Los Angeles International Airport Coastal Dunes Improvement Project Ecological Monitoring Report

20 June 2018

Prepared for Los Angeles World Airports and the California Coastal Commission

The Bay Foundation
8334 Lincoln Blvd. #310, Los Angeles, CA 90045
(888) 301-2527
www.santamonicabay.org

Los Angeles International Airport
Coastal Dunes Improvement Project
Ecological Monitoring Report

20 June 2018

Prepared by: The Bay Foundation (TBF)
Prepared for: Los Angeles World Airports
California Coastal Commission

Authors:
Rodney Abbott, Watershed Programs Coordinator, TBF
Melodie Grubbs, Watershed Programs Manager, TBF
Karina Johnston, Director of Watershed Programs, TBF

Photograph of LAX Dunes restoration event in CDIP project area (credit: K. Johnston, TBF).

Executive Summary

In September 2012, Los Angeles World Airports (LAWA) of the City of Los Angeles applied for a Coastal Development Permit (CDP) through the California Coastal Commission (CCC) to implement the Coastal Dunes Improvement Project (CDIP). The CDP permitted restoration activities in the CDIP area of the northern LAX Dunes. Restoration activities as part of the CDIP included removing selected abandoned streets, curbs, gutters, sidewalks, retaining walls, foundations, above ground utilities, non-native invasive plants, and subsequently planting approximately six acres of native coastal dune and coastal prairie vegetation within an area that was formally a residential subdivision.

The requirement of the restoration program, specified by the Ecological Landscape Plan was to restore a stabilized coastal dune system vegetated with native plants (KMA 2013). The performance standards specified that after the fifth year, the relative native vegetation cover shall be greater than 50%, and the restoration site must exhibit resistance to invasion by non-native species. Following the initial removal of hardscape structures in 2013, LAWA and contractors conducted more than 100 restoration activities focused on non-native vegetation removal, seed collection and broadcasting, container stock planting, and erosion control. Additionally, an estimated 84 restoration events since 2013 have been held by TBF and partners to remove non-native vegetation, with over 2,000 participants committing more than 6,000 volunteer hours.

The 6-acre CDIP restoration area permitted under CDP No. 5-12-263 has met the Ecological Landscape Plan success criteria for the 5-year post-restoration assessment. Restoration performance was evaluated through multiple scientific vegetation assessment metrics. Data suggest the CDIP restoration area contains predominantly native vegetation and unvegetated sand (normal for dune habitats), with ongoing efforts continuing the removal of non-native and invasive vegetation. Wildlife indicators suggest ecological habitat support for several notable species including Blainville's horned lizard (*Phrynosoma blainvillii*) and Southern California legless lizard (*Anniella stebbinsi*), among others.

An assessment of relative native cover by both metrics suggests that the dune is stable, predominantly native with some seasonal variability, and supports an abundance of native wildlife and vegetation. Combined efforts by LAWA, TBF, and their partners have allowed for this restoration area to be transformed from impervious roads and other cement and asphalt surfaces into a thriving native, vegetated dune community. TBF recommends continuing the ongoing LAWA-based and community-based non-native plant removal, especially focused in some of the surrounding portions of the northern dune area (outside of CDIP) that are more prone to non-native vegetation occurrences.

Table of Contents

Photograph of CDIP restoration area at sunrise (credit: Rod Abbott, TBF).

List of Figures

List of Tables

Overview

In September 2012, Los Angeles World Airports (LAWA) of the City of Los Angeles applied for a Coastal Development Permit (CDP) through the California Coastal Commission (CCC) to implement the Coastal Dunes Improvement Project (CDIP). The CDIP proposed to conduct restoration activities in the northern LAX Dunes (also known as the El Segundo Dunes: 8901 S. Pershing Street, El Segundo Dunes, Los Angeles). The LAX Dunes are often known interchangeably as the El Segundo Dunes or the LAX Dunes Preserve (part of the southern portion of the site). For the purposes of this report, the entire site will be referred to as "LAX Dunes", with specifications as necessary for the northern 48-acre portion and the 6-acre CDIP area, in particular. Restoration activities as part of the CDIP included removing selected abandoned streets, including curbs, gutters, sidewalks, retaining walls, foundations, above ground utilities, all covering approximately four acres in area; repairing curb and gutter along Vista del Mar; reducing non-native invasive plants; and planting approximately six acres of native coastal dune and coastal prairie vegetation within an approximately 48-acre area that was formally a residential subdivision.

On 10 January 2013, CCC granted LAWA the CDP necessary to implement the CDIP restoration project, subject to standard and special conditions which included the development and approval of an Ecological Landscape Plan (CDP No. 5-12-263, KMA 2013). Following the submittal and approval of an Ecological Landscape Plan, restoration activities began on 27 June 2013 (KMA 2013). Following the removal of selected streets, the area was regraded and seeded with native dune and coastal prairie species to achieve the goal of restoring dune habitat and improving the aesthetic appearance of the dunes from the surrounding neighborhood.

This Ecological Monitoring Report includes documentation of restoration activities and post-restoration monitoring results associated with the implementation of the CDIP. Since the completion of initial restoration efforts in 2014, LAWA Maintenance Services Division (MSD) along with partners, including The Bay Foundation (TBF) and Friends of the LAX Dunes (FOLD), have continued to conduct habitat maintenance. This report summarizes initial restoration efforts and post-restoration habitat maintenance activities that have occurred as part of the CDIP restoration project. Post-restoration monitoring includes subsections within this report on surveys conducted for photo point, weather conditions, human use, and avifauna, with a significant focus on vegetation cover. The Ecological Monitoring Report concludes with a discussion on success criteria and recommendations.

TBF coordinated with LAWA staff on the implementation of all activities as part of this agreement. The Coastal Development Permit (No. 5-12-263) and associated LAX Coastal Dunes Improvement Project (CDIP) Ecological Landscape Plan served as key guiding documents (KMA 2013). Photographs, maps, and figures in this report should be credited to The Bay Foundation (TBF) unless otherwise documented.

Environmentally Sensitive Habitat Area (ESHA)

The entirety of the LAX Dunes is approximately 302 acres. It is physically divided into two areas by Sandpiper Street and perimeter fencing. The area north of Sandpiper is approximately 48 acres; the area south of Sandpiper is approximately 250 acres in total, with 203 acres of the southern area dedicated as an El Segundo Blue Butterfly Preserve. All previous restoration efforts within the LAX Dunes have occurred in this southern area, except for a 2.4-acre strip of land along the northern boundary of the property. The southern area also contains a navigation equipment site on approximately five acres, which is maintained and operated by the airport with access from Pershing Drive, and an approximately 2-acre public park (Vista del Mar Park) off of Vista del Mar.

As early as 1973, the LAX Dunes were identified in the City of Los Angeles General Plan as an ecologically sensitive area (City of Los Angeles 1973). In 1976, the endemic El Segundo Blue Butterfly was listed as federally endangered, and the LAX Dunes became protected by the U.S. Fish and Wildlife Service under the Endangered Species Act (USFWS 1998). The approximately 48-acre area located north of Sandpiper had not previously experienced any significant restoration efforts since the time all residences were removed in the 1970's under CDP No. P-1-20-75-4657. The northern area is fenced along the entire perimeter, except along the northern portion of the property where the fence is set back approximately 50 feet from the adjacent streets. The 48-acre area previously contained the old streets, some residential foundations, building pads, above and below ground utilities, and non-native landscaping.

Although significantly altered in the past by residential and other types of development, the dunes continue to support a wide variety of native dune flora and fauna. The entire 302-acre LAX Dunes system is considered an Environmentally Sensitive Habitat Area (ESHA). Section 30107.5 of the Coastal Act defines ESHA as: "…any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments." The Coastal Act requires in Section 30240 that such areas be protected against disruption of these habitat values and the development in adjacent areas be compatible with the continuance of such areas.

The LAX Dunes ecosystem also provides habitat for the El Segundo Blue Butterfly, a federally listed endangered species endemic to the LAX Dunes, and other rare species of insects, reptiles, mammals, and plants that are endemic, rare, or of limited distribution. According to the El Segundo Blue Butterfly (ESB) Recovery Plan (approved and published by the U.S. Fish and Wildlife Service in 1998) the LAX Dunes supports a number of unique species, including: Lange's El Segundo Dune Weevil, Dorothy's El Segundo Dune Weevil, Belkin's Dune Tabanid Fly, Henne's Eucosman Moth, Busck's Gall Moth, and the Coastal Little Pocket Mouse. LAWA maintains an approximately 200-acre El Segundo Blue Butterfly preserve adjacent to the project site and south of Sandpiper Street. LAWA continues to maintain the preserve and employs landscape personnel to eradicate non-native vegetation.

Coastal Dunes Improvement Project (CDIP)

The LAX Coastal Dunes Improvement Project (CDIP) originated with the LAX Master Plan Stipulated Settlement Agreement, dated 16 February 2006, which required LAWA to improve the visual appearance of the former residential subdivision located in the northern portion of the LAX Dunes area west of Los Angeles International Airport. To perform the work required by the LAX Master Plan Stipulated Settlement Agreement, LAWA obtained CDP No. 5-12-263 from the California Coastal Commission in 2013.

Following the approval of the CDP in 2013, LAWA began efforts to remove approximately 32,000 square feet of hardscape within the 6-acre CDIP area, which included abandoned streets, curbs, gutters, sidewalks, retaining walls, foundations, and above-ground utilities from an old residential lot. The hardscape areas were replaced with graded soil, resulting in permeable areas for seeding of native plants to restore natural dune habitat areas.

LAWA staff continues to perform basic litter removal, landscaping, and non-native species removal in the CDIP area through a mix of services provided by LAWA's Maintenance Services Division (MSD) and partnerships with The Bay Foundation (TBF) and the Friends of the LAX Dunes (FOLD) that host volunteer restoration events (Figure 1).

Restoration Success Criteria

The requirement of the restoration program, according to the Ecological Landscape Plan as part of CDP No. 5-12-263 was to restore a stabilized coastal dune system vegetated with plants characteristic of Southern Foredunes and Southern Dune Scrub habitats as well as Coastal Prairie habitats described by Robert F. Holland (1986) (KMA 2013). Following the removal of hardscape features, at least 80% of the CDIP area was required to be seeded or planted with native vegetation.

As part of the CDP, the vegetation survey report completed after the fifth post-implementation year should evaluate the success of the restoration effort in achieving the final success criteria and overall goals of the restoration program. This Ecological Monitoring Report provides monitoring results following five years post-restoration and includes a summary of habitat maintenance activities that have occurred since the initial project implementation in 2013. The Scientific Monitoring section of this report details methods used to assess five-year post-restoration vegetation cover and includes a discussion of performance criteria and recommendations.

Final performance criteria focus on native and non-native vegetation cover within the CDIP restored area (Table 1, Figure 2). The performance standard as detailed in the Ecological Landscape Plan specifies that after the fifth year, the relative native vegetation cover shall be greater than 50% (KMA 2013). Additionally, the restoration site must exhibit resistance to invasion by non-native species.

If the final performance criteria are met, a statement regarding completion of the restoration effort shall be included. The California Coastal Commission will have ultimate authority to approve completion of the restoration effort. After notification of completion, a site visit(s) may be conducted by resource agency personnel, the project restoration biologist and representatives from LAWA and other interested federal, state, and local regulating agencies to confirm the completion of the restoration effort.

Table 1. Summary of CDIP restoration performance criteria by CCC and KMA 2013.

Performance Criteria	Cover Metric
Required project area to be planted with native vegetation	≥ 80%
Relative native vegetation cover	> 50%
Resistance to non-native vegetation invasion	N/A

Figure 1. LAX Dunes restoration event (1 April 2017, credit: Rod Abbott, TBF).

Figure 2. Site map of 6-acre LAX Coastal Dunes Improvement Project (green mapped areas).

Restoration Activities

Introduction

The CDIP restoration area is located within an ESHA and adjacent to the El Segundo Butterfly Preserve. Restoration activities were designed to remove hardscape features and restore the area's natural dune habitats. TBF compiled and analyzed available data associated with restoration efforts conducted by LAWA, TBF, and any additional contractors, since the approval of the CDP and commencement of work related to the CDIP in June 2013. Restoration efforts included the removal of hard infrastructure, invasive vegetation management, and installation of native dune species in accordance with CDP No. 5-12-263 and the Ecological Landscape Plan (KMA 2013). Existing project related documents, LAWA maintenance logs, and documentation of community restoration events served as resources to compile prior restoration efforts. Documentation of restoration efforts included, but are not limited to, the monitoring metrics listed in Table 2. This section detailing restoration efforts is subdivided into efforts by LAWA and their contractors, and community restoration efforts led by TBF, Friends of the LAX Dunes (FOLD), and their partners.

Table 2. Restoration activity monitoring summary table (Note: asterisk indicates a monitoring metric that was used to track restoration activities beginning November 2017).

Restoration Activity	Monitoring Metric
Non-native vegetation removal (LAWA)	Available maintenance logs and records
Non-native vegetation removal (TBF)	# of bags and species of invasive vegetation removed # of invasive trees and species removed * # of participants # of volunteer hours # of events Area invasive vegetation removed *
Native seed collection + planting (LAWA)	Available maintenance logs and records
Native seed collection + planting (TBF)	Seed weight and species * Area seeded/planted * Area seed collected *
Hard infrastructure removal (LAWA)	Available LAWA documentation

LAWA and Contractors

Initial restoration efforts included the removal of six paved streets, including gutters, sidewalks, retaining walls, foundations, and above-ground utilities, followed by revegetation through seeding and planting. LAWA began restoration efforts in June 2013 following the issuance of the CDP along with the approved Ecological Landscape Plan (KMA 2013). Detailed engineering plans to remove hardscape were prepared by AECOM and approved prior to implementation (AECOM 2013).

TBF compiled observations and records in the form of maintenance logs and communication with LAWA staff to summarize initial restoration efforts and post-restoration habitat maintenance conducted by LAWA's Maintenance Services Division (MSD).

LAWA and contractors removed the following hardscape as part of initial restoration efforts:

- Napolean Street west of Earldom Avenue (a narrow 10-foot wide maintenance access path remaining to service existing FAA infrastructure in the area);
- Gillis Street west of Rindge Avenue;
- Palace Street west of Ringe Avenue;
- Sterry Street west of Rindge Avenue;
- Bolt Street west of Ringe Avenue;
- Rindge Avenue south of Napoleon Street and north of Sterry Street (10' wide dirt/decomposed granite service access path maintained between Sterry and fenceline);
- Selected retaining walls and foundations; and
- Pope Avenue (between Napoleon Steet and Waterview Street).

Following the removal of hardscape, the restoration area was stabilized with fiber rolls and revegetated using both native seed and container stock (Figure 3). Habitat maintenance has included non-native vegetation removal and management through LAWA MSD staff (Figure 4), and monthly volunter restoration events led by TBF and FOLD. Figures 5, 6, and 7 show the aerial view progression of the site from pre-restoration, to immediately following restoration, to current day, respectively.

Figure 3. LAWA staff and volunteers planting native vegetation container stock (September 2013; credit: LAWA).

Figure 4. LAWA and TBF staff attend habitat management training on 27 March 2018 (credit: TBF).

Figure 5. Aerial imagery of site prior to initial restoration efforts (April 2013) (Source: Google Earth).

Figure 6. Aerial imagery of site following initial restoration efforts (December 2013) (Source: Google Earth).

Figure 7. Aerial imagery of present day (December 2017) (Source: Google Earth).

Following the removal of hardscape structures, LAWA and contractors conducted more than 100 restoration activities focused on non-native vegetation removal, seed collection and broadcasting, container stock planting, and erosion control. Table 3 summarizes the number of LAWA staff and LAWA contractor restoration events based on activity that have occurred since the hardscape removal in 2013. Appendix A includes additional details on restoration activities that have taken place since 2013 based on available maintenance logs and records, including targeted non-native species removed during specific events, number of staff, restoration activity, etc.

Table 3. Summary of LAWA and LAWA contractor restoration activities.

Activity	Number of Events
Non-native weed removal	91
Seed collection	2
Habitat management training	2
Erosion control	2
Management planning / field visits	2
Hardscape removal / sign installation	2

Non-native weed removal efforts by LAWA staff and LAWA contractors primarily employ manual removal of vegetation and occasional herbicide applications to larger non-native iceplant (*Carpobrotus edulis*) sites. Table 3 only lists restoration activities conducted by LAWA staff and LAWA contractors, the following subsection summarizes the additional effort conducted through partners including TBF, FOLD, their partners, and other volunteer-based events.

TBF, FOLD, and Partners

In 2013, during the time the CDIP restoration was being permitted and designed, LAWA developed and managed an “Adopt-a-Dune” Program, which provided opportunities for organizations and their members to provide active stewardship and learn about the LAX Dunes. The following year, LAWA co-founded an organization dedicated to stewardship and community involvement at the dunes, Friends of the LAX Dunes (FOLD), with 15-year-old Girl Scout Gold Award recipient, Ayanna Neal. TBF was an active participant in stakeholder events and through scientific advising. In 2015, TBF staff joined the FOLD advisory board and volunteered to help organize and lead scheduled monthly and special events. In 2016, TBF received a 3-year California State Coastal Conservancy Explore the Coast (ETC) Grant to broaden outreach to diverse and underserved communities, with a special emphasis on elementary and high school aged youth and college students. Volunteers as part of TBF-led events learn about the site’s historical, cultural, and environmental importance, and come to understand the dunes as part of a living shoreline, while also participating in restoration activities (Figure 8). In March 2018, Airports Council International (ACI) recognized the FOLD program with ACI's 2018 Environmental Achievement Award, Innovative and Special Projects category for "recognizing outstanding leadership and contributions in the airport industry for environmental protection and preservation".

Figure 8. Photograph of restoration event in the CDIP area.

TBF and FOLD have formed a strong partnership with LAWA to lead monthly volunteer restoration events at the LAX Dunes and to coordinate additional special events for groups and schools as needed. This large volunteer effort, combined with LAWA's staff time, has contributed greatly to the post-restoration habitat maintenance of the CDIP area. TBF also tracked specific metrics associated with these maintenance activities. Since 2013, an estimated 84 TBF-led (or partner-led) restoration events to remove non-native vegetation have occurred on-site with over 2,000 participants committing more than 6,000 volunteer hours and removing over 2,500 bags of non-native vegetation (Table 4). Appendix A provides additional details on each restoration activity.

TBF targets non-native, invasive species to be removed for each event based on seasonality, seed propagation of each species, an evaluation of which non-natives may be problematic or have the potential to spread and impact natives, and an analysis of scientific monitoring data. A variety of species have been targeted over the years, including common non-natives such as mustards (*Brassica* spp.), broad leaf filaree (*Erodium botrys*), Russian thistle (*Salsola tragus*), and others (Table 5).

Table 4. Summary of volunteer-based restoration activities by year led by TBF or partners.

Year	Number of Events	Number of Participants	Number of Volunteer Hours	Number of Bags of Non-native Vegetation Removed
2013	6	n/a	n/a	n/a – seed collection efforts
2014	8	181	543	263
2015	24	346	1,038	488
2016	13	476	1,428	695
2017	22	557	1,741	730
2018	11	478	1,434	337
Totals	**84**	**2,038**	**6,184**	**2,512**

Table 5. Examples of targeted non-native vegetation species during LAX Dunes restoration events.

Common Name	Scientific Name
iceplant	*Carpobrotus edulis*
black mustard	*Brassica nigra*
Saharan mustard	*Brassica tournefortii*
short pod mustard	*Hirschfeldia incana*
Russian thistle	*Salsola tragus*
Geraldton carnation weed	*Euphorbia terracina*
wild radish	*Raphanus sativus*
castor bean	*Ricinus communis*
broad leaf filaree	*Erodium botrys*
foxtail brome	*Bromus madritensis*
ripgut brome	*Bromus diandrus*
wild oat	*Avena fatua*
acacia	*Acacia cyclops, Acacia retinoides*

Notable groups that have participated in restoration events have included schools, organizations, local businesses, and other participants (Figures 9 and 10). Once TBF began helping FOLD and LAWA coordinate events in 2015, volunteer-led restoration activities began to have a substantial level of volunteer participation across the subsequent years. Through the ETC grant, students and youth have increasingly participated in LAX Dunes restoration events with a majority of the participants as K-12 students (approximately 75% of students) and the other 25% as college and university level students. Over 70% of students surveyed came from disadvantaged or severely disadvantaged communities (Figure 11). In addition to regularly scheduled monthly events, the LAX Dunes has been a designated site for the popular international Coastal Cleanup Day and "Big Sunday" volunteer events (2015-2017). TBF and LAWA would like to thank the following groups for their dedication and participation over the years:

Schools and Universities: Marymount High School, Torrance High School, John C Freeman High School, California Academy of Mathematics and Science (CAMS) Key Club, Crossroads Middle School, Rise Kohyang Middle School, Loyola Marymount University (LMU), including LMU's Engineers without Borders and Coastal Research Institute internship students, Montessori Academy, Lincoln Middle School, California State University Los Angeles – Alpha Phi Omega and Alpha Sigma Tau, University of California Los Angeles, Girls Athletic Leadership School (GALS), Immaculate Heart High School and Middle School, Franklin Elementary, Kentwood School, and "Grades of Green's" Youth Corps Eco Leadership Program

Businesses: Patagonia (Santa Monica and others), Moss Adams LLP, AT&T, Verizon, DirecTV, Raytheon, Apple Store (Glendale), and Google

Organizations and Other Groups: California Native Plant Society, Los Angeles Audubon Society, Watts/Willowbrook Boys & Girls Club, Boy Scouts of America, Girl Scouts of America, LA Neighborhood

Land Trust, Delaware North, Los Angeles World Airport (LAWA) employees, The Bay Foundation (TBF) employees, Heal the Bay, and Friends of the LAX Dunes

Figure 9. Photograph of LAX Dunes restoration event on 8 June 2018 (credit: TBF).

Figure 10. Big Sunday restoration event on 2 May 2015.

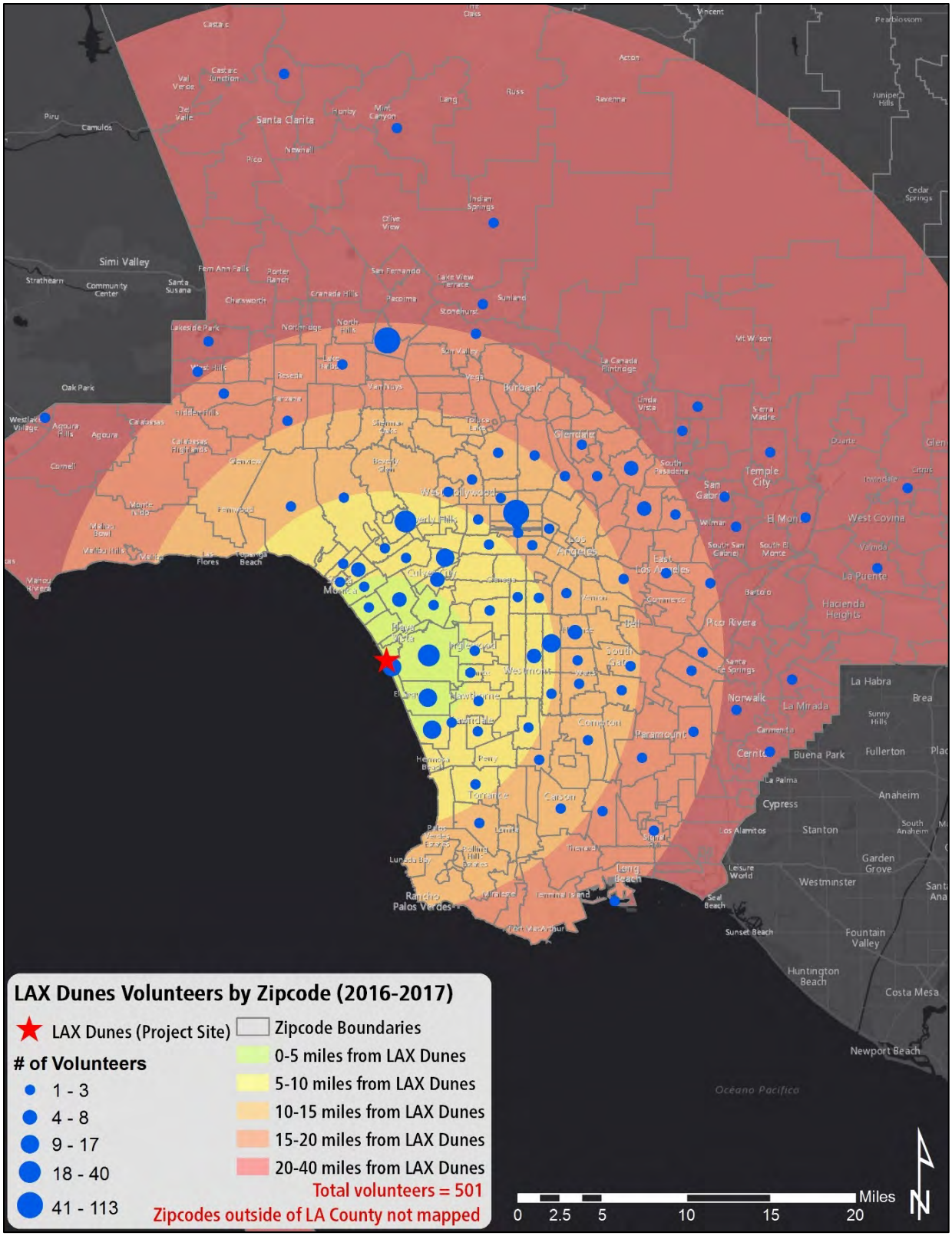

Figure 11. LAX Dunes volunteers by zip code and distance from project site (replicated from: TBF 2017).

Scientific Monitoring

Introduction

Accurate and robust scientific monitoring are a vital part of any restoration project. Rigorous scientific monitoring protocols allow for the evaluation of completed restoration activities on site. Post-restoration data were compared to available baseline monitoring data and allowed for a scientific evaluation of the successes and challenges of restoration efforts. The removal of non-native, invasive vegetation was ongoing; therefore, additional post-restoration monitoring is recommended at a specified frequency appropriate to monitor progress depending on the indicator and protocol (details in Table 6 and below). Post-restoration data contribute meaningful information towards adaptively implementing re-vegetation activities and focusing invasive plant removal efforts in target locations within the site. Table 6 summarizes descriptions of monitoring protocols implemented during this project and their minimum frequency of occurrence. Protocols are discussed in detail below.

Table 6. Description of monitoring protocols and their minimum frequency of occurrence.

Parameter	Indicators	Protocol	Frequency
Photo Point	Visual qualitative change assessment	TBF SOP 7.2	Quarterly
Vegetation Cover	Percent cover, species composition, native and non-native relative cover	TBF SOP 3.2 – line-intercept and cover class; TBF SOP 3.5 - GPS/GIS vegetation mapping	Quarterly
Weather Conditions	Precipitation data, air temperature, wind speed	Compile and analyze data from existing weather stations in vicinity	Historical analysis (2013 to present) and Quarterly
Human Use	Vandalism, vehicle damage	Checklist and observations	Per site visit
Avifauna + Invertebrates	Presence; key sensitive species	Visual presence and behavior; professional ornithologist and entomologist	As needed for pre-restoration activities

Methods

Each of the following subsections summarize each individual protocol implemented as part of the monitoring component of this restoration project. For in-depth details on objectives, equipment, field preparation, field methods, quality control check procedures, and datasheets, refer to the individual Standard Operation Procedures listed within the California Estuarine Wetland Monitoring Manual.

Photo Point

Photo point monitoring occured to identify seasonal site changes and project-level changes resulting from restoration activities (e.g., native vegetation growth). For example, “before” and “after” geotagged photographs were taken at each restoration event and as associated with fixed transect location start

and end points. The application of photo point survey protocols yields qualitative data displayed as photographic site images over time and provides a visual tool to aid in the discussion of the vegetation cover data. Survey methods are described in detail in SOP 7.2 Level 2 Photo Point (TBF 2015a).

Vegetation Cover

Vegetation cover surveys are used to provide a wide range of information and data, including summarizing the prevalence of native and non-native plant cover, determining species cover, and relative species richness and diversity. The primary objective of the transect- and quadrat-level cover surveys for this project was to quantify the relative cover of native dune species and identify non-native invasive species present on site, including an assessment against the CDP success criteria requirements. Permanent and repeatable transects, each 25-meters in length, were established within the six-acre restoration focus area and within the larger 48-acre northern dune footprint (Figure 12). Transect start points and survey direction were both randomly allocated using ArcGIS in a stratified random sampling method design. Vegetation surveys outside the six-acre restoration area will provide comparative data and a more robust analysis of site wide vegetation cover for future reports.

The transect survey methods are described, along with field data sheets, in SOP 3.2 Vegetation Cover Surveys (TBF 2015b). Line-intercept transects document every species observed directly below the transect tape where vegetation crosses a minimum of 0.01 m (or 1 cm). This transect survey method is useful when collecting vegetation cover data in patchy habitats such as dunes or those with a significant amount of unvegetated ground (e.g., sand). Cover class quadrat surveys were conducted to supplement the line-intercept data and provide another level of cover assessment using 1 m^2 PVC quadrats subdivided into 16 sub-quadrats. Nine transects were surveyed in the CDIP restoration area, with an additional 11 "control" transects. Five fixed-location quadrats were surveyed along each transect. Vegetation surveys were conducted on 12, 18, and 26 January; and 9, 12, 16, and 23 February 2018. The nine vegetation transects were resurveyed on 12 June 2018 to assess the effectiveness of restoration efforts within the CDIP area over the four-month period as well as to provide an estimate of seasonal changes (Figure 13). Cover estimate results are provided for both sets of surveys for comparison.

Line-intercept data were summed by species and divided by the total length of transect to determine percent cover for 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 (TBF 2015b). Average cover estimates and standard error were calculated at the transect and CDIP-level with summaries displayed in tables and figures in the results section for vegetation cover.

Figure 12. Map of vegetation monitoring transect locations.

Figure 13. Vegetation cover survey conducted on 12 June 2018.

Vegetation Mapping

The application of the vegetation mapping survey protocol yielded both qualitative and quantitative data displayed as vegetation by species cover and dominant vegetation species polygons for the restoration area (TBF 2015c). Additionally, prior vegetation mapping products from other surveyors were incorporated into analyses, when available. 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 more detail in SOP 3.5 Vegetation Mapping (TBF 2015c). This protocol outlines a synthesized vegetation stand delineation strategy based on a combination of aerial imagery, office digitization (using ArcGIS platform), and in situ field verification. This method used a high-resolution Trimble GPS unit and ArcGIS software to produce detailed, geospatially rectified vegetation maps, allowing for an analysis of vegetation alliance and association coverage. The products produced through the implementation of the GIS mapping protocol facilitated restoration activities and adaptive management of the site. Vegetation mapping was conducted on 8 and 12 June 2018.

Weather Conditions

Monitoring included an analysis of weather conditions in the general region of the project site from 1 January 2013 to 31 May 2018. Weather, particularly precipitation, can affect both native and non-native plant growth during restoration activities. Weather parameters analyzed included precipitation, air temperature, and wind speed data obtained from the closest available weather station (Table 7) included as part of the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC). Additional information was noted on significant weather events for the duration of the monitoring period (1 January 2013 to 31 May 2018). Data were downloaded on 5 June 2018.

Table 7. NOAA weather station details (data were downloaded on 5 June 2018).

Station Name	Los Angeles International Airport, CA US
Station ID	GHCND:USW00023174
Lat/Long	33.938, -118.3888
Data Range Analyzed	2013-01 01 to 2018-05-31
Coverage	99%

Human Use

The restoration area is generally restricted to human use, except for maintenance staff and TBF-led community or group restoration events. However, TBF recorded and reported to LAWA any observations of trespassing, vandalism, and/or vehicle damage in the area. Additionally, restoration efforts were recorded and tracked in a separate subsection of this report ("Restoration Activities").

Avifauna, Insects, and Additional Wildlife

Avifauna (birds) and invertebrates (insects) would have been surveyed for presence of sensitive species or nesting individuals before the large-scale removal of any significant patches of vegetation; however, no significant large-scale tree or shrub removal took place between November 2017 and the time of writing of this report (June 2018) in the CDIP area. One site check / ornithological survey occurred on 8 June 2018, and data are reported as a species list.

Additionally, monitoring notes on wildlife presence and behavior were noted during restoration or monitoring events, with photographs taken, when possible. Data were reported as a species list of additional wildlife visually identified but should not be evaluated as an exhaustive list of species present on site. Instead, the list can be interpreted as common species frequently identified during monitoring or restoration events. Lastly, El Segundo Blue Butterfly (*Euphilotes battoides allyni*) and other flying invertebrate surveys were planned beginning in mid-June 2018, and results of those surveys will be shared in future reports.

Results

Overarching summary results are presented below, with a more in depth analysis compared against restoration success criteria in subsequent sections. Restoration events led by TBF were highly successful over the years, with over 2,000 participants in 84 events. Monitoring data suggest the CDIP restoration area contains predominantly native vegetation and unvegetated sand (normal for dune habitats), with ongoing efforts continuing for removal of non-native and invasive vegetation. Wildlife indicators suggest ecological habitat support for several notable species including Blainville's horned lizard (*Phrynosoma blainvillii*) and Southern California legless lizard (*Anniella stebbinsi*), among others. Weather conditions were predominantly drought-driven, with an El Niño event that occurred over the 2016-2017 rainy season.

Photo Point

Photo Point data are qualitative representations of restoration activities and the dune habitats in general. Figures 14 through 17 display "before" and "after" representative photographs from four restoration areas. Figure 16 is a particularly good example of resilience in the dune system; the last photograph in the series was taken more than a year after a restoration event took place (6 May 2017) and shows only minor non-native invasion (12 June 2018). Figure 17 shows another example of a TBF led restoration event removing Saharan mustard and filaree, which if left unchecked could grow, seed, and threaten native plants such as deerweed, beach evening primrose, and beach bur. Figure 18 displays a representative series of photographs from an established vegetation monitoring transect.

Figure 14. TBF staff cleared non-native mustards on and near areas of restoration on 17 February 2015 (credit: Rod Abbott, TBF).

Figure 15. Volunteers remove non-native vegetation in and around plants such as the deerweed on 1 April 2017 (credit: Rod Abbott, TBF).

Figure 16. UCLA students removed 80 bags of invasive Terracina spurge encroaching on beach blue lupine on 6 May 2017 (credit: Rod Abbott, TBF).

Figure 17. Volunteers removed juvenile Saharan mustard and filaree around deerweed, beach evening primrose, and beach bur on 24 February 2018 (credit: Rod Abbott, TBF).

Figure 18. TBF interns cleared mustards, Terracina spurge, and grasses on 15 May 2018 (credit: Rod Abbott, TBF).

Vegetation Cover

Tables 8 and 9 display the summary results data for both types of surveys and both time periods of surveys (i.e., late winter / early spring and early summer). The most common native vegetation species from the transect-level data was deerweed (*Acmispon glaber*) followed by beach evening primrose (*Camissoniopsis cheiranthaifolia*) and beach blue lupine (*Lupinus chamissonis*) (Figures 19-20). Additional native vegetation species found throughout the restoration area included California croton (*Croton californicus*), beach bur (*Ambrosia chamissonis*), telegraph weed (*Heterotheca grandiflora*), and Jimsonweed (*Datura wrightii*) (Figures 21-22). Additional native vegetation species that were present but less common included (but are not limited to) sea cliff buckwheat (*Eriogonum parvifolium*) and bladderpod (*Peritoma arborea*), among others (Figure 23). The most common non-native vegetation species from the transect-level data was broad leaf filaree (*Erodium botrys,* Figure 24). The average relative native plant cover in the January and February surveys was 58.2% ± 9.0 and 43.9% ± 8.3 on the line-intercept and quadrat cover class surveys, respectively. The average total absolute non-native plant cover in the January and February surveys was 17.4% ± 4.4 and 19.1% ± 4.9 on the line-intercept and quadrat cover class surveys, respectively. The average total absolute non-native grass cover remained low on both surveys, at 3.3% ± 6.2 and 6.2% ± 1.9.

In summary, the June surveys had higher native plant cover than the late winter / early spring surveys and lower non-native plant cover. The average relative native plant cover in the June surveys was 92.4% ± 3.3 and 65.3% ± 9.4 on the line-intercept and quadrat cover class surveys, respectively. The significant discrepancy between the two assessment methods can be attributed to one transect that by chance did not pick up native vegetation cover using the quadrat method though it was present in the area, and thus, likely underrepresented the actual cover of native vegetation considerably. The average total absolute non-native plant cover in the June surveys was very low at 2.3% ± 1.3 and 3.2% ± 1.2 on the line-intercept and quadrat cover class surveys, respectively. The average total absolute non-native grass cover remained extremely low on both surveys, at 0.4% ± 0.2 and 2.0% ± 0.9. For a full plant list of species found on the transect-level surveys, see Appendix B.

Results of the cover analyses are likely conservative estimates for relative native plant cover based on the assessment methods; thus, the assessments were also analyzed for 'live only' plant cover, which removed the data points for dead vegetation. When data were evaluated for live cover only across both survey methods and both survey times, the relative native cover increased (Table 8).

Results for the most recent set of analyses (i.e., early summer, June surveys) and both cover estimate methods (i.e., line-intercept and cover class transects) show that the vegetation cover data are currently meeting the relative native vegetation cover success criteria (> 50% relative native cover) for CDP No. 5-12-263. Additional information is provided in Table 8 and Table 9 on the average absolute native, non-native, unvegetated, and non-native grass cover to supplement the understanding of the vegetation community. Additional information can also be found in the mapping results subsection of this report.

Table 8. Average relative cover, absolute cover, and standard error for all native and non-native vegetation (dead plants included in analyses).

	Jan/Feb Line-Intercept Data (all)	Jan/Feb Quadrat Data (all)	June Line-Intercept Data (all)	June Quadrat Data (all)
Average Relative Native % Cover	58.2%	43.9%	92.4%	65.3%
Standard Error (Native)	9.0%	8.3%	3.3%	9.4%
Average Absolute Native % Cover	21.7%	17.7%	23.0%	20.0%
Standard Error (Native)	3.2%	3.5%	2.9%	3.5%
Average Absolute Non-Native % Cover	17.4%	19.1%	2.3%	3.2%
Standard Error (Non-Native)	4.4%	4.9%	1.3%	1.2%
Average Absolute Unvegetated Sand % Cover	51.9%	44.9%	69.1%	65.8%
Standard Error (Sand)	2.2%	4.5%	4.1%	5.2%
Average Absolute Non-Native Grass % Cover	3.3%	6.2%	0.4%	2.0%
Standard Error (Non-Native Grass)	0.7%	1.9%	0.2%	0.9%

Table 9. Average relative cover, total cover, and standard error for live native and non-native vegetation.

	Jan/Feb Line-Intercept Data (live only)	Jan/Feb Quadrat Data (live only)	June Line-Intercept Data (live only)	June Quadrat Data (live only)
Average Relative Native % Cover	62.5%	44.0%	98.9%	67.1%
Standard Error (Native)	8.8%	10.5%	0.6%	9.6%
Average Absolute Native % Cover	21.5%	15.2%	22.6%	18.1%
Standard Error (Native)	3.2%	3.2%	2.8%	3.5%
Average Absolute Non-Native % Cover	14.3%	16.1%	0.3%	0.5%
Standard Error (Non-Native)	4.2%	3.8%	0.2%	0.3%
Average Absolute Unvegetated Sand % Cover	51.9%	44.9%	69.1%	65.8%
Standard Error (Sand)	2.2%	4.5%	4.1%	5.2%
Average Absolute Non-Native Grass % Cover	3.0%	5.2%	0.0%	0.0%
Standard Error (Non-Native Grass)	0.6%	1.7%	0.0%	0.0%

Figure 19. Photographs of native deerweed (*Acmispon glaber*, left) and beach evening primrose (*Camissoniopsis cheiranthaifolia*, right) at the LAX Dunes (8 June 2018).

Figure 20. Photograph of native beach blue lupine (*Lupinus chamissonis*) at the LAX Dunes (8 June 2018).

Figure 21. Photographs of native beach bur (*Ambrosia chamissonis*, left) and California croton (*Croton californicus,* right) at the LAX Dunes (8 June 2018).

Figure 22. Photographs of native telegraph weed (*Heterotheca grandiflora*, left), and Jimsonweed (*Datura wrightii*, right) at the LAX Dunes (8 June 2018).

Figure 23. Photographs of native sea cliff buckwheat (*Eriogonum parvifolium*, left) and bladderpod (*Peritoma arborea*, right) (8 June 2018).

Figure 24. Photograph of non-native broad leaf filaree (*Erodium botrys*) at the LAX Dunes (12 June 2018; credit: Rod Abbott, TBF).

Vegetation Mapping

Vegetation mapping results obtained species level cover data throughout the entirety of the CDIP restoration area. Figure 26 displays mapping results of relative native vegetation cover within GIS polygons and Figure 25 shows quantitative acreage totals of relative native vegetation cover. Within the CDIP area, 69.5% (4.61 acres) had relative native vegetation cover higher than 50%. While 27.4% of the total CDIP area exhibited relative native vegetation cover in the 26-50% range, only a small area (0.2 acres or 3.1%) had relative native vegetation cover under 25%. This area in particular has already been targeted for subsequent restoration events. Figure 27 displays the distribution of absolute non-native vegetation cover across the mapped CDIP site.

Dominant species within each GIS polygon are displayed in Figure 28. Native species dominated approximately 85.5% of the total project area, and polygons dominated by non-native species accounted for approximately 14.6% of the total project area. Deerweed and beach evening-primrose dominated approximately 82% of the total CDIP area. Except for a small stand of non-native red-eyed wattle (*Acacia cyclops*), only 14.5% of the total CDIP area was dominated by non-native vegetation consisting of ripgut brome (*Bromus diandrus*) and filaree.

Vegetation mapping results established similar trends as the cover assessment surveys. High relative native vegetation cover dominated the majority of the CDIP restoration area, with small areas of non-native cover, particularly along the fence line separating the dunes from Vista del Mar.

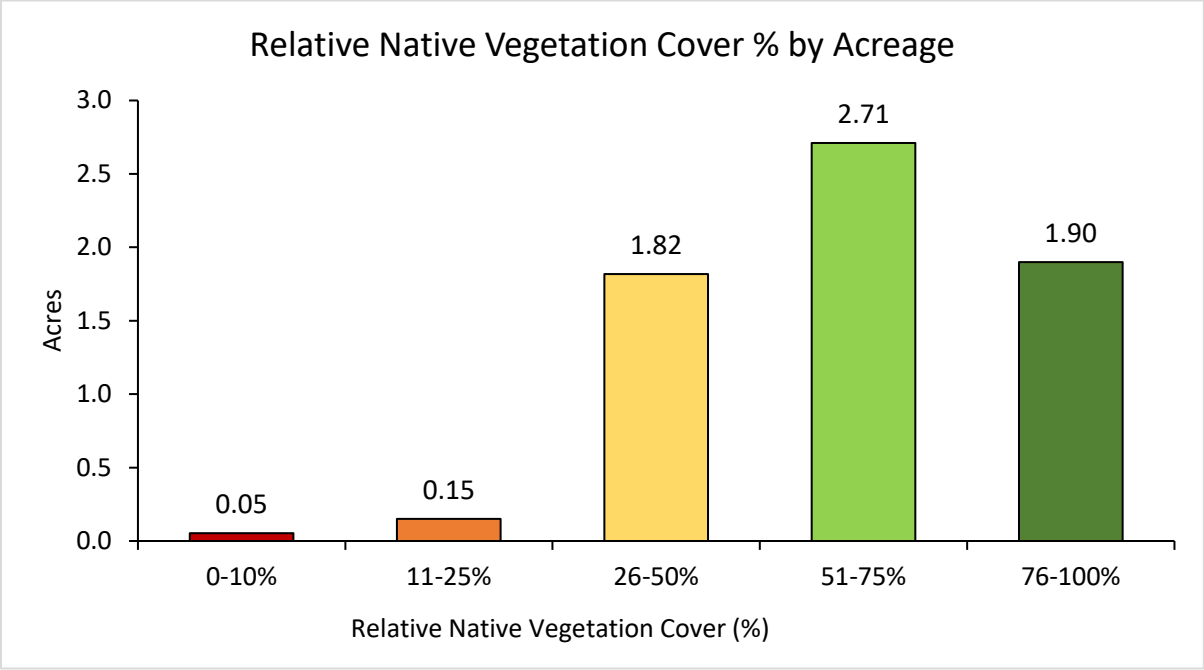

Figure 25. Relative native vegetation cover percentage by acreage. Note: bar graph labels refer to exact acreage of each percentage category.

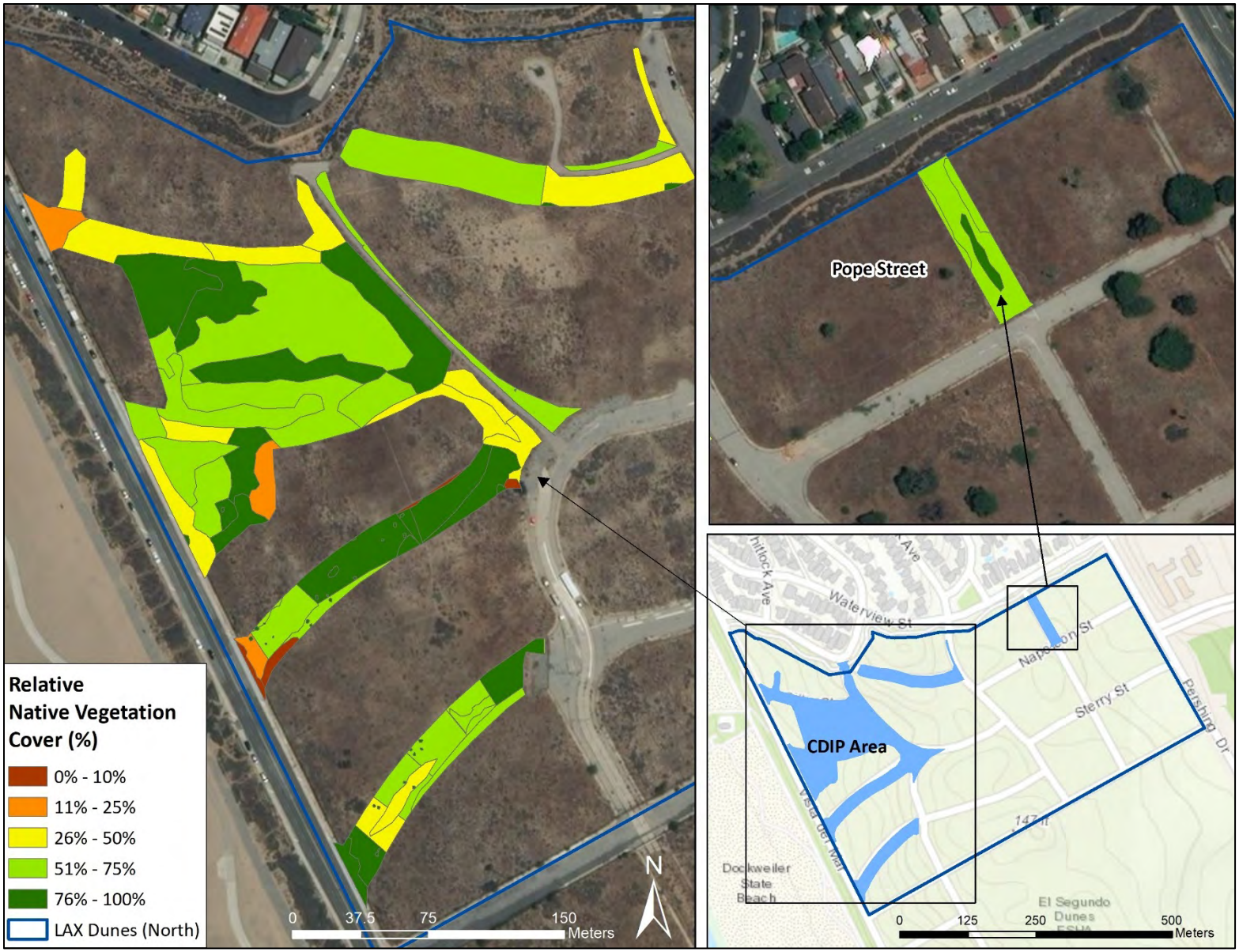

Figure 26. Relative native vegetation cover map of CDIP restoration area.

Figure 27. Absolute non-native vegetation cover map of CDIP restoration area.

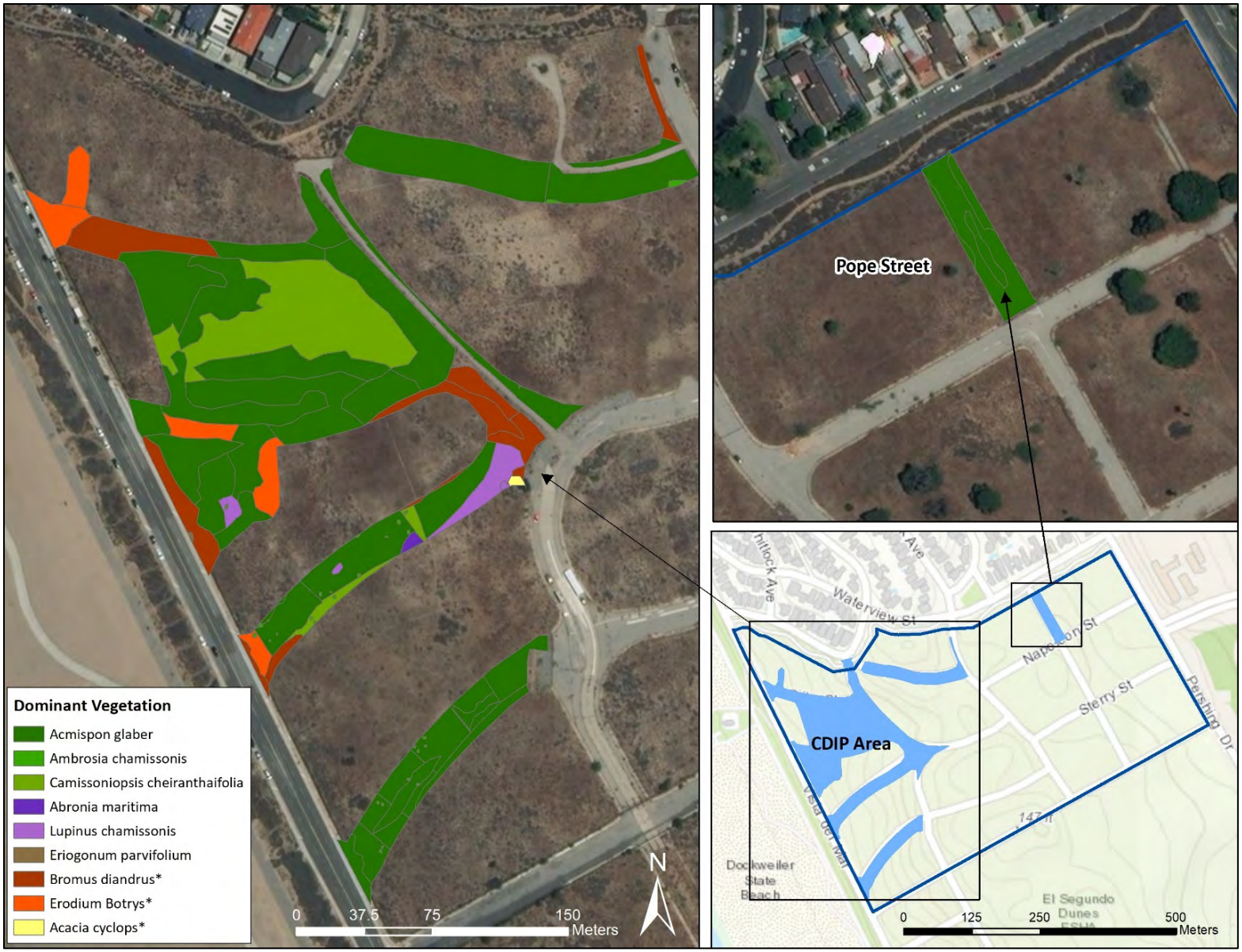

Figure 28. Dominant vegetation within CDIP area (* indicates non-native species).

Weather Conditions

Between 2013 to 2015, drought conditions were prevalent across most of Los Angeles County and southern California. El Niño conditions during the winter of 2016-2017 recorded the highest precipitation amounts following initial restoration activities in 2013, though still below 15 inches, which is the approximate "average" annual rainfall for the Los Angeles region (NOAA 2018). In January 2017, over seven inches of rain was recorded at the LAX station. Figure 29 summarizes total annual precipitation recorded at LAX, and Table 10 details monthly total precipitation (inches), average wind speed (miles per hour, mph), and air temperature (°C) parameters (i.e., average, minimum, and maximum) from January 2013 to May 2018. Note that the precipitation and wind speed units are intentionally English standard instead of metric for ease in interpretation. Inches and mph, respectively, are most commonly used by the US public.

Average wind speed showed consistent patterns over the five-year period with a range from approximately 5 mph to 10 mph. Average wind speed typically increased during the spring months, which can be attributed to the Santa Ana wind phenomenon. Average air temperature typically ranged from a monthly average of approximately 18 °C in the winter months to approximately 27 °C in the warmer summer months.

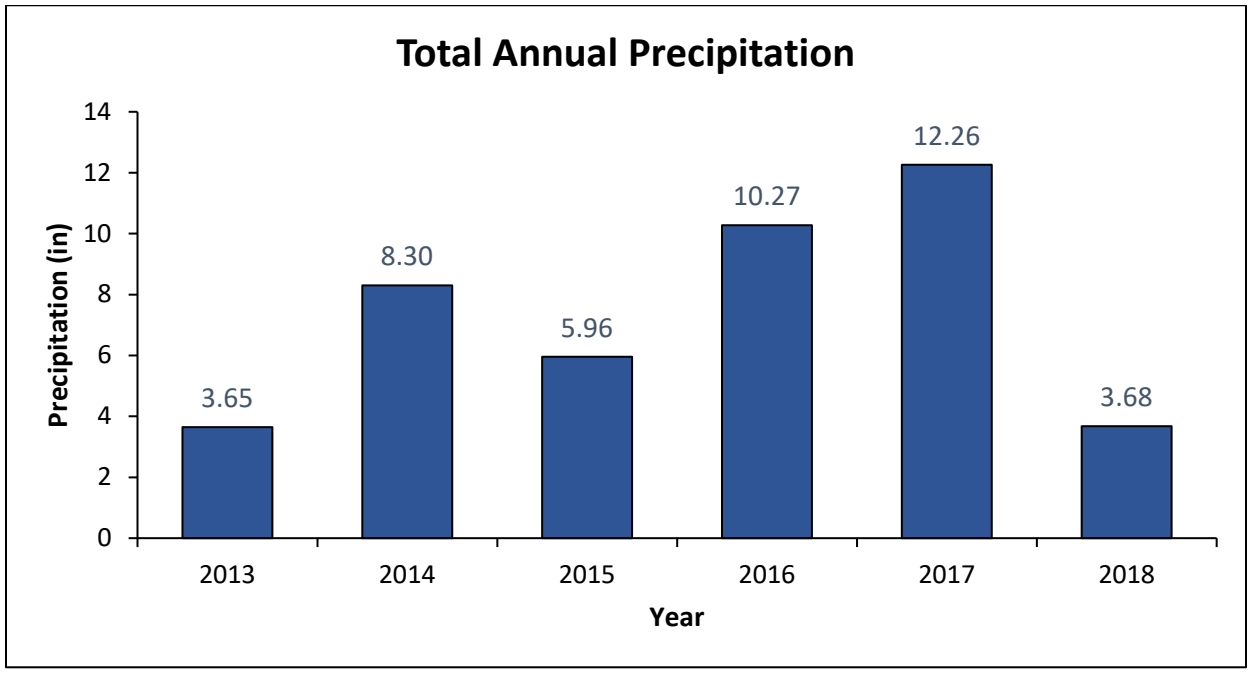

Figure 29. Total annual precipitation from January 2013 through May 2018. Note that an annual total breaks up the winter season at 31 December each year.

Table 10. Monthly precipitation and temperature from 2013-2018. Note: nd = no data available.

Year	Month	Precipitation (in)	Temperature (°C)			Wind Speed (mph)
		Total	Average	Maximum	Minimum	Average
2013	January	1.3	nd	18.7	8.5	5.7
	February	0.2	nd	18.2	8.6	6.5
	March	0.7	nd	18.5	11.7	6.6
	April	0.1	16.2	20.2	13.3	8.4
	May	0.4	18.7	22.5	15.8	7.8
	June	0.0	19.2	22.8	17.1	7.4
	July	0.0	20.0	23.3	17.8	7.3
	August	0.0	19.7	23.4	17.3	7.1
	September	0.0	20.8	24.9	17.5	6.9
	October	0.0	18.4	22.8	14.6	6.4
	November	0.7	17.2	22.4	13.2	5.5
	December	0.3	14.8	20.8	9.2	5.0
2014	January	0.0	15.9	22.0	10.6	4.6
	February	2.8	14.9	19.3	11.5	6.2
	March	0.4	16.5	20.6	13.1	7.4
	April	0.3	16.6	21.0	13.1	8.3
	May	0.0	20.0	24.8	16.3	8.2
	June	0.0	19.3	22.5	17.1	7.6
	July	0.1	21.5	25.0	19.3	8.0
	August	0.0	21.3	24.8	18.8	7.7
	September	0.0	22.2	26.0	19.5	7.2
	October	0.2	20.6	25.1	17.1	5.9
	November	0.4	18.1	23.1	13.5	5.9
	December	4.0	14.6	18.3	10.8	5.6
2015	January	1.3	15.1	20.4	10.5	4.4
	February	0.3	15.8	20.4	11.9	6.1
	March	0.5	17.6	22.9	13.2	6.3
	April	0.1	16.5	20.9	12.7	8.1
	May	0.4	15.7	19.0	13.2	8.3
	June	0.0	18.4	22.0	16.1	7.6
	July	0.4	20.7	24.1	18.5	8.1
	August	0.0	22.1	25.8	19.6	7.3
	September	1.8	23.4	27.3	20.6	6.5
	October	0.1	22.9	27.3	19.3	6.9
	November	0.1	16.9	22.3	11.3	7.0
	December	1.1	14.1	18.9	9.2	7.0
2016	January	2.9	13.9	17.8	9.9	6.0

Year	Month	Precipitation (in)	Temperature (°C)			Wind Speed (mph)
		Total	Average	Maximum	Minimum	Average
	February	0.7	16.9	23.0	11.5	5.5
	March	1.5	15.6	19.5	12.2	8.4
	April	0.3	17.1	21.5	13.5	8.2
	May	0.6	16.5	19.9	14.3	8.1
	June	0.0	19.0	22.9	16.3	7.9
	July	0.0	21.4	25.2	18.8	8.3
	August	0.0	20.8	24.5	18.4	8.3
	September	0.0	21.3	25.4	18.0	7.8
	October	0.4	19.6	24.2	16.1	7.1
	November	1.1	17.8	23.6	12.9	6.2
	December	2.8	14.4	18.8	10.3	7.0
2017	January	7.4	13.1	17.1	9.3	7.2
	February	4.0	13.7	17.0	11.0	7.2
	March	0.1	15.6	20.7	11.6	7.7
	April	0.4	17.0	22.2	13.0	9.0
	May	0.1	16.9	20.8	14.0	8.6
	June	0.0	18.7	22.5	16.0	7.9
	July	0.0	21.4	25.3	18.8	8.0
	August	0.0	21.5	25.2	19.3	8.1
	September	0.1	21.5	25.8	18.1	8.0
	October	0.0	21.3	26.9	17.0	6.6
	November	0.1	18.3	23.2	14.1	6.4
	December	0.0	16.1	22.5	10.2	5.0
2018	January	1.4	16.2	21.8	11.4	5.7
	February	0.1	14.4	19.6	9.7	7.2
	March	2.1	14.5	18.5	11.1	8.0
	April	0.1	16.1	20.6	12.7	8.6
	May	0.1	16.8	20.2	14.2	8.5

Human Use

Throughout the monitoring time period and during restoration events over the last five years, TBF has tracked human use of the site and provided notices to LAWA most frequently via phone calls from the field to notify LAWA of any unpermitted use of the northern 48-acre dune area. In summary, several people experiencing homelessness created encampments between the fence line of the northern 48-acre dune area and the southern LAX Dune Preserve, but on only one instance (8 June 2018) with one individual man was there any illegal trespassing recorded within the fenced off 48-acre site. LAWA security was immediately notified and responded accordingly. All other human use tracked by TBF was

either LAWA staff, approved contractors, or partners (e.g., TBF, FOLD) conducting restoration or monitoring work. No vehicle damage or vandalism was recorded by TBF.

Additionally, residents and visitors frequently jog, walk, and bike along the public path on Waterview Street adjacent to and outside of the fenced restoration area. This path continues to be used frequently and is maintained by LAWA staff.

Monthly and additional opportunistic community hand-restoration events continue to occur through the time of writing of this report and will continue at a minimum of monthly through the remainder of 2018. For additional information on community participation in restoration events, their frequency, and targeted non-native vegetation, please refer to Appendix A.

Avifauna, Insects, and Additional Wildlife

Monitoring notes and presence of avifauna, wildlife, and notable invertebrates were recorded and photographed, when possible, during restoration events and scientific monitoring days. One site check and ornithological survey occurred on 8 June 2018, and data are reported as a species list in Table 11. Four horned larks were identified on this survey and while they do not have a listing status as a rare species, they are important to note as they have been previously identified as extirpated from the region for breeding behavior (D. Cooper, ornithologist, pers. comm. 2018). They may represent one of the last coastal lowland breeding populations in LA County.

Additional wildlife recorded as present on at least one survey are reported in Table 12. Data were reported as a species list of wildlife visually identified but should not be evaluated as an exhaustive list of species present on site. Instead, the list can be interpreted as common species frequently identified during monitoring or restoration events. In particular, invertebrates were not surveyed using targeted methods; instead, the brief list describes some of the more visible or unusual species.

Frequently identified wildlife included herpetofauna (e.g., western fence lizard, *Sceloporus occidentalis*, and Blainville's horned lizard, *Phrynosoma blainvillii,* Figure 30), mammals (e.g., desert cottontail rabbit, *Sylvilagus audubonii*, and California ground squirrel, *Otospermophilus beecheyi*), birds (e.g., American crow, *Corvus brachyrhynchos*, and red-tailed hawk, *Buteo jamaicensis*), and invertebrates (e.g., Red harvester ant, *Pogonomyrmex barbatus*) (Table 12, Figures 31-32).

Figure 30. Photograph of Blainville's horned lizard (*Phrynosoma blainvillii*) at LAX Dunes (credit: Rod Abbott, TBF).

Table 11. Birds Identified as present on site in a survey on 8 June 2018.

Common Name	Scientific Name
Rock Pigeon (Feral Pigeon)	*Columba livia*
Eurasian Collared-Dove	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Allen's Hummingbird	*Selasphorus sasin*
American Kestrel	*Falco sparverius*
Cassin's Kingbird	*Tyrannus vociferans*
American Crow	*Corvus brachyrhynchos*
Horned Lark	*Eremophila alpestris*
Northern Mockingbird	*Mimus polyglottos*
California Towhee	*Melozone crissalis*
Hooded Oriole	*Icterus cucullatus*
House Finch	*Haemorhous mexicanus*
House Sparrow	*Passer domesticus*

Table 12. Wildlife identified as present on site during scientific monitoring or other restoration events.

	Common Name	Scientific Name	Notes
Herpetofauna	Western fence lizard	*Sceloporus occidentalis*	Very common
	Side blotched lizard	*Uta stansburiana*	----
	Blainville's horned lizard	*Phrynosoma blainvillii*	CDFW – Species of Special Concern
	Southern California legless lizard	*Anniella stebbinsi*	CDFW – Species of Special Concern; G3 Vulnerable
	San Diego gopher snake	*Pituophis catenifer annectens*	----
Mammals	Desert cottontail rabbit	*Sylvilagus audubonii*	Very common
	Black-tailed jackrabbit	*Lepus californicus*	----
	California ground squirrel	*Otospermophilus beecheyi*	Very common
	Botta's pocket gopher	*Thomomys bottae*	Indirect evidence from burrows and skeleton
	Fox (unknown species)	Family: *Canidae*	Indirect evidence from skeleton; either red fox or grey fox
Avifauna	Black phoebe	*Sayornis nigricans*	----
	Burrowing owl	*Athene cunicularia*	At least two wintering individuals
	Great egret	*Ardea alba*	----
	Great blue heron	*Ardea herodias*	----
	Red-tailed hawk	*Buteo jamaicensis*	Often perched in trees or flying overhead
Invertebrates	Red harvester ant	*Pogonomyrmex barbatus*	Favorite food of horned lizards; very common
	California common scorpion	*Paruroctonus silvestrii*	----
	Fiery skipper	*Hylephila phyleus*	----
	Cabbage white butterfly	*Pieris rapae*	----

Figure 31. Photographs of burrowing owl (*Athene cunicularia*, left) and red-tailed hawk (*Buteo jamaicensis*, right) (credit: Rod Abbott, TBF).

Figure 32. Photographs of red harvester ant (*Pogonomyrmex barbatus*, left) and fiery skipper (*Hylephila phyleus*, right) (credit: Rod Abbott, TBF).

Final Restoration Assessment

The 6-acre LAX Coastal Dunes Improvement Project (CDIP) restoration area permitted under CDP No. 5-12-263 has met the Ecological Landscape Plan success criteria for five years post-restoration. Restoration performance was evaluated through multiple scientific vegetation assessment metrics, including transects and mapping (Table 13). An assessment of relative native cover by both metrics suggests that the dune is stable, predominantly native with some seasonal variability, and supports a plethora of native wildlife and a wide variety of vegetation.

Table 13. CDIP performance criteria results.

Performance Criteria	Metric	Status
Required project area to be planted with native vegetation	≥ 80%	Met
Relative native vegetation cover	> 50%	Met
Resistance to non-native vegetation invasion	-	Conditionally Met

One of the identified success criteria suggests that the CDIP restoration area should exhibit a resistance to invasion by non-native vegetation. While complicated to assess ecologically-speaking, due to species-level variability, seasonality, and within-site patchiness, several metrics can serve to inform this type of assessment. One set of results that informs this criterion is an assessment of vegetation cover within portions of the CDIP restoration area that have undergone only minimal restoration maintenance efforts over the 5-year time span. For example, both line-intercept and quadrat cover data averaged across transects within areas that received minimal-to-no active restoration maintenance actions were still above the 50% relative native cover success criteria requirement. Line-intercept relative native vegetation cover (average ± standard error) ranged from 64.3% ± 5.1 in February 2018 to 85.6% ± 9.1 in June 2018. Similarly, quadrat relative native vegetation cover (average ± standard error) ranged from 50.4% ± 4.0 in February 2018 to 78.1% ± 8.7 in June 2018. Some of the variability can be explained due to the seasonal die-off of non-native annual vegetation, but even at the peak of the wet season, vegetation cover was predominantly native. Because of the lack of restoration actions that occur in these areas, this portion of the CDIP area can be qualified as resistant to invasion, even accounting for seasonal variability.

Another metric of assessment to inform the 'resistant to invasion' criterion is targeted species-level restoration efforts over time, and a qualitative assessment of trends. Specifically, targeted species in the areas that have had significant community-driven restoration efforts over time such as the middle foredune portion of the CDIP area have shifted efforts from targeting perennial invasive species such as iceplant, to efforts controlling annual non-native grasses or filaree. Additionally, efforts have shifted from triaging large-scale removal efforts across wide patches of spreading invaders, to controlling smaller individual plants as they sprout and before they seed. Both invasion resistance metrics suggest a trend towards a stable, predominantly native dune system.

Combined and ongoing efforts by LAWA, TBF, and their partners such as Friends of the LAX Dunes (FOLD) have succeeded in transforming this restoration area from impervious roads and other cement and asphalt surfaces into a thriving native, vegetated dune community. Additionally, it provides support for several rare species and is a regionally-important dune ecosystem, one of the last remaining significant dune systems in southern California. In addition to the native species support, the dunes also provide an opportunity to continue organized community engagement, including to underserved communities and schools. Over 2,000 people have visited the northern area of the dunes since 2013 during tours or restoration events, including groups from inner city schools. These opportunities have been met with enthusiasm from stakeholders, as well as support and encouragement from LAWA.

Dunes are characteristically dynamic and vibrant systems that fluctuate over time due to wind, seed dispersal, variations in weather patterns, and larger scale climatic changes (Maun 2009). As is usual for a dune system, a significant amount of the CDIP restoration area remained predominantly unvegetated sand, although it is not necessarily appropriate to call it “bare ground,” as there was often terrestrial debris such as leaves, twigs, and other detritus present, among other types of organisms. Wind is the predominant method of sand transport and deposition in dunes once the dune is initially formed, though the variation in deposition can often be dependent on a number of other physical factors such as suspension, surface creep, and saltation (Maun 2009). Thus, unvegetated areas of dunes are often just as important to the variability and dynamic nature of dune systems as vegetated areas and should be assessed as such, rather than striving for a falsely-inflated high vegetation cover. The Ecological Landscape Plan and CDP took unvegetated areas into consideration, thus the evaluation of “relative” average native plant cover alongside the “absolute” average native and non-native plant cover.

The CDIP restoration area has been stabilized by straw wattles and vegetation growth over time, and has ongoing commitment to maintenance by LAWA, TBF, and their partners. Native habitat restorations in urban environments generally have ongoing challenges from non-native vegetation invasion, but continued maintenance and community restoration events have been shown to successfully mitigate their impacts at the CDIP restoration area within the LAX Dunes. The CDIP area can act as a model for supplemental efforts conducted throughout the rest of the 48-acre northern restoration dune area and more generally to dunes in southern California. Based on the assessments of restoration activities as well as the final vegetation data, TBF scientists have confidence in an assessment of high ecological condition throughout the CDIP area.

Recommendations and Future Directions

The permit conditions state that if target goals are not achieved at the end of the 5-year monitoring period, additional supplemental plantings or other contingency measures may be recommended (KMA 2013). However, since the CDIP restoration is meeting the ecological success criteria, TBF recommends continuing the ongoing LAWA-based and community-based non-native plant maintenance, especially focused in some of the surrounding portions of the northern dune area (outside of CDIP) that are more prone to non-native vegetation occurrences. Specific supplemental plantings and seedings do not seem

to be necessary at this time. TBF also recommends continued periodic vegetation cover monitoring, at the discretion of LAWA, to assess site trends, identify early non-native vegetation threats, and strategically guide ongoing community restoration events. Additionally, TBF will provide LAWA with an annual progress report detailing additional monitoring and recommendations for the larger northern 48-acre area in November 2018.

Figure 33. Beach bur in the CDIP restoration area (25 May 2018, credit: Rod Abbott, TBF)

Literature Cited

AECOM. 2013. Coastal Dunes Improvement Project - Engineering Plans. Prepared for Los Angeles World Airport.

California Coastal Commission. 2013. TH 9a Staff Report: Regular Calendar. Application Number 5-12-263. Applicant: Los Angeles World Airports. 25 March 2013.

City of Los Angeles. 1973. City of Los Angeles General Plan – Conservation Element. Los Angeles Department of City Planning.

Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. California Department of Fish and Game, Sacramento.

(KMA) Kevin Merk Associates, LLC. 2013. Ecological Landscape Plan for the LAX Coastal Dunes Improvement Project, City of Los Angeles, California. Prepared for Los Angeles World Airports.

Maun, M.A. 2009. The Biology of Coastal Sand Dunes. Published by Oxford University Press. 264 pp.

NOAA. 2018. Los Angeles WBO CA Climate Normals. National Oceanic and Atmospheric Administration. Retrieved 13 June 2018. ftp://ftp.atdd.noaa.gov/pub/GCOS/WMO-Normals/RA-IV/US/GROUP1/00045115.TXT

Sawyer, J.O., Keeler-Wolf, T., and Evens, J., 2009. A Manual of California Vegetation 2nd ed. California Native Plant Society Press: Sacramento, CA. 1300 pp.

TBF. 2015a. Level 2 Photo Point Standard Operating Procedures (SOP 7.2). Unpublished protocols. The Bay Foundation, Los Angeles, CA. 30 June 2015.

TBF. 2015b. Vegetation Cover Surveys Standard Operating Procedures (SOP 3.2). Unpublished protocols. The Bay Foundation, Los Angeles, CA. 30 June 2015.

TBF. 2015c. Vegetation Mapping Standard Operating Procedures (SOP 3.5). Unpublished protocols. The Bay Foundation, Los Angeles, CA. 30 June 2015.

TBF. 2017. Coastal Dune Community Stewardship Project – Year 1 Report SCC 15-110 Explore the Coast Grant. The Bay Foundation. 30 June 2017.

USFWS. 1998. Recovery Plan for the El Segundo Blue Butterfly (*Euphilotes battoides allyni*). Portland, Oregon. 67 pp.

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
1/15/2013	Invasive weed removal	Staff	-	-	-	Terracina spurge, cheeseweed, annual grasses
3/15/2013	Survey	-	3	-	-	Survey Phacelia stellaris
3/25/2013	Seed collection	Volunteers	-	-	-	-
5/1/2013	Seed collection	Volunteers	-	-	-	Morning glory, deerweed, lupine, sand verbena, sunflower
5/7/2013	Invasive weed removal	LAWA contractors	1	-	15	-
6/1/2013	Seed collection	Volunteers	-	-	-	Pincushion, sand verbena
6/6/2013	Seed collection	LAWA contractors	2	-	-	
6/21/2013	Seed collection	LAWA contractors	1	-	-	-
7/1/2013	Invasive weed removal	Volunteers	100	300	150	Iceplant and forbs
7/1/2013	Seed collection	Volunteers	-	-	-	Phacelia
8/1/2013	Seed collection	Volunteers	-	-	-	Phacelia, pincushion, lupine, deerweed
11/22/2013	Remove fire hydrants, street lights, and poles	LAWA contractors	-	-	-	-
6/14/2014	Invasive weed removal	Volunteers	15	45	22.5	
7/12/2014	Invasive weed removal	Volunteers	120	360	180	Iceplant, Russian thistle, Mustard, Wild radish
8/24/2014	Invasive weed removal	Volunteers	25	75	37.5	-
9/6/2014	Invasive weed removal	Volunteer	12	36	18	-
9/8/2014	Erosion Control	LAWA Staff	-	-	-	-
9/9/2014	Invasive weed removal	LAWA Staff	-	-	-	-
10/16/2014	Management planning, field visit	LAWA Staff	5	15	-	-
10/18/2014	Invasive weed removal	Volunteers	3	9	4.5	Iceplant
11/4/2014	Invasive weed removal	Volunteers	-	-	-	-
12/8/2014	Assist Nursery set-up and plant care	Volunteers	1	3	-	-
12/13/2014	Invasive weed removal	Volunteers	-	-	-	-
2015	Invasive weed removal	Volunteers/LAWA Staff	-	-	-	Mustard, wild radish, filaree, Russian thistle, european/ornamental grasses, acacia, ficus, sycamores, young pine trees
2015	Erosion control	LAWA Staff	-	-	-	-
2015	Irrigation	LAWA Staff	-	-	-	-
2015	Install Adopt-A-Dune signs	LAWA Staff	-	-	-	-
1/10/2015	Invasive weed removal	Volunteers	2	6	30	-
2/7/2015	Invasive weed removal	Volunteers -CNPS	14	42	21	-
2/17/2015	Invasive weed removal	Volunteers -TBF, FOLD	15	45	12	Mustard

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
2/21/2015	Invasive weed removal	Volunteers -TBF, FOLD, Boy Scouts Troop 283 +927	21	63	30	Mustard and grass
3/7/2015	Invasive weed removal	Volunteers - TBF, FOLD	5	15	7	Mustard
3/21/2015	Invasive weed removal	Volunteers -TBF, FOLD, LAWA/LMU Christian Life/Girl Scout Troop 1535	22	66	52	Mustard
4/4/2015	Invasive weed removal	Volunteers - TBF, FOLD	8	24	12	Tocalote and Mustard
4/17/2015	Invasive weed removal	Volunteers -TBF, FOLD, Girl scout 4365	2	6	3	-
4/18/2015	Invasive weed removal	Volunteers - Girl Scout Troop 4365	28	84	12	Tocalote, Terracina spurge, and other invasive vegetation
5/2/2105	Invasive weed removal	Volunteers				Russian thistle, Mustard, grasses
5/12/2015	Habitat management training	LAWA Staff	10	30	-	-
5/16/2015	Seeding	Volunteers	2	6	-	Planted Stipa cernua (full tray) and Distichlis spicata (12)
5/18/2015	Invasive weed removal	Volunteers - TBF, FOLD, ITG/Do Good Bus	30	90	30	Russian thistle, mustard, acacia, Terracina spurge, and iceplant
6/2/2015	Invasive weed removal	Volunteers - TBF, FOLD, Direct TV	22	66	33	Filaree
6/6/2015	Invasive weed removal	Volunteers	3	9	4	invasive vegetation
6/13/2015	Invasive weed removal	Volunteers	2	6	10	Terracina spurge, Russian thistle, Mustard, Wild radish, grasses, wild oats, cheatgrass
6/27/2015	Invasive weed removal	Volunteers	5	15	8	horseweed, mustard, filaree
7/11/2015	Invasive weed removal	Volunteers	6	18	8	Non-native vegetation
7/25/2015	Invasive weed removal	Volunteers	6	18	9	Mustard, wild radish, filaree
8/1/2015	Invasive weed removal	Volunteers	7	21	10.5	Iceplant, Russian thistle, Terracina spurge
8/8/2015	Invasive weed removal	Volunteers	2	6	7	Mustard, Russian thistle, spurge
9/19/2015	Invasive weed removal	Volunteers - Cloastal Cleanup Day 2015	70	210	150	Russian thistle, iceplant
10/3/2015	Invasive weed removal	Volunteers - Eagle Scout project	26	78	39	Removed approximately 1,400 square meters of iceplant
11/7/2015	Invasive weed removal	Volunteers	38	114	5	Russian thistle
12/5/2015	Invasive weed removal	Volunteers	10	30	5	Russian thistle, filaree

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
2/6/2016	Invasive weed removal	Volunteers	23	69	24	Filaree, Terracina spurge, grasses
3/5/2016	Invasive weed removal	Volunteers	22	66	33	Filaree, Terracina spurge, grasses
4/2/2016	Invasive weed removal	Volunteers	8	24	12	Wild radish, Mustard, filaree
4/30/2016	Invasive weed removal	Volunteers	76	228	114	Wild radish, Mustard, filaree
5/7/2016	Invasive weed removal	Volunteers	24	72	36	Terracina spurge
6/4/2016	Invasive weed removal	Volunteers	49	147	73	Acacia, Russian thistle, grasses
7/9/2016	Invasive weed removal	Volunteers	10	30	17	Russian thistle
7/13/2016	Invasive weed removal	Volunteers	72	216	47	Russian thistle, iceplant, acacia
8/6/2016	Invasive weed removal	Volunteers	14	42	26	Iceplant, Russian thistle, castor bean, terracina spurge
9/17/2016	Invasive weed removal	Volunteers	132	396	206	Iceplant, Russian thistle
10/1/2016	Invasive weed removal	Volunteers	13	39	27	Iceplant, Russian thistle, Terracina spurge, black mustard
11/5/2016	Invasive weed removal	Volunteers	17	51	55	Iceplant, Russian thistle, acacia
12/3/2016	Invasive weed removal	Volunteers	16	48	25	Iceplant
1/18/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo ; dead Acacia and iceplant removal
1/26/2017	Invasive weed removal	LAWA Staff	2	18	-	Acacia trimming for LA Zoo; iceplant and weed removal
2/2/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo
2/4/2017	Invasive weed removal	Volunteers	12	36	27	Filaree, Russian thistle, saharan mustard, iceplant, Terracina spurge
2/9/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo
2/16/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; iceplant and weed removal
2/23/2017	Invasive weed removal	LAWA Staff	2	18	-	Acacia trimming for LA Zoo; iceplant and weed removal
2/25/2017	Invasive weed removal	Volunteers	20	60	21	Black mustard, saharan mustard
3/2/2017	Invasive weed removal	LAWA Staff	3	27	4.5	Removed weeds and iceplant
3/4/2017	Invasive weed removal	Volunteers	11	33	11	Filaree, Terracina spurge, grasses
3/9/2017	Invasive weed removal	LAWA Staff	3	27	4.5	Removed weeds and iceplant
3/16/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; iceplant removal
3/23/2017	Invasive weed removal	LAWA Staff	4	36	-	Acacia trimming for LA Zoo; iceplant and weed removal
3/30/2017	Invasive weed removal	LAWA Staff	4	36	-	Acacia trimming for LA Zoo; iceplant and weed removal
4/1/2017	Invasive weed removal	Volunteers	77	231	90	Filaree, black mustard, grasses
4/6/2017	Invasive weed removal	LAWA Staff	4	36	-	Acacia trimming for LA Zoo; iceplant removal
4/13/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; iceplant removal
4/20/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; iceplant removal
4/27/2017	LA Zoo Acacia trimming	LAWA Staff	3	27	-	Acacia trimming for LA Zoo
5/2/2017	Invasive weed removal	LAWA Staff	3	27	9	Removed old/new growth acacia and castor bean; acacia cuttings for LA Zoo

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
5/6/2017	Invasive weed removal	Volunteers	47	141	80	Terracina spurge
5/11/2017	Invasive weed removal	LAWA Staff	3	27	-	Removed old/new growth acacia and castor bean; acacia cuttings for LA Zoo
5/16/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed dead acacia, Russian thistle, and iceplant
5/18/2017	Invasive weed removal	LAWA Staff	1	9	-	Removed old/new growth acacia and castor bean; acacia cuttings for LA Zoo
5/18/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	24	Iceplant, Russian thistle, mustards, wild radish, grasses
5/18-5/19/2017, 5/22/2017	Invasive weed removal	LAWA Contractors				Blackwood acacia, iceplant, bermuda grass, Terracina spurge, wild radish, fountain grass, Russian thistle, Brazilian pepper, London rocket
5/23/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed Russian thistle, dead acacia, and iceplant
5/25/2017	Invasive weed removal	Volunteers & Patagonia Staff	116	348	71	Iceplant
5/25/2017	Invasive weed removal	LAWA Staff	1	9	0	Acacia trimming for LA Zoo; iceplant removal
5/26/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	18	Russian thistle, grasses
6/1/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; iceplant removal
6/2/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	9	Russian thistle, grasses
6/8/2017	Invasive weed removal	LAWA Staff	2	18	-	Acacia trimming for LA Zoo; iceplant removal
6/9/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	14	Russian thistle, grasses
6/13/2017	Invasive weed removal	LAWA Staff	2	18	6	Dead Acacia and iceplant removal
6/15/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	10	Russian thistle, grasses
6/15/2017	Invasive weed removal	LAWA Staff	2	18	6	Dead Acacia and iceplant removal
6/20/2017	Invasive weed removal	LAWA Staff	2	18	6	Weed removal in street; iceplant removal
6/21/2017	Invasive weed removal	LAWA Staff	2	18	6	Weed removal
6/22/2017	Invasive weed removal	LAWA Staff	2	18	-	Acacia trimming for LA Zoo; Removed ficus and weeds
6/28/2017	Invasive weed removal	LAWA Staff	2	18	10	Removed castor bean and weeds
6/29/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	15	Iceplant, Russian thistle, grasses
6/30/2017	Invasive weed removal	Volunteers - Patagonia Staff	2	16	12	Iceplant, Russian thistle, grasses
7/6/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia for LA Zoo
7/8/2017	Invasive weed removal	Volunteers	24	72	21	Terracina spurge, grasses, acacia, Russian thistle
7/12/2017	Invasive weed removal	LAWA Staff	2	18	6	Pulled iceplant, Russian thistle, and new acacia growth
7/19/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed dead acacia and Russian thistle
7/20/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia for LA Zoo; removed Russian thistle

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
7/27/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and Ficus for LA Zoo
8/3/2017	Invasive weed removal	LAWA Staff	2	18	-	Acacia trimming for LA Zoo; removed dead acacia and trimmed Pershing fenceline
8/5/2017	Invasive weed removal	Volunteers	8	24	8	Russian thistle, iceplant, grasses
8/8/2017	Invasive weed removal	LAWA Staff	2	18	6	Trimmed acacia from Vista Del Mar fenceline; removed castor bean and weeds
8/9/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed dead acacia, castor bean, and Russian thistle
8/17/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo
8/22/2017	Invasive weed removal	LAWA Staff	2	18	10	Iceplant
8/24/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo; removed Russian thistle
8/26/2017	Invasive weed removal	Volunteers	58	174	52	Russian thistle, iceplant, Terracina spurge, grasses
8/29/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed acacia and Russian thistle at Pershing fenceline
8/30/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed weeds, new growth acacia, and Russian thistle
8/31/2017	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia for LA Zoo; removed Russian thistle
9/6/2017	Invasive weed removal	LAWA Staff	2	9	6	Hand pulled iceplant and castor bean
9/16/2017	Invasive weed removal	Volunteers	43	129	56	Russian thistle, iceplant, grasses
9/19/2017	Invasive weed removal	LAWA Staff	2	9	6	Pulled new growth acacia and removed dry Russian thistle
9/22/2017	Invasive weed removal	Volunteers	11	33	33	Russian thistle, iceplant, grasses
9/26/2017	Invasive weed removal	Volunteers - Patagonia Staff	20	60	55	Iceplant, Russian thistle, acacia, grasses
9/27/2017	Invasive weed removal	LAWA Staff	2	9	6	Acacia trimming for LA Zoo; iceplant removal
9/28/2017	Invasive weed removal	LAWA Staff	2	9	6	Cut acacia and Russian thistle
10/3/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed acacia
10/4/2017	Invasive weed removal	LAWA Staff	2	18	6	Removed acacia and Russian thistle
10/5/2017	Invasive weed removal	LAWA Staff	2	18	6	Acacia trimmed for LA Zoo
10/6/2017	Invasive weed removal	LAWA Staff	1	9	3	Cut acacia and removed new growth and weeds
10/7/2017	Invasive weed removal	Volunteers	10	30	10	Russian thistle, iceplant
10/17/2017	Invasive weed removal	LAWA Staff	2	9	6	Cut acacia and removed iceplant
10/19/2017	Invasive weed removal	LAWA Staff	2	9	-	Acacia trimmed for LA Zoo
10/25/2017	Invasive weed removal	LAWA Staff	2	9	6	Removed acacia and Russian thistle
11/1/2017	Invasive weed removal	LAWA Staff	3	27	9	Acacia and weed removal
11/2/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; Russian thistle removal
11/4/2017	Invasive weed removal	Volunteers	24	72	16	Russian thistle, Terracina spurge, grasses
11/14/2017	Invasive weed removal	LAWA Staff	3	27	9	Acacia and iceplant removal
11/16/2017	Invasive weed removal	LAWA Staff	3	27	9	Acacia and ficus trees trimmed for LA Zoo

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
11/27/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimmed for LA Zoo
12/2/2017	Invasive weed removal	Volunteers	62	186	77	Russian thistle, Terracina spurge, filaree
12/7/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; removed ficus and weeds
12/14/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; removed Russian thistle
12/18/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo
12/20/2017	Invasive weed removal	LAWA Staff	3	27	9	Pulled new growth acacia and removed dry Russian thistle
12/21/2017	Invasive weed removal	LAWA Staff	3	27	-	Acacia trimming for LA Zoo; castor bean removal
1/3/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed acacia and Russian thistle
1/9/2018	Invasive weed removal	LAWA Staff	2	18	6	Removed Russian thistle and downed palms
1/10/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed ficus tree
1/13/2018	Invasive weed removal	Volunteers	20	60	5	Filaree, Saharan mustard
1/25/2018	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo
1/30/2018	Invasive weed removal	LAWA Staff	2	18	6	Removed dead acacia and Russian thistle
2/1/2018	Invasive weed removal	LAWA Staff	2	18	6	Trimmed acacia and ficus for LA Zoo
2/3/2018	Invasive weed removal	Volunteers	79	237	10	Filaree, Terracina spurge, Saharan mustard
2/5/2018	Invasive weed removal	LAWA Staff	2	18	-	Removed new acacia growth
2/8/2018	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo; removed Russian thistle
2/15/2018	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo
2/22/2018	Invasive weed removal	LAWA Staff	2	18	-	Trimmed acacia and ficus for LA Zoo
2/24/2018	Invasive weed removal	Volunteers	6	18	1	Saharan mustard, filaree
2/28/2018	Invasive weed removal	LAWA Staff	2	18	6	Removed dead acacia, iceplant, and Russian thistle
3/1/2018	Invasive weed removal	LAWA Staff	3	27	-	Trimmed acacia and ficus for LA Zoo
3/7/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed acacia and iceplant
3/8/2018	Invasive weed removal	LAWA Staff	3	27	-	Trimmed acacia and ficus for LA Zoo
3/14/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed iceplant and castor bean
3/15/2018	Invasive weed removal	LAWA Staff	3	27	-	Trimmed acacia and ficus for LA Zoo
3/27/2018	Habitat management training	LAWA Staff/ TBF	9	27	-	-
3/29/2018	Invasive weed removal	LAWA Staff	3	27	-	Trimmed acacia and ficus for LA Zoo
4/7/2018	Invasive weed removal	Volunteers	47	141	40	Filaree, black mustard, Terracina spurge
4/12/2018	Invasive weed removal	Volunteers	12	36	13	Black mustard, filaree
4/20/2018	Invasive weed removal	Volunteers	105	315	100	Wild radish, filaree, Saharan mustard
4/21/2018	Invasive weed removal	Volunteers	12	36	15	Filaree, black mustard, wild radish
4/24/2018	Invasive weed removal	Volunteers	36	108	23	Black mustard, Saharan mustard

Appendix A – Restoration Activity Summary

Date	Restoration Activity	Personnel	# of Personnel	Volunteer Hours	Non-native Vegetation Removed	Target Species
			Staff or Volunteers		# of bags	
4/27/2018	Invasive weed removal	Volunteers	92	276	78	Wild radish, black mustard, filaree
5/5/2018	Invasive weed removal	Volunteers	49	147	35	Wild radish, filaree, black mustard
5/8/2018	Invasive weed removal	LAWA Staff	3	27	-	Trimmed acacia for LA Zoo; removed iceplant and Terracina spurge
5/15/2018	Invasive weed removal	LAWA Staff	3	27	12	Removed dead acacia and Russian thistle
5/16/2018	Invasive weed removal	LAWA Staff	3	27	12	Removed dried Russian thistle
5/19/2018	Invasive weed removal	Volunteers	20	60	17	Filaree, black mustard, Terracina spurge
5/22/2018	Invasive weed removal	LAWA Staff	3	27	9	Weed removal along curbs
5/23/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed iceplant, Terracina spurge, and curb weeds
5/30/2018	Invasive weed removal	LAWA Staff	3	27	9	Removed dead acacia

Appendix B – Vegetation Species List

Species Key	*Scientific Name*	Common Name	Native/Exotic	Type
ABUM	*Abronia umbellata*	pink sand verbena	N	perennial herb
ACGL	*Acmispon glaber*	deerweed	N	perennial herb
AMCH	*Ambrosia chamissonis*	beach bur	N	perennial herb
CACH	*Camissoniopsis cheiranthaifolia*	beach evening-primrose	N	perennial herb
CALE	*Camissoniopsis lewisii*	Lewis' evening-primrose	N	annual herb
CRCA	*Croton californicus*	California croton	N	perennial herb
CLCO	*Cleveland's cryptantha*	Common cryptantha	N	annual herb
DAWR	*Datura wrightii*	Jimsonweed	N	perennial herb
ERER	*Ericameria ericoides*	mock heather	N	shrub
ERPA	*Eriogonum parvifolium*	sea cliff buckwheat	N	shrub
ENCA	*Encelia californica*	California brittlebush	N	shrub
HEGR	*Heterotheca grandiflora*	telegraph weed	N	annual, perennial herb
LUCH	*Lupinus chamissonis*	beach blue lupine	N	shrub
STPU	*Nassella pulchra*	purple needlegrass	N	grass
ACCY	*Acacia cyclops*	red-eyed wattle	E	shrub
BRDI	*Bromus diandrus*	bromegrass, ripgut brome	E	annual grass
BRNI	*Brassica nigra*	black mustard	E	annual herb
BRTO	*Brassica tournefortii*	Saharan mustard	E	annual herb
CAED	*Carpobrotus edulis*	iceplant	E	perennial herb
CAMA	*Cakile maritima*	sea rocket	E	annual herb
CYDA	*Cynodon dactylon*	Bermuda grass	E	perennial grass
ERBO	*Erodium Botrys*	Filaree	E	annual herb
DELI	*Delosperma litorale*	Seaside delosperma	E	shrub
EUTE	*Euphorbia terracina*	Terracina Spurge	E	perennial herb
HIIN	*Hirschfeldia incana*	Shortpod mustard	E	perennial herb
MEIN	*Melilotus indicus*	yellow sweetclover	E	annual herb
OXPE	*Oxalis pes-caprae*	bermuda buttercup	E	perennial herb
RASA	*Raphanus sativus*	radish	E	annual, biennial herb
SATR	*Salsola tragus*	Russian thistle	E	annual herb
SOOL	*Sonchus oleraceus*	common sowthistle	E	annual herb