surveys were conducted during Year 2. Additionally, site checks throughout Years 3 and 4 noted birds and wildlife in site when observed.

Avifauna and Wildlife Survey Results

No wildlife mortality was observed under the tarps during or after restoration. In fact, several reptiles (i.e., Western fence lizards, an alligator lizard, and a juvenile gopher snake) and several amphibians (i.e., 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 other trained surveyors using Cooper methods. Birds were also identified as part of wildlife observation and monitoring days conducted by TBF and FBW. Table 5 includes a list of species identified as part of these monitoring surveys within the restoration area (first two columns). The rest of the columns to the right-hand side summarize specialized bird survey results. It should be noted that this table 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 birds and wildlife using the restoration area and are not intended for statistical analyses or to infer project success. Table 5 is intended as a checklist of birds by survey date. 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 5 displays bird presence survey results. Many of the birds on the specialized ornithological surveys were identified immediately adjacent to the project area, rather than within the restoration footprint. 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-A. During the most recent bird survey on 31 October 2019, multiple individuals of several species were seen, including black phoebe, Say's phoebe, common yellowthroat, song sparrow, and great egret. Additionally, snowy egrets were commonly identified in the tide channel adjacent to Site 2-A, and one great blue heron was seen foraging in the western portion of the restoration area in April 2020 (Site 1-C).

During restoration events and post-monitoring surveys, a number of wildlife were seen and recorded such as butterflies and moths (Table 6). Post-restoration wildlife identified included a variety of herpetofauna, mammals, and invertebrates, with some occasionally photographed such as the western spotted orbweaver (Figure 20). Western fence lizards, side-blotched lizards (Figure 21), and Pacific tree frogs were frequently observed, and alligator lizards were seen occasionally. A Southern California legless lizard was found in the restoration site on 21 December 2018, in an area where iceplant was removed in 2016. Butterflies, moths, and other notable invertebrates were also recorded and included wandering skipper, cabbage white butterflies, 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 6 displays wildlife presents results. Similarly to the birds, this table is not intended as a comprehensive or exhaustive list of species using the restoration area or adjacent habitats. These results are intended to provide an overall understanding of some of the wildlife using the restoration area and are not intended for statistical analyses or to infer project success.

Figure 20. Photographs of western spotted orbweaver (left), and bee (right).

Table 5. Bird species identified in and around the restoration project area.

Common Name	Pre-restoration (and during) *	Post-restoration *	Cooper (5/1/17) **	Cooper (12/1/17) **	Cooper (7/13/18) **	Cooper & Associates (2/12/19) **	Cooper & Associates (4/11/19) **	FBW – Cooper (07/30/19) **	FBW – Cooper (10/31/19) **
Allen's hummingbird			X		X	X	X	X	
American crow					X		X		
American kestrel				X	X				X
Anna's hummingbird					X	X	X		
Black phoebe	X	X		X	X	X		X	X
Black-crowned night-heron							X		
Brown-headed cowbird							X		
Bushtit		X	X			X	X		X
California towhee			X	X					
Cassin's kingbird				X					
Common raven			X						
Common yellowthroat		X	X	X	X	X	X	X	X
Cooper's hawk					X				X
Gadwall							X		
Great blue heron		X							
Great egret									X
Great horned owl							X		
Green-winged teal						X			
Hooded oriole							X	X	
House finch			X	X	X	X	X	X	
House sparrow							X		
House wren		X	X						X
Least sandpiper						X			
Lesser goldfinch					X		X	X	
Lincoln's sparrow						X			X

Common Name	Pre-restoration (and during) *	Post-restoration *	Cooper (5/1/17) **	Cooper (12/1/17) **	Cooper (7/13/18) **	Cooper & Associates (2/12/19) **	Cooper & Associates (4/11/19) **	FBW – Cooper (07/30/19) **	FBW – Cooper (10/31/19) **
Killdeer		X							
Mallard						X	X		
Marsh wren				X		X			X
Mourning dove		X	X		X	X	X		
Northern rough-winged swallow							X		
Orange-crowned warbler				X					
Osprey		X							
Pigeon									
Red tailed hawk		X		X		X	X		
Red shouldered hawk									
Ruby-crowned kinglet						X			X
Savannah sparrow				X		X			X
Say's pheobe						X			X
Scrub jay									
Song sparrow			X	X	X	X	X	X	X
Yellow warbler			X	X			X		X
Warbling vireo			X						
Western meadowlark						X			
White-crowned sparrow				X					
Wilson's warbler			X				X		

** Note: Pre-restoration (and during) survey efforts and post-restoration survey efforts are not equivalent and are not intended to be compared quantitatively or to infer project success.*

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

Table 6. 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
Southern California legless 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 21. Side-blotched lizard found on site on 27 September 2019.

Photo-point

A series of geotagged photo-points were established to document change over time at the restoration site. The photos provide a series of "after restoration" visual representations of tarped and hand-pulled restoration areas over time. To date, five permanent, photo-monitoring locations (Table 7 and Figure 22) have been established to visually document the restoration site over time. Stations were located using GPS and baseline photographs. Photo point stations 1 through 3 were established in November 2016 with 15 total photos, and station 4 was established during Year 3 (September 2018) with seven total photos. Station 4 was established to document restoration expansion into new areas during Year 3. Photo point monitoring at each station is represented in Appendix A.

Table 7. Photo point stations, approximate bearing, and number of photos.

Station	Approximate Bearing	Total Number of Photos	Date Established
1	70°	15	29 November 2016
2	300°	15	29 November 2016
3	270°	15	29 November 2016
4 (a,b)	173°; 61°	7	20 September 2018

Additional photos of restoration areas over time and before and after restoration events have been included throughout this report. Appendix A shows a series of photographs from fixed locations over time, including Year 4 restoration progress in Site 1-C before iceplant removal and then in several successive photos following implementation of restoration actions through community events. Photograph details can be found in the figure captions.

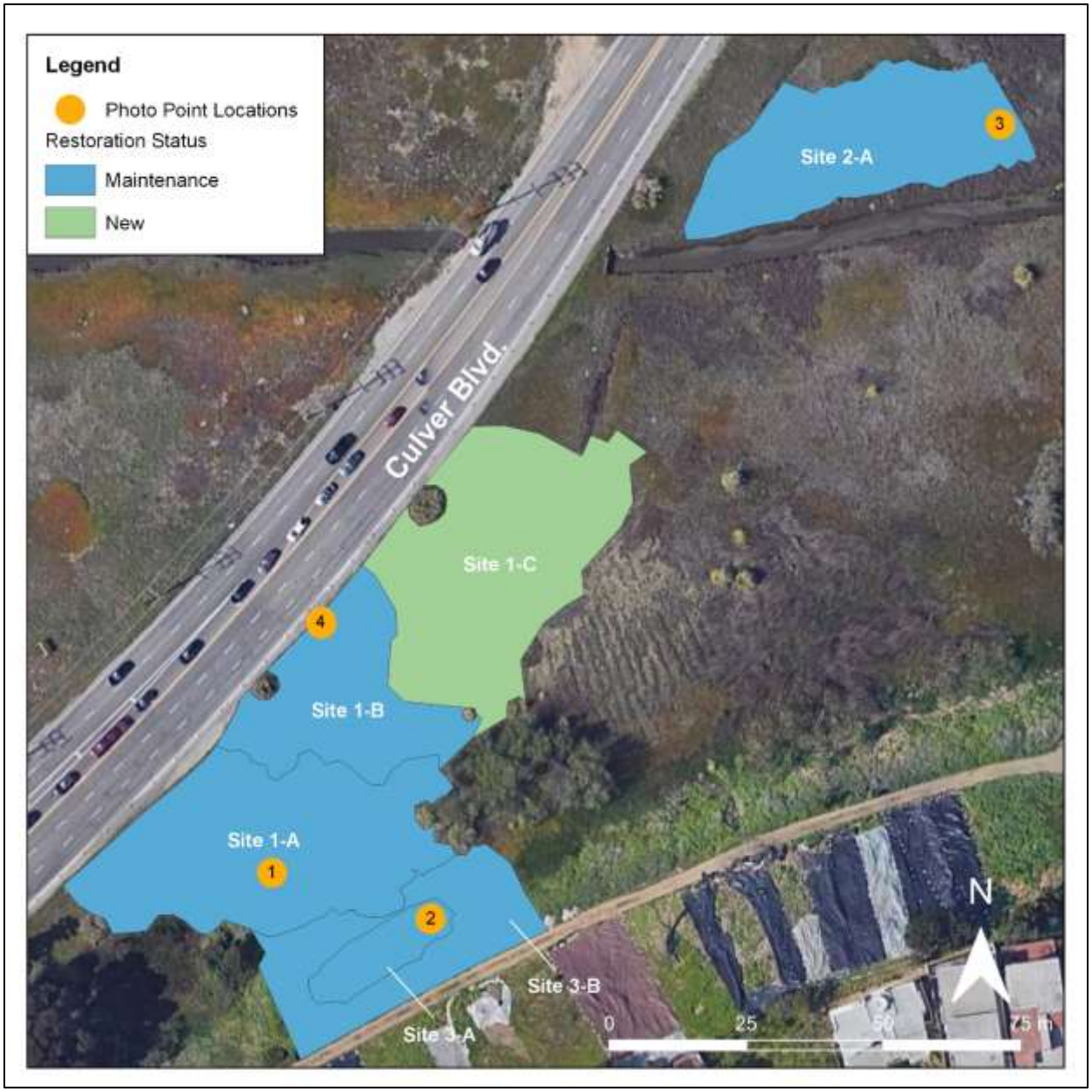


Figure 22. Location of photo point monitoring stations.

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 CDP No. 5-15-1427 was issued. Shortly after the first report 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.

On 22 May 2020, BWLT submitted a second request for permit revocation and enforcement to CCC regarding the project. TBF responded with a letter dated 2 June 2020 in an attempt to address BWLT concerns. Subsequently, on 5 June 2020, BWLT submitted an amended request to require revocation proceedings for the project, with additional details, which included a request to revoke the permit and

subsequently to “issue a new permit to allow the applicant to maintain the project areas” followed by an additional and presumably separate third permit to “expand the project area”. TBF responded in a letter dated 24 June 2020. At the time of authoring this report (31 July 2020), TBF had not received a notice on whether CCC would require a hearing to address BWLT’s second revocation request.

TBF continues ongoing invasive vegetation management and scientific monitoring within the permitted project area in accordance with all permits and its associated documents. TBF recognizes that long-term dedication to improving the health of this project area in a degraded urban system is likely to require ongoing maintenance for a period of time. Activities such as weed removal or further seeding and planting of native plants will continue until the system is further stabilized with native cover. Ongoing adaptive management and scientific monitoring will continue to inform non-native vegetation removal in future years (see separate sections of this report for details).

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 CCC staff.

Challenges

The importance of iceplant removal at a degraded urban site like the 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 prior to implementation of this project. While this project is focused on a relatively small area, it serves to inform future hand-restoration efforts both at the Reserve and throughout southern California. This project has been successful both at iceplant removal and at community engagement; however, ongoing maintenance of other invasive weedy vegetation remains a challenge in portions of the restoration area.

Restoration and enhancement activities in a heavily degraded urban environment continued to pose challenges in Year 4. 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 through site maintenance. Additionally, natural native vegetation recruitment was strong in some areas of the site, especially where intermixed saltgrass was present in baseline conditions; however, some portions of the site continued to have low native plant recruitment, especially areas that were higher in elevation, that had several feet of dense iceplant monocultures in baseline conditions (pre-restoration), and those areas impacted by illegal activities (see subsection below). Plans for Year 5 include additional revegetation strategies to help improve overall conditions in some of the areas with higher bare ground or more annual non-natives. Long-term restoration of the project site will likely require a period of ongoing effort to remove non-native, invasive vegetation (e.g., Table 8), and continued monitoring will inform necessary adaptive management decisions (see subsequent chapter).

Similar to Year 3, Year 4 saw additional volunteer participation and an increase in the number of public events. This support allowed for both ongoing maintenance activities as well as expanded iceplant removal in new areas. This support was provided in part by schools, individuals, and through Loyola Marymount University's Coastal Research Institute internship students and was supplemented through outreach and communication strategies as well as project partners such as FBW. While not directly a challenge, hosting community restoration events at the site includes logistical issues like the lack of adjacent parking and restroom facilities, as well as ongoing efforts to maintain safety due to the proximity of restoration activities to vehicular traffic on Culver Boulevard.

Year 4 Challenge – Illegal Vehicles and Sediment Dumping

Year 4 saw several substantial new challenges. One of the most significant was the series of illegal incursions on-site of vehicles which repeatedly impacted the restoration project area and progress, especially on project Sites 3-A, 3-B, 1-A, and 1-B (the hillside and below). Vehicles have ranged from personal cars, to tow trucks, to dump trucks. Beginning in July 2019, significant disturbance of the project site by trespassing vehicles from Cabora Road (above the project site) onto the Reserve caused recurring impacts to the hillside and additional areas of the project where the vehicles further drove across and through to reach Culver Boulevard. This was first publicly identified in the Year 3 Report (photographs from 31 July 2019). At least one additional illegal vehicle incursion occurred in summer

2019. Subsequently, on 14 November 2019, CCC informed a construction company that they were in violation of the Coastal Act (Violation #: V-5-19-0140) through unpermitted development including: (1) placement of fill in a wetland, (2) removal of major vegetation including native wetland vegetation as a result of driving through the wetlands and placing fill, and (3) change in the intensity of use of water resulting from altering the hydrology of wetlands through soil compaction, placement of fill and driving through the wetlands. Both the vehicles and the dumping of sediment on top of the restoration area caused impacts, especially to the seeded hillside, which was one of the focus areas of revegetation in Year 3. Erosion control mats were broken, new seedlings were trampled or uprooted, and soil was severely disturbed (Figures 23 and 24). Due to impacts from the driving (multiple incursions) and placement of sediment, emergency erosion control actions were needed at the Reserve within the violation area. On 26 November 2019, TBF, with authorization from CDFW, applied for an Emergency Permit to address immediate potential impacts of the dumping within the restoration area through emergency erosion control measures. Photographs and additional details can be found in TBF's Emergency Permit application and in Figures 23 and 24, below.

While CCC continued enforcement conversations with the alleged violator, TBF was asked to temporarily refrain from project activities within the impacted area, which reduced weeding and revegetation efforts temporarily in those areas. Conversations with CCC in June and July have clarified the process for which the violator's impacts to the site will be resolved. Once the dumped sediment piles are removed, TBF plans to implement native container stock planting and seeding along the hillside and the rest of the impacted area of the restoration project site, in accordance with the Implementation and Monitoring Plan and the next phase of the restoration project.

Figure 23. Photographs taken of the impacted area of the hillside with disturbed soils and tracks before emergency measures were taken (top) and after erosion control mats were placed (bottom) (26 November 2019).

Figure 24. Photographs taken of one of the dumped sediment and trash piles in the restoration area before being covered (top) and after (bottom) (26 November 2019).

Year 4 Challenge – COVID-19

Beginning in December 2019, a novel coronavirus outbreak began in Wuhan, People's Republic of China (SARS-CoV-2), which caused a disease known as COVID-19. Over the subsequent months, the virus and its associated disease spread globally and turned into a worldwide pandemic. As of end of July 2020, there have been over 17 million cases and over 650,000 deaths worldwide across 188 countries or regions (Johns Hopkins University of Medicine, accessed 29 July 2020). Beginning in March 2020, the

State of California and Los Angeles County Department of Public Health issued a “stay-at-home” order with specific restrictions on all activities.

These restrictions caused all on-site project activities from 20 March through 21 April 2020 to be cancelled or postponed in accordance with state and local guidance, including a restoration event on 10 March 2020. During this time, TBF and partners coordinated to adapt to these challenges by drafting safety guidelines and protocols to follow in the field, such as social distancing, face coverings, and limiting exchanges of any items. Once COVID-19 restrictions lessened, TBF resumed non-public staff maintenance weeding activities in these areas (beginning end of April 2020), and weeding activities (e.g., hand removal, weed-whacking). Implementation of on-site project activities in response to COVID-19 requires extensive preparation, collaboration, and communication to prioritize human health, reduce safety risks, and follow local and State of California guidelines. When activities resumed, on 22 April 2020, they were limited to staff and some interns only.

TBF continues to have a long-term commitment to the management of invasive species on site and has managed to conduct onsite operations while responding to the necessary precautions resulting from COVID-19. Additional efforts have been made to plan for future volunteer events, including detailed protocols and guidelines for events, potential changes to event scheduling, a revised waiver, revisions to volunteer documentation strategies, and other efforts. This public health crisis is causing a considerable challenge in the context of project implementation.

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 similar projects throughout the region and the larger BWER restoration planning efforts.

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 Year 3 and 4. Weed succession refers to the growth of other weed species following the removal of one type of vegetation and is further discussed below after four 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. Similarly to Year 2, Years 3 and 4 saw varied invasion based on project area and season, with some areas more resistant than others. A strong continued maintenance regime is recommended and will continue. Once COVID-19 restrictions lessen and with appropriate protocols in place, 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 5 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 8 provides a list of invasive species, with subsequent descriptions by species of the adaptive management efforts undertaken in Year 4, anecdotal results based on recurrence, and recommendations by species for Year 5. TBF will continue focus on removing the dominant invaders in Year 5 as part of ongoing long-term maintenance of the site. Perhaps equally as important is consideration of additional revegetation options, as discussed in the several chapters above.

Ongoing Maintenance

Year 4 maintenance required less effort than the first implementation year, which allowed for an expansion of the project footprint, similarly to Year 3. Trends indicated fewer perennials including iceplant (only a few small sprouts of re-growth were identified within the previous project area and were removed). The primary target species for Year 4 included perennial iceplant and castor bean, as well as a variety of annuals including Geraldton carnation weed, wild radish, and brome grasses. For additional details by species, see subsections below and Table 8.

Year 5 restoration activities will focus on strategically controlling non-native invasive vegetation within the previous restoration footprint (Years 1-4); additional native vegetation seeding and plantings; and continued hand restoration removal of iceplant and 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 9). The following subsections provide details for the dominant vegetation invaders present within the restoration project area and suggested control methods. Table 8 and Table 9 summarize maintenance information by species. All removed non-native plant material will be disposed of offsite. One native species, Canadian

horseweed, was trimmed before seeding, with targeted patches removed. This species, though native, can invade other native plant habitat areas to create dense monocultures, so it was controlled.

Table 8. Summary of weed maintenance adaptive management strategies by species (non-natives).

Scientific Name	Common Name	Growth Type	Year 4 Summary	Recommendations for Year 5
Atriplex semibaccata	Australian saltbush	Perennial	Present in low amounts in Sites 2-A and 1-C; hand removed	Hand removal by roots
Atriplex prostrata	Fat-hen	Annual	Individuals present sporadically in Sites 1-B and 1-C; targeted for future events	Hand removal by roots
Avena spp.	Wild oat	Annual	Present in low amounts, primarily in Sites 3-A and 3-B (hillside); hand removed throughout; weed-wacked in Sites 3-A and 3-B	Weed-whacker before seeding or hand removal by roots before seeding
Brassica spp.	Mustard	Annual	Present in low amounts in Year 4; primarily situated along the roadside; weed-wacked and hand removed	Weed-whacker before seeding or hand removal by roots before seeding
Bromus spp.	Brome grasses	Annual	Present throughout; maintained through pulling; weed-wacked in Sites 3-A and 3-B (hillside)	Weed-whacker before seeding or hand removal by roots before seeding
Carpobrotus spp.	Iceplant	Perennial	Very little regrowth in Year 4; hand removed individual sprouts	Hand removal by roots
Cortaderia selloana	Pampas grass	Perennial	Not targeted during Year 1 and Year 2; opportunistically cut flower heads, trimmed back large plants on targeted individuals, removed new (small) plants in Year 4	Clipping and bagging of seed heads from plants within project area; manual removal of plants when feasible
Euphorbia terracina	Geraldton carnation weed	Perennial	Spread of boundary maintained in Year 4; continued removing by hand throughout areas where present	Hand removal by roots
Glebionis coronarium	Crown daisy	Annual	Present in Year 4 within site, especially in Sites 3-A and 3-B (hillside) and dense around periphery; targeted in Sites 3-A and 3-B (hillside) in Year 4 by weed-whacking	Hand removal by roots or weed-wrench before seeding; expand perimeter maintenance
Lysimachia arvensis	Scarlet pimpernel	Annual	Almost no presence in Year 4; hand removed several individuals	Hand removal by roots or weed-wrench before seeding

Scientific Name	Common Name	Growth Type	Year 4 Summary	Recommendations for Year 5
Melilotus indicus	Sweet-clover	Annual	Dense patches in Sites 2-A and 1-A; overall less invasive than Year 3; hand removed	Weed-whacker (or clipping) before seeding or hand removal by roots before seeding
Oxalis pes-caprae	Bermuda buttercup	Perennial	Low presence in Year 4; hand removed	Hand removal by roots or weed-wrench before seeding; make sure to remove bulbs
Polypogon monspeliensis	Rabbitsfoot grass	Annual	Present in several patches primarily on Site 1-C; hand removed	Hand removal by roots
Raphanus sativus	Wild radish	Annual	Present in Year 4, especially around periphery and Sites 1-A, 3-A, and 3-B; hand removed throughout; weed-wacked in dense areas of Sites 3-A and 3-B (hillside)	Weed-whacker (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; present in low amounts in Sites 3-A and 3-B (hillside); hand-pulled before seeding	Bag seeds; hand removal by roots or weed-wrench before seeding; expand perimeter maintenance
Rumex crispus	Curly dock	Perennial	Present sporadically in Site 1-C; hand removed	Hand removal by roots
Sonchus oleraceus	Common sowthistle	Annual	Present in low amounts primarily in Site 1-B; hand removed	Hand removal by roots or weed-wrench before seeding

Table 9. 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
Australian saltbush												
Fat-hen												
Wild oat												
Mustard												
Brome grasses												
Iceplant												
Pampas grass												
Geraldton carnation weed												
Crown daisy												
Scarlet pimpernel												
Sweetclover												
Bermuda buttercup												
Rabbitsfoot grass												
Wild radish												
Castor bean												
Curly dock												
Common sowthistle												

Perennial Non-native Species

Carpobrotus spp.

Iceplant re-growth was not present in significant amounts in Year 4, 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 it continued to encroach from the perimeter, especially at Site 1-A and Site 3-B. During Year 3, the spread of Geraldton carnation weed seemed to be contained within Site 1-A and continued to be removed by hand during restoration events. During Year 4, a similar pattern was seen as Year 3.

Geraldton carnation 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

During Years 3 and 4, there was minimal presence of Bermuda buttercup (*Oxalis pes-caprae*) compared to the higher densities in Year 2. Additionally, Bermuda buttercup grew earlier and was able to be targeted by ongoing community restoration events in the winter. 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 and 4 activities included clipping the seed heads from targeted pampas grass plants located in the extended project footprint and removing several 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. During Years 3 and 4, small numbers of sprouts were pulled in Sites 3-A, 3-B, and 1-A. The sprouts likely originated from large individuals bordering the project site. 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 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-A. During Year 3, Australian saltbush continued to be pulled from Site 2-A, and during Year 4, regrowth was limited to a patch within the same area; additionally, small sprouts and a handful of individuals were found and pulled on the base of the hillside at Site 3-B.

Rumex crispus

Curly dock (*Rumex crispus*) is a perennial non-native herb characteristic of disturbed areas and can be found in wetlands or non-wetlands. It produces a flower stalk that can grow up to over a meter in height. It was not present in the footprints of Years 1-3 and was only sporadically present in small amounts in the new restoration area (Site 1-C). Recommendations for Year 5 include monitoring of re-growth and removal if necessary.

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. During Year 4, brome grasses continued to be problematic, especially closer to Culver Boulevard. For Year 5, these non-natives should continue to be removed prior to seeding by hand removal. Some recommendations for removal include possibly using a weed-whacker 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 Year 1 restoration sites, especially along the base of the bluff. During Year 4, crown daisy was observed and pulled on the hillside of Sites 3-A and 3-B, though in much lower densities than Year 3. 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 can also prevent native plants from recolonizing if not removed (Tuttle et al. 2011). Crown daisy can be removed by hand or weed wrench. For Year 5, the adjacent crown daisy should continue to be assessed, and additional recommendations for this species include expanding 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-A and 3-B as small scattered individual plants in Year 2. During Years 3 and 4, only a couple of sprouts of scarlet pimpernel were observed and removed in portions of Sites 3-A and 3-

B. 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 4 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. Sweetclover was somewhat problematic in Site 2-A during Years 3 and 4, with little invasion in other restoration sites, but overall the species was found in much lower densities than 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-whacker, the plant needs to be cut below the lowest branch axil to prevent resprouting. For Year 5, 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. During Years 3 and 4, wild radish continued to be a common invader in the restoration site, especially in the hillside area (Sites 3-A and 3-B). Radish was less dense in areas with established native cover (e.g., saltgrass and Canadian horseweed) and denser in areas with little to no native cover. 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 three feet or taller and reproduces only by seed. Seeds can remain viable for long periods of time and can germinate in spring on fall depending on weather. 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 4 include controlling wild radish within the restoration site and expanding perimeter maintenance activities.

Sonchus oleraceus

Common sowthistle (*Sonchus oleraceus*) was present in small amounts in various places throughout the restoration area in Year 4. 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 four 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 5 include continued hand removal and maintenance.

Polypogon monspeliensis

Rabbitsfoot grass (*Polypogon monspeliensis*) is an annual non-native grass. Native to southern Europe, this grass has large fluffy inflorescence and can grow in height up to one meter (including seed stalks). During Year 4, several small patches were present in Site 1-C and subsequently removed. Recommendations for Year 5 include monitoring or re-growth and removal if necessary.

Atriplex prostrata

Fat-hen (*Atriplex prostrata*) an annual non-native herb that can be found in wetland habitats. During Year 4, individuals were present scattered throughout Sites 1-B and 1-C, though they were not targeted as a high priority invasive species. Recommendation for Year 5 is to hand remove.

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 and alters soil chemistry, 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 (prior to 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 and engaging the local community and school groups to varying degrees. Over the course of four implementation years, an estimated total of over 32 tons of iceplant were removed from the site, with removal of numerous other non-native invasive plants species. Additional efforts to continue to engage the public are made available through these reports, the project webpage, periodic newsletters, project partners, and engagement through social media. Allowing students and the community to actively participate in improving the health of the Reserve will encourage stakeholder involvement in the larger restoration process for the whole Reserve and broaden the hands-on educational opportunities for Los Angeles. For all years combined, 457 volunteers have contributed 1,218 hours across 41 community restoration events.

While the initial results of the tarping and hand-pull restoration efforts successfully removed iceplant with very little regrowth exhibited, Year 4 saw the continued need for maintenance of non-native vegetation, particularly annual species in areas lacking some mixed native cover in the baseline conditions. However, some areas of the project demonstrated high native plant cover expansion (e.g., Site 1-B and 1-C). Areas more susceptible to annual invaders or areas dominated by bare ground will benefit from additional native plant revegetation efforts. 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 such as targeted non-native, invasive weed removal will allow for enhancement in future years, as restoration efforts continue, as well as informing a long-term understanding of invasive plant succession within the restoration area. Saltgrass continues to expand within the restoration area, especially in areas that had some pre-restoration baseline cover prior to iceplant removal. 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.

While the initial efforts specifically targeted at 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 further expanding the perimeter to restrict encroachment of non-natives into the project area. Lastly, additional efforts to monitor and implement additional revegetation efforts will be necessary in Year 5 and beyond.

Year 4 saw several substantial new challenges, including a series of illegal incursions on-site of vehicles which repeatedly impacted the restoration project area and progress, and the dumping of sediment and construction debris on the hillside area of the restoration. Additionally, the restrictions and challenges associated with SARS-CoV-2 and COVID-19 required extensive preparation to prioritize human health, reduce safety risks, and follow regulatory restrictions. On 1 August 2020, the public permit conditions of CDP No. 5-15-1427 will begin again. TBF has developed strategies and practices to eventually resume public events in a safe manner.

TBF recognizes that long-term dedication to improving the health of this project area in a degraded urban system is likely to require ongoing maintenance for a period of time. Activities such as weed removal or further seeding and planting of native plants will continue until the system is further stabilized with native cover. Ongoing adaptive management and scientific monitoring will continue to inform non-native vegetation removal in future years.

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APPENDIX A

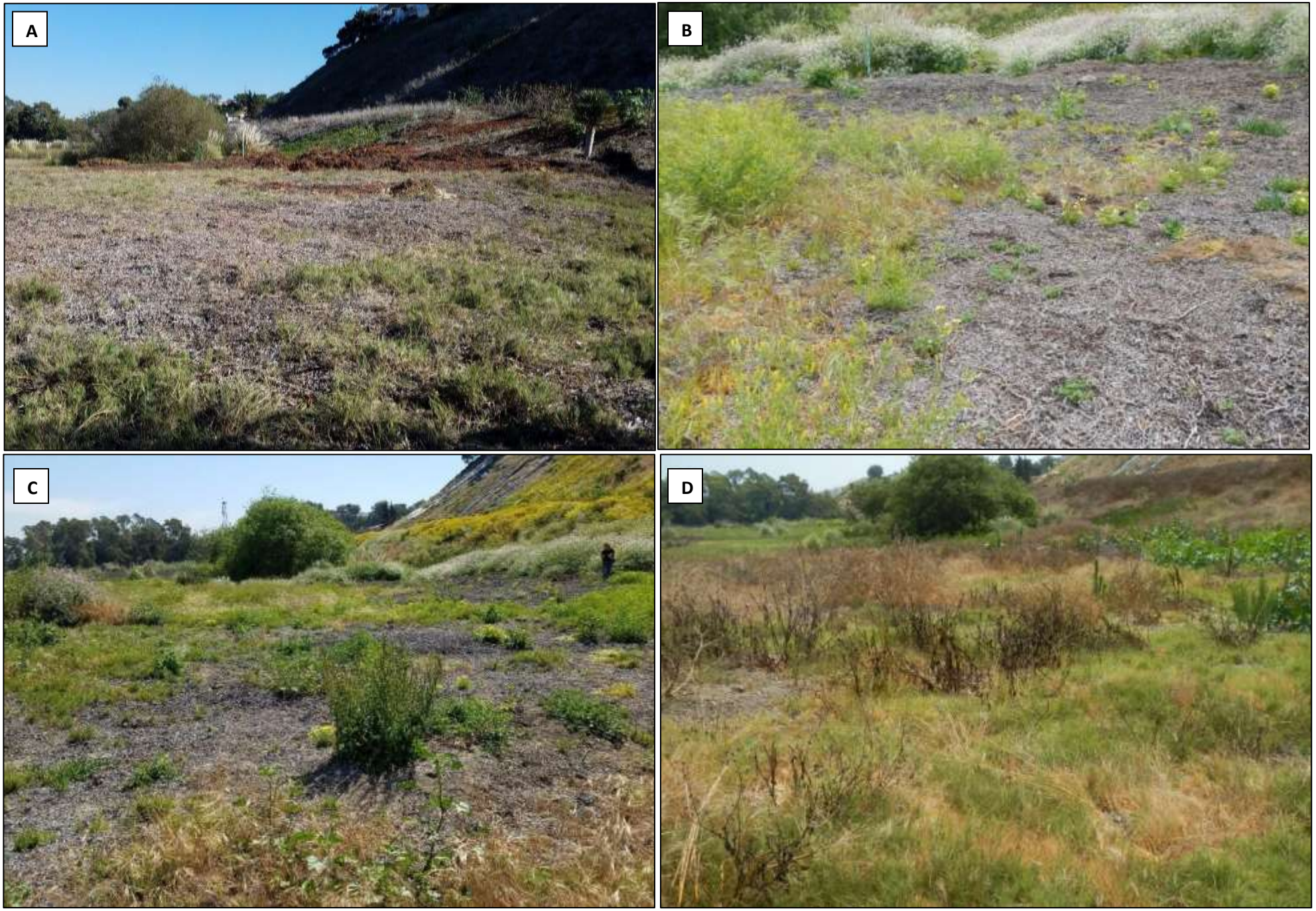

Figure A-1. Photo Point 1 at bearing 70° on (A) 29 November 2016; (B) 25 April 2016; (C) 2 May 2017; (D) 12 July 2017.

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Figure A-2. Photo Point 1 at bearing 70° on (E) 12 August 2017; (F) 6 March 2018; (G) 18 May 2018; (H) 31 July 2018.

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Figure A-3. Photo Point 1 at bearing 70° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

APPENDIX A

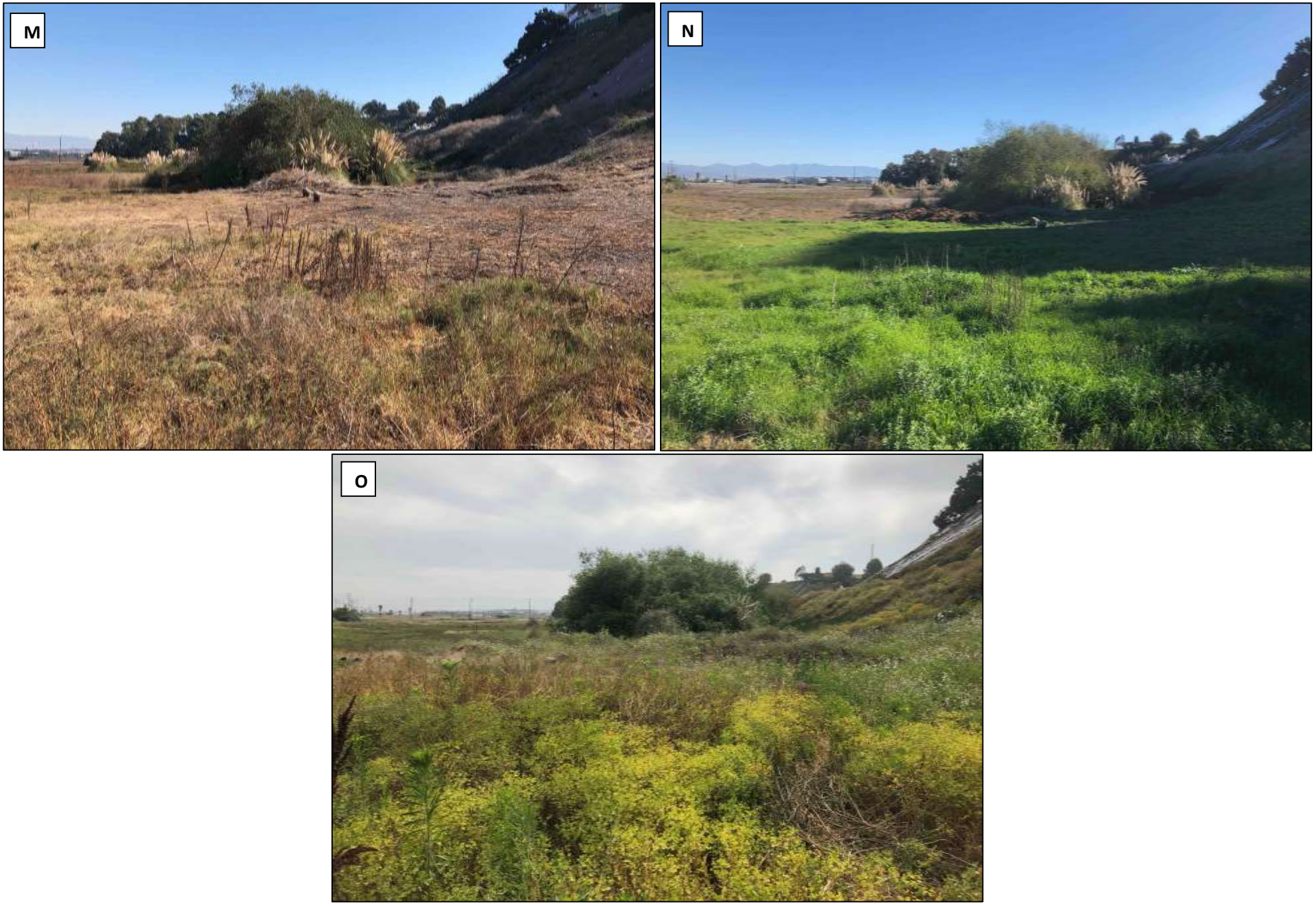

Figure A-4. Photo Point 1 at bearing 70° on (M) 31 October 2019; (N) 11 February 2020; (O) 2 June 2020.

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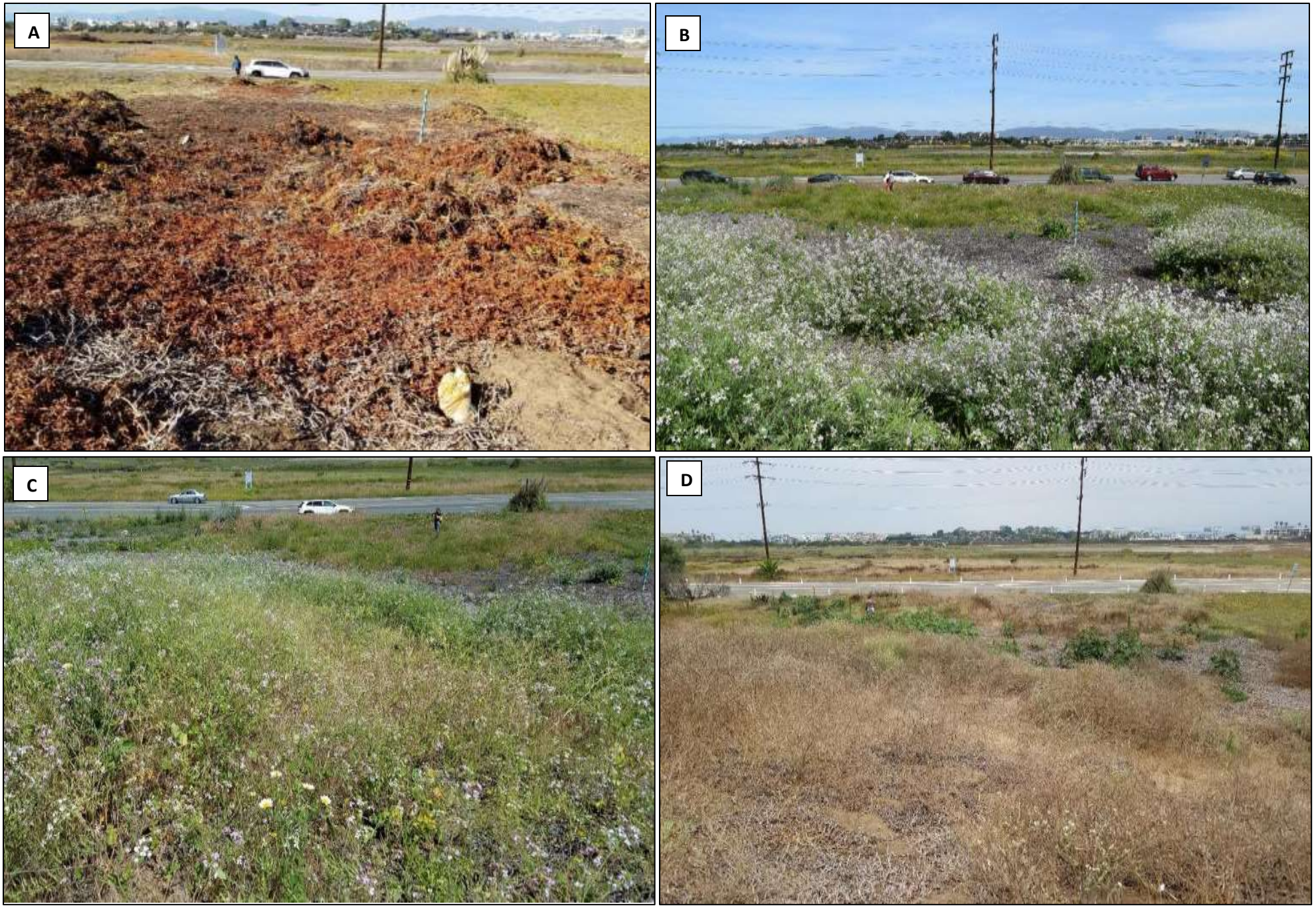

Figure A-5. Photo Point 2 at bearing 300° on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017- different than Year 2 report, bearing accurate.

APPENDIX A

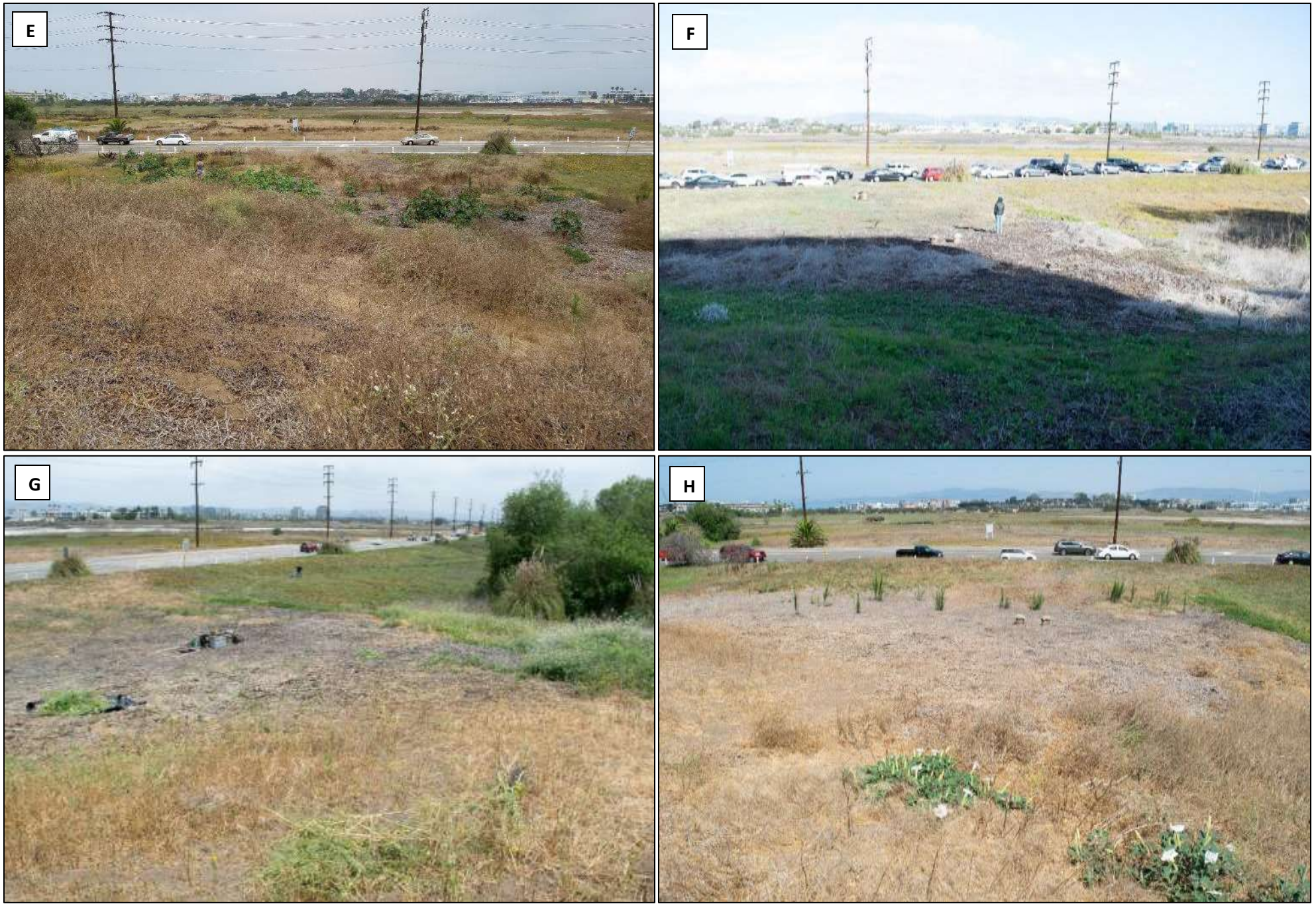

Figure A-6. Photo Point 2 at bearing 300° on (E) 12 August 2017; (F) 27 February 2018; (G) 18 May 2018; (H) 31 July 2018.

APPENDIX A

Figure A-7. Photo Point 2 at bearing 300° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

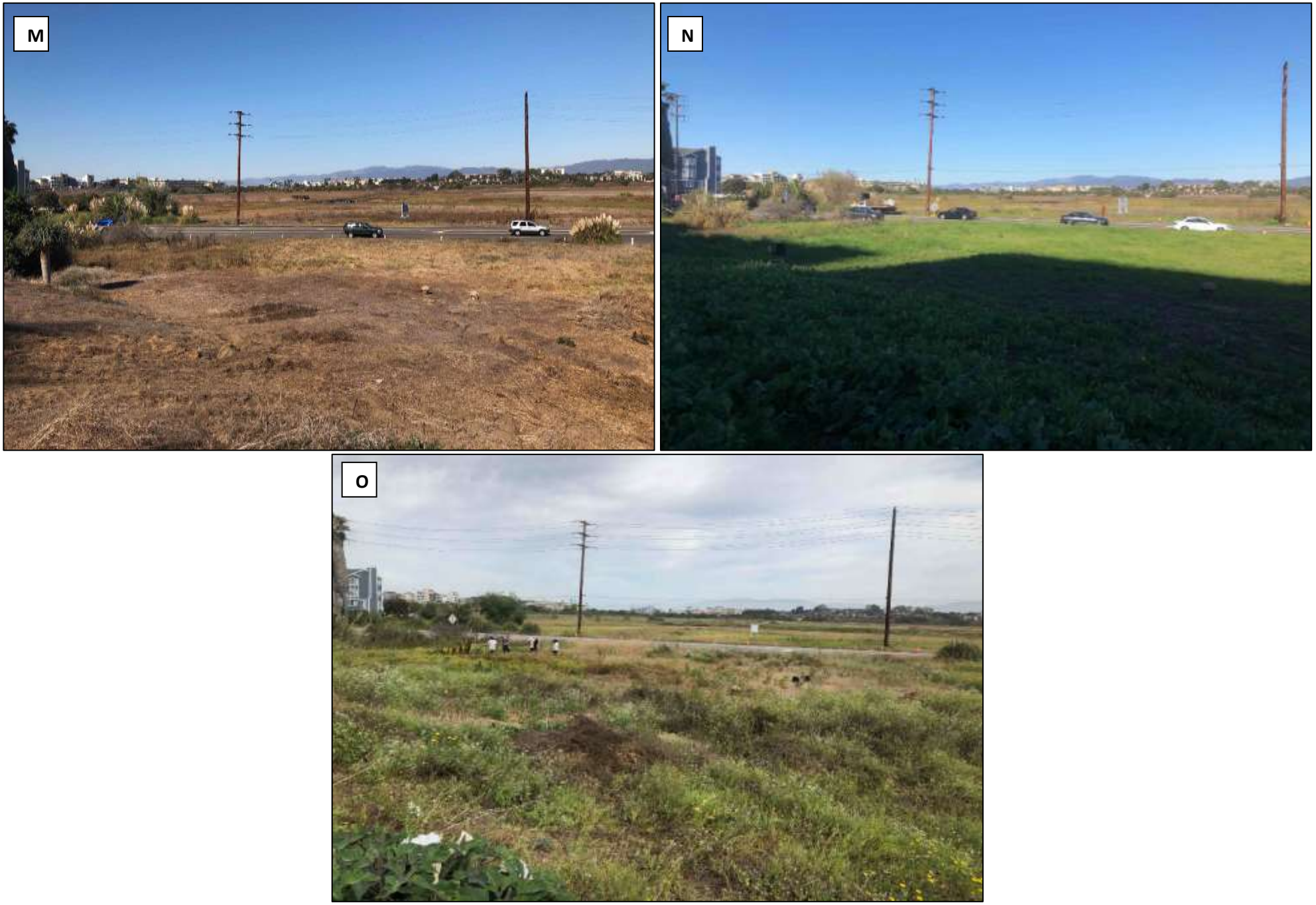

Figure A-8. Photo Point 2 at bearing 300° on (M) 31 October 2019; (N) 11 February 2020; (O) 2 June 2020.

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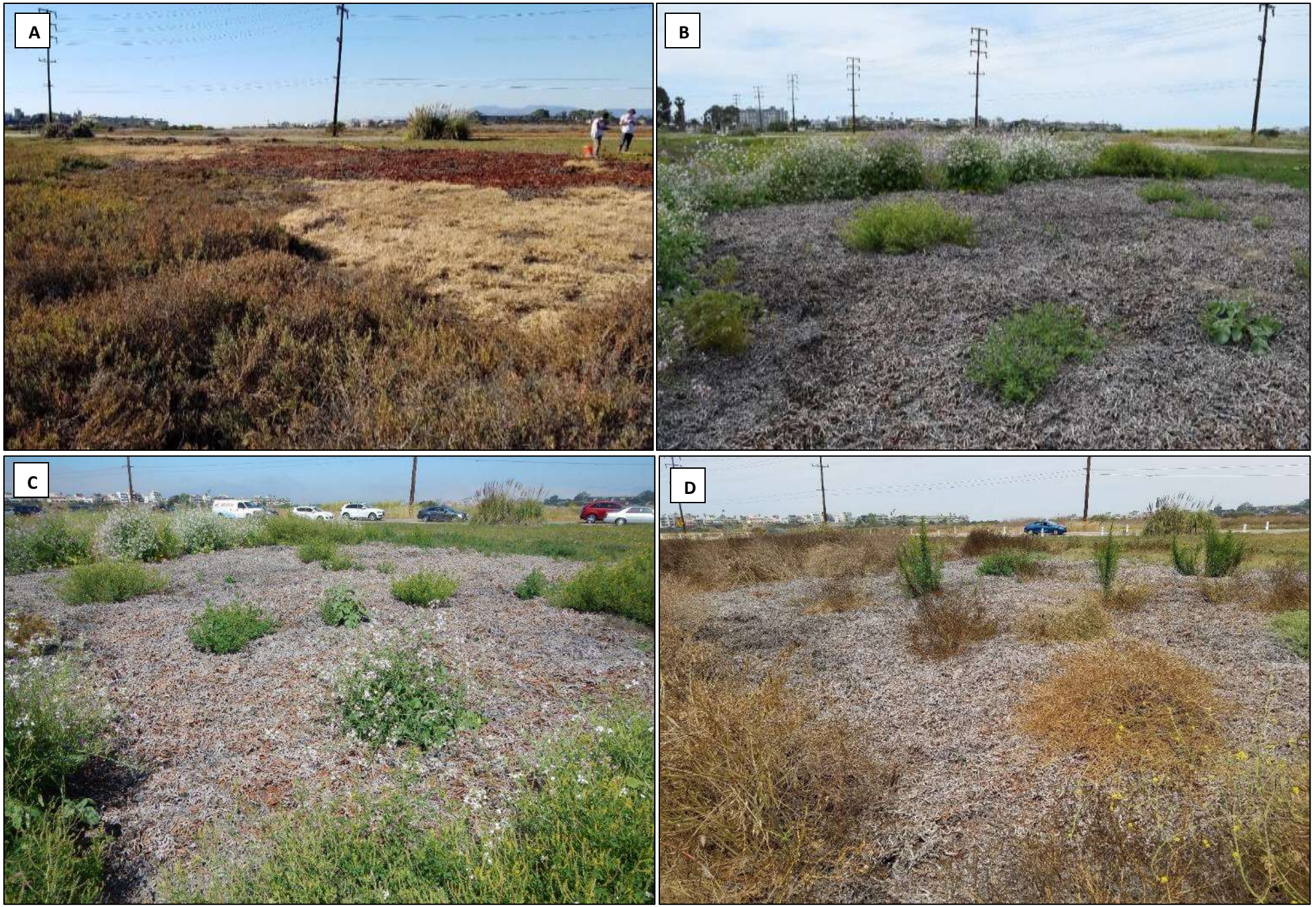

Figure A-9. Photo Point 3 at bearing 270° on (A) 29 November 2016; (B) 25 April 2017; (C) 2 May 2017; (D) 12 July 2017.

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Figure A-10. Photo Point 3 at bearing 270° on (E) 12 August 2017; (F) 16 November 2017; (G) 18 April 2018; (H) 31 July 2018.

APPENDIX A

Figure A-11. Photo Point 3 at bearing 270° on (I) 20 September 2018; (J) 21 February 2018; (K) 30 April 2019; (L) 24 July 2019.

Figure A-12. Photo Point 3 at bearing 270° on (M) 31 October 2019; (N) 11 February 2020; (O) 2 June 2020.

APPENDIX A

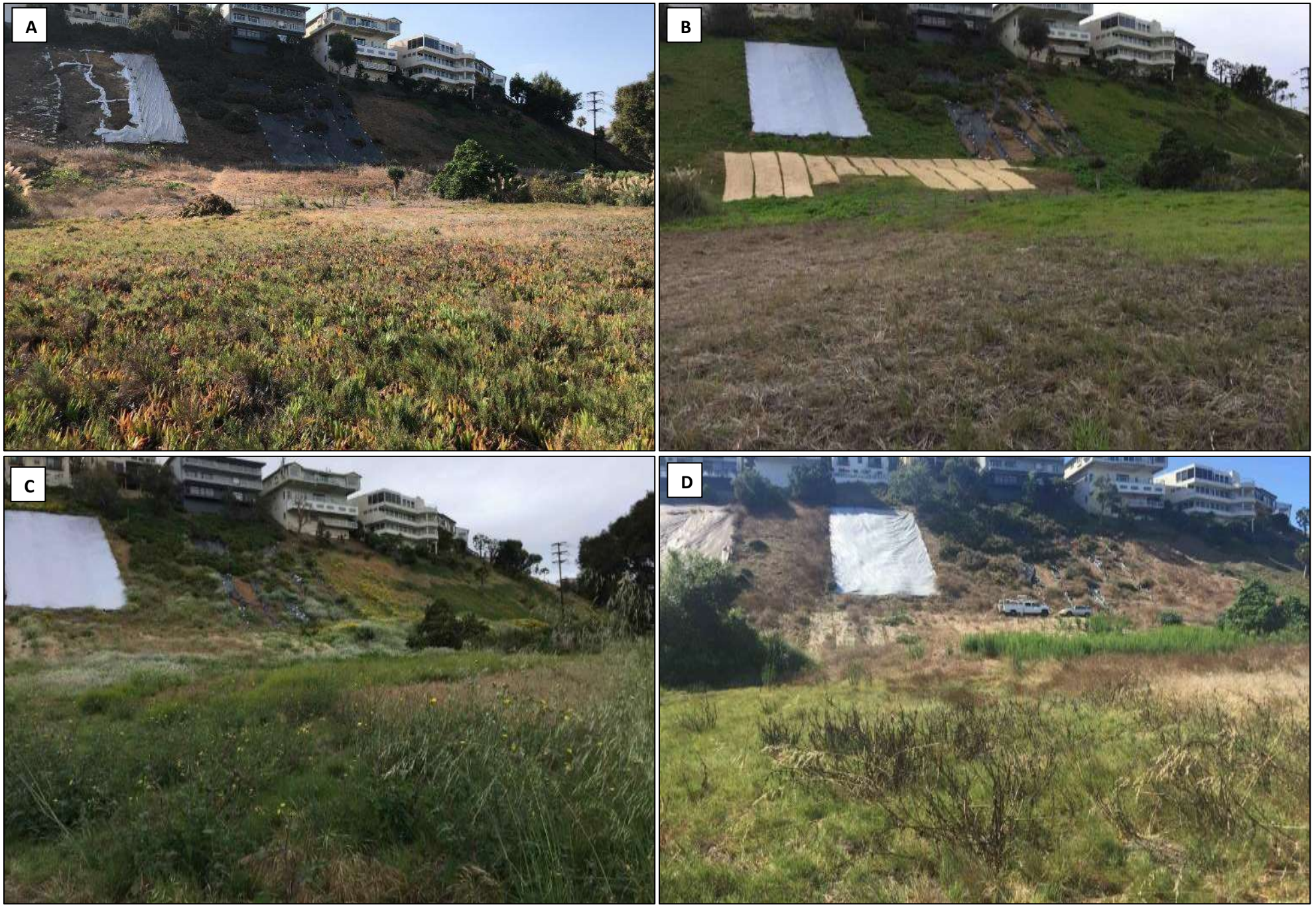

Figure A-13. Photo Point 4a at bearing 173° on (A) 20 September 2018; (B) 21 February 2019; (C) 30 April 2019; (D) 24 July 2019.

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Figure A-14. Photo Point 4a at bearing 173° on (E) 31 October 2019; (F) 11 February 2020; (G) 2 June 2020.

APPENDIX A

Figure A-15. Photo Point 4b at bearing 61° on (A) 20 September 2018; (B) 21 February 2019; (C) 30 April 2019; (D) 24 July 2019.

Figure A-16. Photo Point 4b at bearing 61° on (E) 31 October 2019; (F) 11 February 2020; (G) 2 June 2020.

APPENDIX A

Figure A-17. Series of photos demonstrating Year 4 restoration progress. Top: photo of iceplant dominated cover pre-restoration; Middle: photo following restoration event on 13 November 2019; Bottom: photo taken during event on 19 February 2020 showing progress of restoration footprint.