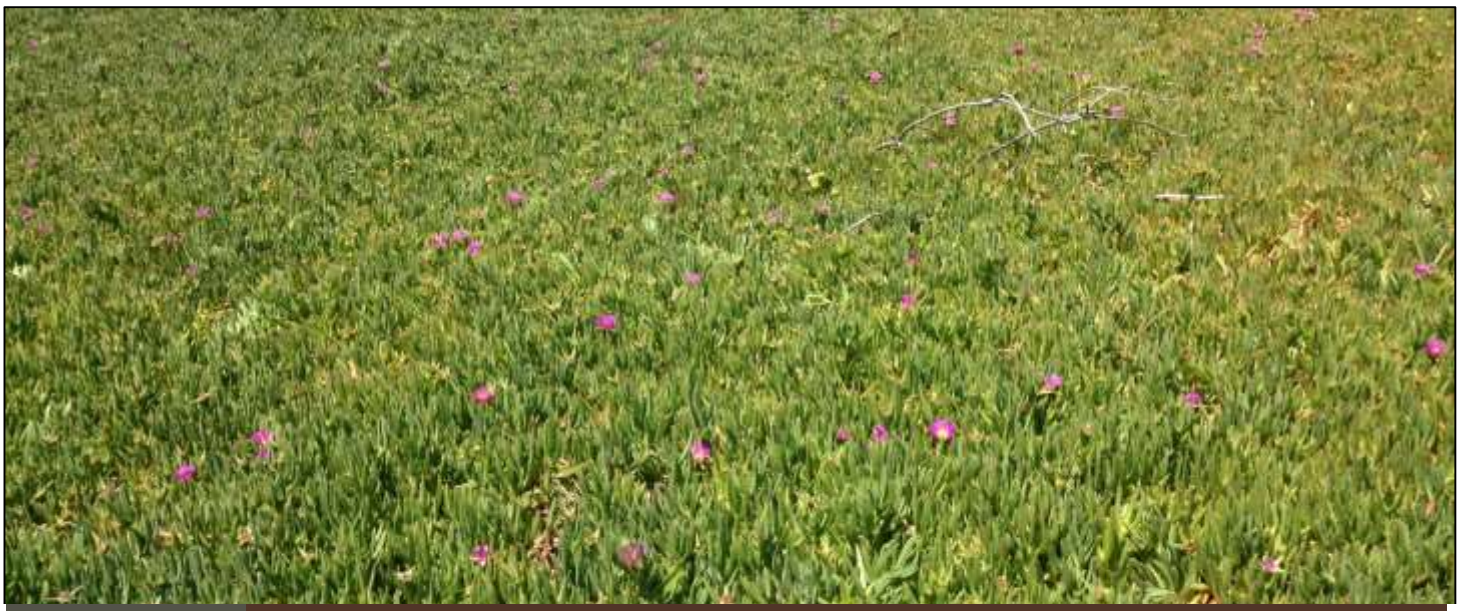

Ballona Wetlands Ecological Reserve: Iceplant Removal and Wetland Restoration

Implementation and Monitoring Plan

June 2016

Prepared for the California Coastal Commission and the California Department of Fish and Wildlife

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Timing of Operations: Project operations, including vegetation eradication and removal, hauling, annual maintenance, and spot removal shall be prohibited from February 1 through August 30 to avoid impacts to avian species during breeding season in accordance with Coastal Commission Permit No. 5-15-1427.

Background

Over 96% of the vegetated estuarine wetlands have been lost over the past century and a half in the Los Angeles region (Stein et al. 2014). The Ballona Wetlands Ecological Reserve (Reserve), located on the Los Angeles County coast, is an example of this phenomenon, having suffered from over a century of abuse and land degradation. Historically a bar-built estuary of over 2,100 acres (Dark et al. 2011), the Reserve has been reduced in size to less than 600 acres of open space, with over half of the vegetated habitats dominated by non-native species and with significantly reduced or absent ecosystem functions (Medel et al. 2014).

Currently, only approximately one quarter of the Reserve is considered delineated wetlands (WRA 2011). Similarly to the rest of the site, much of the remaining wetland habitats suffer from invasive and non-native species encroachment. There are over 35 acres of iceplant throughout the site, and 10 acres of iceplant concentrated south of Culver Boulevard in Area B, in large patches within the wetland and adjacent sandy dune habitats. This project will focus iceplant removal efforts south of Culver Blvd, to stay within the area that will not be affected by the long-term restoration project and to provide the maximum possible ecological benefits to the habitats by removing contiguous patches.

The Bay Foundation (TBF), in partnership with the California Department of Fish and Wildlife (CDFW), received Wetland Recovery Project Community Restoration Grant Program funds to manually remove invasive vegetation while broadening community and public involvement and stewardship at the Reserve. The Reserve is undergoing an intense, large-scale restoration planning effort. TBF will organize public, community functions that will provide a diverse range of community members and students the opportunity to participate in hands-on wetland restoration activities to restore three acres of degraded wetland habitat, and become engaged in the larger restoration planning effort.

Project Goals

TBF will conduct 10 public, on-site restoration events engaging approximately 250-300 community members and students with the goal of educating participants about non-native and invasive vegetation and the need for their removal to create healthy wetland habitats. The project will focus on the removal of *Carpobrotus* spp., or iceplant, from a targeted area within the Reserve that will not undergo significant changes (e.g., re-grading) during construction or restoration (Appendix A: Site Map, Figure 1).

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 subsequent introduction of native wetland species will provide an increase in the health and condition of the wetland habitats in Area B – south of Culver, and will allow for community engagement in restoration efforts at the Reserve. Restoration activities are in accordance with CDP No. 5-15-1427.

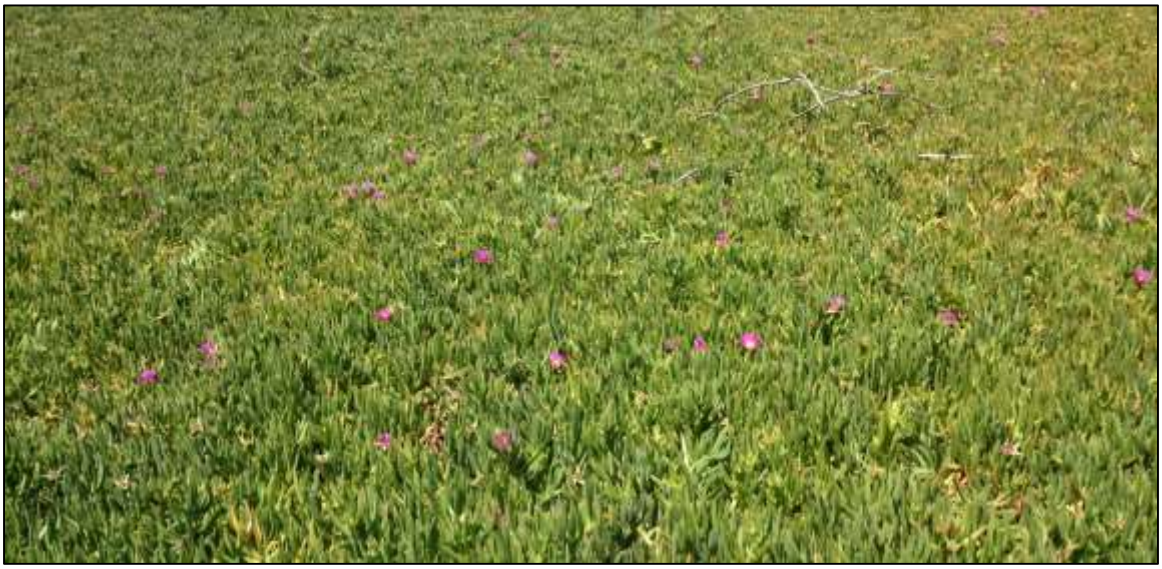

Figure 1. Photograph of an iceplant monoculture at the project location within the Reserve.

Ecological Benefits

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

Iceplant removal and native seeding will provide immediate and long-term ecological benefits to the Reserve. Following establishment, native vegetation will increase ecological function by proving habitat, food sources and opportunities for foraging by fish and birds, and protective cover for a variety of native fauna. New vegetation will increase native biodiversity and provide healthier habitat for several endangered and special concern species such as the Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) and South Coast marsh vole (*Microtus californicus stephensi*). Revegetation efforts will also increase the ability of local flora and fauna to compete against invaders, increasing the resilience of the restored areas and their ability to respond to urban stressors. Restored areas will be monitored to quantify native species richness, plant cover, and invertebrate biomass.

Invasive Plant Removal: Implementation

The removal of invasive species such as iceplant will occur through the implementation of two primary removal protocols during community restoration events, solarization and hand-removal. Solarization will be prioritized for the majority of the restoration areas as this protocol does not involve soil disturbance. Hand-removal may be implemented along margins or edges with intermixed native plant species to reduce impacts to native vegetation.

Invasive plants are those identified in the California Native Plant Society, Los Angeles – Santa Monica Mountains Chapter handbook entitled "Recommended List of Native Plants for Landscaping in the Santa Monica Mountains," January 20, 1992, those species listed by the California Invasive Plant Council on any of their watch lists as published in 2007, and those otherwise identified by the Department of Fish and Wildlife or the United States Fish and Wildlife Service. No non-native or invasive vegetation species shall be planted on site as part of this restoration. Details for each of the two primary removal protocols are described below.

Removal Protocol 1: Solarization *(no soil disturbance)*

Solarization of iceplant monocultures will be the primary removal method implemented by project partners and participants using large black tarps to eliminate radiant sunlight. The tarps will be left on for approximately 1-3 months during warm weather, at which point the tarps will be removed and the desiccated iceplant material left in place. This technique allows for the eradication of iceplant without the use of herbicides or heavy soil disturbance. Leaving the desiccated iceplant in place also prevents erosion through the retention of the existing root structure, even though it will no longer be viable. Soil bacteria, fungi, and other microorganisms create a natural below ground ecosystem that will be maintained when the soil layers are not displaced.

The desiccated iceplant also acts as a form of mulch, helping to control non-native species invasions, while keeping the soil moisture high for native plants. Wetland habitats at the Reserve have been heavily disturbed and most are hydrologically disconnected from estuarine waters. Retaining moisture in the soils through the use of 'mulch' will encourage native salt marsh regrowth with fewer plantings or seedlings needed. Previous studies have confirmed the presence of a native seed bank beneath the iceplant (Johnston et al. 2011, 2012, R. Brody, pers. comm., 2015).

The following steps summarize Removal Protocol 1:

1) Tarps deployed to cover invasive vegetation monocultures (e.g. iceplant)
2) Edges staked down using garden stakes (approximately 1-3 feet between stakes to allow for small animal movement underneath the tarp)
3) Leave tarps in place for approximately 1-3 months during warm weather
4) Remove tarps
5) Leave desiccated iceplant material in place

Minimizing or eradicating soil disturbance through the retention of desiccated iceplant also allows for the preservation of culturally-sensitive areas. The protocols described above will retain any existing resources in place and have been approved by CDFW and their Native American consultants.

Removal Protocol 2: Hand-Removal (minimal soil disturbance)

Restoration events may also involve a small amount of additional hand-pulling of invasive species by volunteers along the margins of the iceplant monocultures in areas that are too patchy (with intermixed native plants) for broad-scale solarization. This will avoid impacts to existing native vegetation, and will allow for the spread and expansion of the remaining native plants into the newly restored micro-habitats. All non-native, invasive plants will be removed by hand or with hand tools (e.g. garden spade). Additionally, no herbicides or rodenticides will be employed as part of this restoration effort.

The following steps summarize Removal Protocol 2:

1) Restoration ecologists will lead volunteer groups – walking will occur over invasive species or desiccated iceplant monocultures to access the restoration areas
2) Hand-pulling of targeted invasive, non-native vegetation species:
    a. Slowly remove invasive plant, including roots, by hand-pulling or using hand tools
    b. Gently shake loose attached dirt (if present) from plant and roots
    c. Replace dirt into hole (if hole was created) from removed plant area
3) Dispense of invasive, non-native plant into a green waste dumpster
4) Track and record area of restoration (geospatial); weight, condition, and species of removed plants; and basic volunteer statistics

The protocols described above will retain existing resources in place and have been approved by CDFW and their Native American consultants.

Re-vegetation

Re-vegetation of the restoration area may occur in several ways, through an iterative adaptive management and monitoring process. The protocols to be implemented will depend on the recruitment success of the first growing season. The following three protocols summarize the techniques that will be implemented post-solarization or post-hand restoration. Protocol 1 will be implemented first, and after a thorough post-restoration monitoring evaluation after the first growing season, Protocols 2 and 3 may be implemented, if necessary. At the request of CDFW, re-vegetation protocols that involve no soil disturbance will be prioritized.

Re-Vegetation Protocol 1: Natural Recruitment (no soil disturbance)

Natural recruitment of native vegetation species from the existing seed bank may occur. This protocol involves passive monitoring to visually identify if native vegetation is recruiting naturally. No soil disturbance would occur. If recruitment of native vegetation occurs using this method, no further actions are required other than post-restoration monitoring.

Re-Vegetation Protocol 2: Hand-Seeding (no soil disturbance)

If subsequent post-restoration monitoring shows poor native plant recruitment or minimal species richness (e.g. only one species recruiting), then hand-seeding to supplement the native plant recruitment may be considered. Broadcast dispersing of native vegetation seeds and cuttings by hand in the restoration area would occur as part of this protocol. No soil disturbance would occur. If recruitment of native vegetation occurs using this method, no further actions are required other than post-restoration monitoring.

Re-Vegetation Protocol 3: Planting (minimal soil disturbance)

Targeted infill plantings with native species in the restored areas may be conducted, based on the success of the natural recruitment protocol and hand-seeding protocol implementation. Small, native (1 gallon or smaller) container stock may be considered if Re-Vegetation Protocols 1 and 2 are insufficient to achieve native vegetation recruitment. The plant palette reflects hardy, salt-tolerant species which can also withstand seasonal reduced hydrology. Vegetation planted on the site will consist of native plants present in the Reserve. The plant palette will be developed in greater detail, along with a final planting plan, after the first growing season to adaptively manage the restoration area and allow for maximum potential natural native plant recruitment to take place. The planting plan will be developed in coordination with CDFW and their Native American consultants. The palette may include (but not be limited to) the following native species, and will vary based on the recruitment success of the micro-habitats:

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*.

Scientific Monitoring

A rigorous scientific monitoring plan will allow for adaptive management of restoration activities. Table 1 summarizes the monitoring sampling design. It lists nine major parameters, the primary protocol(s) which will be implemented for each parameter, and the frequency of implementation.

Pre-restoration baseline monitoring will occur prior to the implementation of the restoration project to allow a comparison of the pre- and post-project conditions of the area. Ongoing implementation monitoring will occur throughout the duration of the restoration activities to adaptively manage and avoid impacts to native plant and wildlife species. Post-restoration monitoring will occur after restoration activities are concluded and will allow a scientific evaluation of the successes and challenges of the implementation strategies. Additionally, post-restoration data will contribute meaningful information towards adaptively implementing re-vegetation activities. It will allow for a thorough scientific evaluation of restoration efforts. If seedlings are not present during post-restoration monitoring after the wet season, supplemental seeding or planting may be required. At this time, a detailed re-vegetation plan will be written, in conjunction with CDFW and their consultants.

Table 1. Description of protocols to be 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
Vegetation Removal	Area, Species, and Weight		✓		N/A
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
Volunteer Event Data	Counts		✓		N/A
Vegetation Planting	Size, Species, and Location		✓	✓	As needed
Cultural Resources	Identification and BMPs	✓	✓	✓	N/A

Individual Protocol Details

Each of the following subsections summarizes an individual protocol to be implemented as part of the monitoring program. For in depth details on objectives, equipment, field preparation, field methods, quality control check procedures, and datasheets, refer to the individual Standard Operating Procedures listed below within the California Estuarine Wetland Monitoring Manual, publically available for free download: http://www.santamonicabay.org/california-estuarine-wetlands-monitoring-manual-level-3/.

Invasive Vegetation Cover (GIS)

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 mapping methods employ *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 uses a Trimble GPS unit and ArcGIS software to produce detailed, geospatially rectified vegetation maps, allowing for an analysis of vegetation alliance and association coverage. It will facilitate the adaptive management restoration activities.

Invasive Vegetation Cover (Transect)

Vegetation cover surveys can be 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, relative species richness and diversity, and assessing canopy height. The primary objective of the transect- and quadrat-level cover surveys for this project is to assess the approximate cover of invasive, non-native vegetation over time. Transect- and quadrat-level plant cover data will be collected on five, 25-meter permanently identified transects randomly allocated within the restoration area. Both "Line-Intercept Transects" and "Cover Class Quadrats" will be implemented.

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 the vegetation crosses a minimum of 0.01 m. Line-intercept data will be summed by species and divided by the total length of transect to determine percent cover for each transect and habitat. Cover Class Quadrat surveys will be conducted using 1 m^2 PVC quadrats subdivided into 16 sub-quadrats. Ten quadrats will be completed along each transect. Cover class species data will be 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).

Seedling Density

A seedling density survey will be conducted on restored areas. This quantitative assessment method will allow for a post-restoration evaluation of germination success of native plant species. Individual seedlings will be counted within randomly selected quadrats as part of the Cover Class Quadrat vegetation cover assessment method. Data will be presented in germinated seedlings per square meter categorized by species and nativity, following assessment procedures described in SOP 3.4 Seed Bank Germination (TBF 2015c). Seedling density will be determined by adding the total number of individuals of each species in all quadrats per area and dividing by the total area of all the quadrats surveyed to determine density (e.g., Species A, 100 seedlings / 10 m^2 = 10 seedlings/m^2). Photographs of each quadrat will also be collected concurrently.

Vegetation Removal

Photo-documentation will occur prior to and after invasive plant removal efforts, including solarization and community restoration events involving invasive plant removal. A quantitative weight and area estimate of removed invasive vegetation will be conducted during each restoration event, along with species-level identification of removed vegetation. See also "Volunteer Event Data", below, for additional details on human use data that will be collected.

Additionally, the site shall be visited weekly following the installation of tarps, until they are removed. During weekly site visits, environmental data including soil temperature, tarp surface temperature, and weather conditions shall be recorded. Additionally, the tarps shall be monitored for condition (e.g. ripping, staples pulled out, animal use). After tarps have been pulled, site visits for other monitoring activities will occur in the frequency for each individual protocols described in Table 1, above.

Avifauna (Bird)

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. Bird survey methods are described in detail, along with field data sheets, in SOP 5.1 Bird Abundance-Activity (TBF 2015d).

There are two primary purposes of avifauna surveys for this project. First, it is to confirm a lack of breeding or nesting behavior prior to the commencement of restoration activities to ensure no disturbance. Second, it is to provide a general understanding of the bird community in the restoration area before and after restoration. This survey will be performed by an ornithologist and will entail both observational visual and auditory bird surveys. Additionally, breeding or nesting activity of birds will be recorded and, if present, will require the immediate delay of any restoration activities.

Other Wildlife (Mammals and Herpetofauna)

Observational data will be collected on mammal and herpetofauna present during the implementation of other survey protocols. Additionally, visual surveys including species-level presence and counts will be conducted throughout the restoration area prior to any restoration activities commencing.

Photo-Point

Photo point monitoring will occur to identify seasonal site changes or project-level changes as a result of the restoration activities (e.g. native vegetation community expansion). Survey methods are described in detail in SOP 7.2 Level 2 Photo Point (TBF 2015e). Permanent photo point locations will be established during baseline monitoring and the locations recorded using a GPS. Photographs can be used as qualitative assessments of broad-scale changes following community restoration activities and solarization of iceplant.

Volunteer Event Data

Volunteer event data will be collected for all public restoration events, including the date of the event, the number of participants, hours worked, and any incidental useful supplemental information such as the school and age group, etc. Data may be analyzed in conjunction with the Vegetation Removal data to evaluate average weight or area of invasive species removal by volunteer, as one example.

Vegetation Planting

Following any re-vegetation efforts, the site will be examined and photo-documented. Any problems with newly installed plants that might adversely affect the success of the restoration will be documented. Adaptive management or maintenance may occur as described in the protocols above.

Cultural Resources

If suspected cultural or historic artifacts are identified through monitoring in invasive vegetation removal or planting procedures described above, field staff conducting invasive plant management work will implement the following best management practices (BMPs) to avoid impacts.

Subsequent steps are as follows:

1) Immediately stop work
2) Contact the land manager (CDFW) via phone from the field
3) Replace the soil and artifact where it was found and photograph the location
4) GPS specific location and send location and photograph to land manager (CDFW)

In compliance with the Native American Graves Protection and Repatriation Act of 1990, CDFW will notify and consult affiliated tribal representatives for proper treatment of human remains, funerary, and sacred objects, should these be discovered.

Maintenance

Site visits will be conducted quarterly for a period of no less than two years to visually assess the restoration progress and evaluate the need for maintenance activities. The overall condition of the restoration areas will be noted, along with detailed observations including presence of invasive species re-growth or environmental stressors (e.g. prolonged dry periods) that may suggest maintenance actions are needed. Photographic documentation of any observations of concern will occur. If invasive vegetation such as iceplant returns to a restored area, adaptive management steps such as weed removal with hand tools may need to be taken.

Reporting

A publically-available annual report will be compiled and produced at the culmination of each year of work. A year of work is between the beginning of August through end of July each year. It will be published on The Bay Foundation's website: www.santamonicabay.org, on the Technical Report page. Each annual report will contain summary details on restoration activities and monitoring results as well as photographs documenting the restoration activities over time. Annual reports will be published for a minimum of two years or through the duration of the restoration activities.

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Appendix A: Site Map – Invasive Iceplant Removal Sites