ATTACHMENT 2

WESTERN STEGE MARSH RESTORATION PROJECT: VEGETATION MONITORING REPORT – 2009, MAY & ASSOCIATES, INC.

Western Stege Marsh Restoration Project: Vegetation Monitoring Report - 2009

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0.0 EXECUTIVE SUMMARY

This document presents results of the fifth and final year (2009) vegetation monitoring of the Western Stege Marsh Restoration Project (WSMRP) at the Richmond Field Station (RFS), University of California, Berkeley (UC Berkeley) campus. The RFS is located at 1301 South 46th Street in Richmond, Contra Costa County, California (Figure 1). The Western Stege Marsh occupies approximately 7.5 acres: approximately 5 acres of marsh and ecotone habitat are the subject of this report, as this area was disturbed during environmental remediation activities. Habitat restoration work began following the University's removal of environmental contaminants from the eastern section of the marsh system in 2004. Habitat restoration has continued from 2004 until the present, with a primary focus on invasive non-native plant control and revegetation.

The purpose of this vegetation monitoring report is to document the results of the Western Stege Marsh Restoration Project (WSMRP) vegetation surveys and assessments conducted in 2009; to summarize how restoration project performance standards (as defined within the WSMRP Monitoring Plan (Blasland, Bouck and Lee, Inc. 2004)) were achieved.

Several methods were used to monitor the vegetation within the WSMRP. These included monitoring vegetation quadrats within the project area; mapping the aerial extent and distribution of pickleweed and the distribution and cover of Pacific cordgrass using a global position system (GPS); and conducting a species inventory. Spring ecotone transect surveys were conducted on May 15 and May 16, 2009 by Loran May, Senior Botanist and Sharon Farrell, Senior Botanist with May & Associates, Inc. Vegetation transect surveys, vegetation community mapping, and Pacific cordgrass monitoring was conducted on September 18, 26, and 27, 2009 by Loran May, Sharon Farrell, and Christina Crooker, GIS Specialist. All of the permanent photopoints were monitored as part of both the spring and fall 2009 vegetation monitoring activities.

In summary, by September 2009 the WSMRP has achieved all stated program standards, including the recommended revised acreage establishment of Pacific cordgrass (*Spartina foliosa*) (described in more detail below). The WSMRP had the following observed site characteristics in 2009:

- The observed native vegetation cover in 2009 was 81.7%, exceeding the stated Year 5 success criteria of 80%.
- The acreage of pickleweed (*Salicornia virginica*) observed in 2009 was approximately 1.71 acres, greatly exceeding the stated Year 5 success criteria of 1.5 acres.

- Thirty-three (97%) of the 34[1] quadrats assessed in 2009 exhibited either "good" or "excellent" vigor. Therefore, the project target of *80 percent of the quadrats with planted stock showing "good" or "excellent" vigor* was met in Year 5. This is a 4% increase over the 2008 results.

The observed 2009 Pacific cordgrass patch size (1.12 acres) was almost double the area measured in 2008 (0.65 acre). The vigor of the transplanted colonies and the vegetative growth from the existing stand was determined to be excellent in 2009, with no disease or pathogens observed. Despite great increases in patch size, overall acres of Pacific cordgrass fell short of the original project performance standard of 2.2 acres, but met the 2008 proposed modified project performance standard (described below).

As described in the 2008 monitoring report and summarized in Chapter 4, we believe that the original project performance standard over-estimated the amount of potential habitat available onsite to be colonized by Pacific cordgrass and further, over-estimated the growth rate for Pacific cordgrass after establishment (i.e. overestimated the rate at which the newly planted material would spread from the original planting site). We concluded in 2008 that it might never be possible for the site to support 2.2 acres of Pacific cordgrass (the original projected acreage estimated for the site). We concluded that the original performance standards and annual target measurements for Pacific cordgrass were simply too high to be achievable within the performance period, and even if achieved, would result in loss of valuable unvegetated mud flat foraging habitat and loss/conversion of pickleweed habitat, two undesirable project outcomes. We proposed that a more feasible Year 5 performance measure would be 1.12 acres (a projected acreage derived by re-estimating available habitat and observed colonization patterns). Assuming that USFWS accepts the proposed new performance standard of 1.12 acres for Pacific cordgrass, the project has met the performance standard for Pacific cordgrass.

Based on the observed 2009 site conditions, we believe that the restoration effort has met the intent of the modified performance standard for Pacific cordgrass and the original performance standards for all other monitoring parameters. No remedial actions or additional monitoring years are required, and we recommend that USFWS accept this project as complete.

[1] The number of quadrats evaluated under this performance measure increased to 34 in 2009 from 27 in 2008 due to inplanting within WSMRP.

1.0 INTRODUCTION

This document presents results of the fifth and final year (2009) monitoring of the Western Stege Marsh Restoration Project (WSMRP) at the Richmond Field Station (RFS), University of California, Berkeley (UC Berkeley) campus. May & Associates, Inc. was contracted by UC Berkeley in October 2008 to conduct the fifth and final year of vegetation monitoring in Western Stege Marsh. This Year 5 monitoring report has been prepared in compliance with regulatory permits associated within the environmental remediation activities (Phases 1-3, completed by 2004). The permits require that the post-remediation restoration activities be monitored to evaluate the project's success.

The WSMRP Monitoring Plan (Blasland, Bouck and Lee, Inc. 2004) defines the post-remediation vegetation monitoring required under the regulatory permits for the WSMRP. The WSMRP Monitoring Plan outlines project targets for hydrology, water quality, and restoration of salt marsh and coastal scrub communities, and also the overall program goal of establishing a compositionally and structurally complex system. The WSRMP Monitoring Plan defines vegetation project targets, standards, measurements, and survey methods and frequencies. These standards were designed to detect changes in marsh dynamics and vegetation community composition following the initial remediation and restoration events.

This report summarizes the results of the Year 5 monitoring conducted at the WSMRP site in 2009, specific to the vegetation targets presented in the WSMRP Monitoring Plan. It also summarizes how restoration project performance standards (as defined within the WSMRP Monitoring Plan (Blasland, Bouck and Lee, Inc. 2004)) were achieved.

1.1 Purpose

The purpose of this vegetation monitoring report is to document the results of the Western Stege Marsh Restoration Project (WSMRP) vegetation surveys and assessments conducted in 2009. The objectives of the vegetation monitoring are to:

- Quantitatively assess cover and vigor of the low salt marsh (Pacific cordgrass);
- Quantitatively assess the cover and vigor of the middle salt marsh (pickleweed);
- Quantitatively assess the cover, composition and vigor of the ecotone and upland coastal scrub habitat;
- Quantitatively evaluate the overall vegetation community composition of the restoration project;
- Illustrate progress toward, or deviation from, proposed vegetation project targets as articulated by the WSMRP Monitoring Plan; and
- Assess the overall program's success in achieving the vegetation performance standards for the restoration project.

1.2 Location

The RFS is located at 1301 South 46th Street in Richmond, Contra Costa County, California (Figure 1).

1.3 Environmental Setting/Site Background

The RFS supports grassland and wetland habitat of high ecological value. The RFS occupies approximately 96 acres of upland, 5.5 acres of transitional area (upland fill on former tidal mud flat), and 68.5 acres of tidal marsh and mudflats. The Western Stege Marsh occupies approximately 7.5 acres. Included within these areas is a diversity of habitat types that support a number of native vegetation communities including salt and brackish marsh, freshwater meadow and seep associations, and coastal scrub. Prior to UC Berkeley purchasing the RFS property in 1950, it was owned by the California Cap Company who used the property for over half a century to manufacture explosives. Many of these habitats have been disturbed through the introduction of fill materials, the invasion of non-native plant species, increased development, and the impacts of past industrial operations from on and off site sources. Today, these habitats support a diversity of vegetation and wildlife species including the federally endangered California clapper rail *(Rallus longirostris obsoletus*).

As mentioned above, the Western Stege Marsh occupies approximately 7.5 acres. Approximately 5 acres of marsh and ecotone habitat are the subject of this report, as this area was disturbed during environmental remediation activities. Habitat restoration work began following UC Berkeley's removal of environmental contaminants from the eastern section of the marsh system in 2004 and has continued to the present, with a primary focus on invasive non-native plant control and revegetation with native plants. The environmental remediation efforts provided a unique opportunity to enhance the vegetation communities within Western Stege Marsh by increasing native vegetation richness and advancing the establishment of a viable seed bank while maintaining an opportunity for natural vegetative recruitment within the re-graded marsh habitat.

As a result of the habitat restoration efforts, the marsh ecosystem in the WSMRP is composed of ecologically diverse and well-established high, middle, and low marsh habitats. The upper marsh edge is defined as the five-foot contour (National Geodectic Vertical Datum (NGVD 29) in the project area.

The ecotone (transition zone) is also well-developed and averages between 10-25 feet in width between the high marsh and upland habitats. Upland habitat has been established on all but the western section of the marsh, and upland revegetation activities have also occurred on the "island" area just north of the Bay Trail. Upland habitat primarily consists of coastal scrub, coastal terrace prairie and ruderal habitat.

Figure 1. Project Location - Western Stege Marsh Restoration Project

Project Site

0 0.5 1 2
Miles

N
W E
S

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C. Crooker ~ 12/19/07
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2.0 METHODS

2.1 Data Compilation

Prior to initiating the 2009 vegetation monitoring surveys, the following tasks were completed:

- The species list on the 2009 vegetation monitoring data sheet was revised (Appendix A). This was accomplished by walking the site and augmenting the current species list with species observed in 2008 and spring 2009;
- The 2005, 2006, 2007, and 2008 vegetation monitoring data sets were reviewed;
- Smooth cordgrass control measures performed in 2006, 2007, 2008, and 2009 were reviewed and organized chronologically into a table (Appendix B);
- Previous photo documentation records were reviewed; and
- The restoration project activities, monitoring results, and invasive non-native plants control actions performed by the RFS Restoration Coordinator and Shelterbelt Builders Inc. were reviewed.

2.2 Vegetation Field Survey Dates and Methods

Several methods were used to monitor the vegetation within the WSMRP. These included monitoring the vegetation quadrats within the project area, mapping the aerial extent and distribution of pickleweed and the distribution and cover of Pacific cordgrass using a global position system (GPS), and conducting a species inventory. These methods provide several measures of the health of the vegetation community, including native plant cover, richness, and health, non-native plant occurrences; vegetation community composition and the spatial extent of targeted species within the low and mid marsh habitats. Each method is described in detail below.

2.2.1 VEGETATION QUADRAT SURVEY METHODS

Ecotone transect surveys were conducted on May 15 and May 16, 2009 by Loran May, Senior Botanist and Sharon Farrell, Senior Botanist with May & Associates, Inc. using the methods specified within the WSMRP Monitoring Plan (BBL, 2004). Ecotone monitoring points were confirmed with UC Berkeley staff prior to conducting surveys (Haines, pers. comm., 2009). All fourteen ecotone monitoring points were surveyed (i.e., monitoring points A-1 through A-5, A'-1' through A'-3', B-1, C-0, D-0, E-0, F-1 and G-1). (Figure 2.2.1).

Vegetation transect surveys were conducted in 49 quadrats on September 18 and 26, 2009 by Loran May, Sharon Farrell, and Christina Crooker. Vegetation transect points were confirmed with the RFS project's Restoration Coordinator prior to conducting surveys (Haines, pers. comm., 2009).

Figure 6 from the *Draft Year 2 Monitoring Report for Western Stege Marsh Restoration Project* (Tetra Tech EM Inc., 2007) (Figure 2.2.1) and Figure 2.2.2 from the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2008* (May and Associates Inc.) were used to identify the location of each vegetation transect point. Permanent points had been previously demarcated with either a 6-foot green T-stake or a 3-foot wooden stake. The labeling identifying each specific quadrat stake however, had faded from some of the T-stakes in 2008 so each stake had to be relabeled as a part of the Year 5 (2009) monitoring effort.

A one-meter quadrat was placed at the southwestern corner of each monitoring stake. All native and non-native plant species found within each quadrat was recorded on the data sheet. Plants were identified using the *Jepson Manual: Higher Plants of California* (Hickman 1993). Additionally, the cover class was recorded using the midpoint classes of percent cover, as specified in the WSMRP Monitoring Plan (BBL, 2004) and illustrated in Table 2.2.1.1. Dominant species were noted and the vigor of the dominant planted material was qualitatively assessed using the criteria indicated in Table 2.2.1.2.

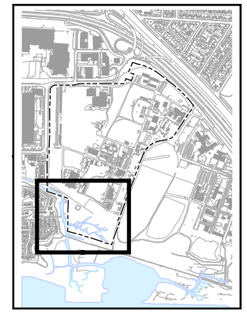
Table 2.2.1.1. Cover Class Midpoints

Percent Cover Range	Cover Class Midpoint
< 1%	0.5
1 – 5 %	3
6 – 15 %	10.5
16 – 25 %	20.5
26 – 45 %	38
46 – 75 %	63
76 – 90 %	85.5
> 90 %	98

Table 2.2.1.2 Qualitative Score for Assessing the Vigor of Planted Stock

Score	Description of Score
Excellent	No evidence of stress; minor pest or pathogen damage may be present
Good	Some evidence of stress; pest or pathogen damage present
Fair	Moderate level of stress; high levels of pest or pathogen damage
Poor	High level of stress; high levels of pest or pathogen damage

Appendix C contains the summarized vegetation quadrat survey data for both the spring and fall surveys, respectively.



- Vegetation Sampling Quadrats
- Transects
- Exising Buildings
- Marsh Area Boundary
- Property Boundary
- Surface Water
- Pacific Cordgrass (*Spartina foliosa*); 1.120 acres
- Salty Susan (*Jaumea carnosa*); 0.185 acres
- Saltgrass (*Distichlis spicata*); 0.289 acres
- Pickleweed (*Salicornia virginica*); 1.546 acres
- Ecotone; 0.607 acres
- Restored Upland; 0.373 acres
- Mud; 1.007 acres
- Bulrush (*Scirpus americanus*); 0.32 acres
- Non-Native Transitional Upland; 5.24 acres
- Approximate Clapper Rail Habitat Area
- Approximate 200-foot Buffer
- Biologically Active Permeable Barrier Wall
- Former Seawall (Approximate)
- Slurry Wall
- Roads and Other Landscape Features

Storm Drain Lines:

- Open Swale
- Underground Culvert

Sanitary Sewer Lines:

- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

100 0 100

Feet

TETRA TECH EM INC.

Richmond Field Station
University of California, Berkeley

FIGURE 2.2.1
VEGETATION COMMUNITY DATA

2009-12-15 v:\misc_gis\richmond_field_station\projects\marsh_monitng\year_5\mxds\marsh_habitat_areas.mxd TtEMI-OAK colin.lee

Figure 2.2.2. Location of Permanent Vegetation Quadrats and Transects

Vegetation Quadrats

0 10 20 40 60
Meters

N
W E
S

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C. Crooker ~ 02/03/2008
Fig_2_2_2_loc_perm_veg_quadrats_transects2_11x17_20080203.mxd

2.2.2 DOMINANT VEGETATION MAPPING METHODS

The WSMRP Monitoring Plan specifies that the acreage of Pacific cordgrass and pickleweed habitat will be evaluated during the fall (i.e., September/October) monitoring event through use of vegetative mapping and through data collected from quadrats. It suggests that dominant vegetation groups be calculated and shown on computer-aided design (CAD) drawings.

In 2009, the aerial extent of pickleweed and other dominant low and mid marsh vegetation groups was mapped. The outer edges of all pickleweed, salty Susan and salt grass populations, and upland restoration plot boundaries were recorded in the field using GPS. The minimum mapping unit was 2 square-meters. This methodology was also used in 2007 and 2008, replacing the methods used in 2005 and 2006 in order to increase the level of accuracy in estimating acreages. The vegetation community mapping was conducted on September 26 and 27, 2009 by Sharon Farrell and Christina Crooker, GIS Specialist. The data was uploaded into a Geographic Information (GIS) database. Results of the dominant vegetation mapping are reported in Section 3.2.

2.2.3 PACIFIC CORDGRASS (SPARTINA FOLIOSA) SURVEY METHODS

Year 1 (2005) and Year 2 (2006) monitoring methods for Pacific cordgrass had limited success in evaluating the establishment and vigor of the plantings (Hans, pers. comm., 2007). Therefore, May and Associates Inc. developed a more rigorous monitoring methodology in Year 3 (2007) to better evaluate the growth of the cordgrass. The area was divided into polygons, and discreet plant clusters that were visible in the field were flagged then mapped using GPS, as described below and as illustrated in Appendix D (data and figures) and Appendix G (map of polygon locations).

Pacific cordgrass was mapped using the same cover class types that were used for characterizing the plant cover within the vegetation quadrats. The mapping was conducted on September 26 and 27, 2009 by Sharon Farrell and Christina Crooker, GIS Specialist. The entire cordgrass population within the WSMRP was broken into polygons based upon differences in cover class and mapping unit size throughout its distribution. Changes in cover class were noted by botanists using ocular estimates. The outer edges of each polygon were then demarcated with pin flags. The cover class for each polygon was then recorded using the data sheet illustrated in Appendix D. Each distinct polygon was photographed. The minimum mapping unit was one square-meter, plantings under this size were mapped as discreet individuals.

All polygons and discreet individuals were mapped using GPS. Additionally, the leading edge of the existing Pacific cordgrass stand west of the WSMRP and any individuals seedlings were also mapped using GPS. The data was uploaded into a Geographic Information (GIS) database. Results of the Pacific cordgrass mapping are reported in Section 3.3 below.

2.3 Photodocumentation

Photodocumentation provides a visual record of the restoration progress within the WSMRP. Figure 6 from the draft *Year 2 Monitoring Report for Western Stege Marsh Restoration Project* was used to identify the location of each photomonitoring point. All of the permanent points were monitored during both the spring (May 16, 2009) and fall (September 18, 2009) vegetation monitoring activities. Directional bearings were assigned to each point in 2007 as these were not previously noted in any monitoring documents. A list of these bearings is presented in Table 2.3. Additionally, photographs of each vegetation quadrat were taken. Appendix E contains of the permanent photopoint images and Appendix F contains the 2009 vegetation transect monitoring images.

Table 2.3. WSMRP – Permanent Photo Points

Photo Point Number	**Location** **Photo point # and bearing in degrees***
1	West 240 West 236
2	East 124 SE 148 South 190
3 South	NW 296 West 280 190
4	North 0 NW 330 West 292
5	East 106 NE 32 West 306
Notes: *compass was set for 14 degrees declination Camera set at maximum wide angle, 38 mm.	

2.4 Plant Species Inventory

Appendix G contains an inventory of plant species observed during the May and September vegetation monitoring activities. Both native and non-native species were recorded.

3.0 RESULTS

The vegetation project targets are outlined under Project Target #3 in the WSMRP Monitoring Plan (Blasland, Bouck and Lee, Inc. 2004). The overall target is to:

> "*Restore low salt mash (i.e., Pacific cordgrass), middle salt marsh (i.e., pickleweed), emergent marsh, and coastal scrub native plant communities within the WSMRP."*

The Monitoring Plan (Blasland, Bouck and Lee, Inc. 2004) identifies four standards to evaluate the degree to which the target has been met. The standards are listed below:

- Percent cover of native vegetation (excluding areas of tidal mudflat);
- Total acreage of Pacific cordgrass;
- Total acreage of pickleweed; and
- Vigor of planted stock.

Table 3.0 identifies to the associated field indicators/measurements for each project standard by year (following the initial restoration actions). The 2009 vegetation monitoring results are compared to the highlighted Year 5 field indicators/measurements.

Table 3.0 Project Standards for the WSMRP (BBL, 2004)

Project Target #3: *Restore low salt mash (i.e., Pacific cordgrass), middle salt marsh (i.e., pickleweed), emergent, and coastal scrub native plant communities within the WSMRP.*

Project Standard	Field Indicator/Measurement
Percent cover of native vegetation (excluding tidal mudflats)	Year 2: Greater than or equal to 20% Year 3: Greater than or equal to 40% Year 4: Greater than or equal to 60% Year 5: Greater than or equal to 80%
Total acreage of Pacific cordgrass	Target Acreage: 2.6 acres Year 1: Greater than or equal to 15% of target acreage (0.4 acres) Year 2: Greater than or equal to 30% of target acreage (0.8 acres) Year 3: Greater than or equal to 50% of target acreage (1.3 acres) Year 4: Greater than or equal to 65% of target acreage (1.7 acres) Year 5: Greater than or equal to 85% of target acreage (2.2 acres)
Total acreage of pickleweed	Target Acreage: 1.7 acres Year 1: Greater than or equal to 15% of target acreage (0.3 acres) Year 2: Greater than or equal to 30% of target acreage (0.5 acres) Year 3: Greater than or equal to 50% of target acreage (0.9 acres) Year 4: Greater than or equal to 65% of target acreage (1.1 acres) Year 5: Greater than or equal to 85% of target acreage (1.5 acres)
Vigor of planted stock	Greater than or equal to 80% of vegetation plots assessed as "Good" or "Excellent"

3.1 Vegetation Quadrat Survey Results

Vegetation monitoring activities were conducted in 14 ecotone quadrats on May 15 and 16, 2009, and 50 quadrats on September 18 and 25, 2009. Quadrat surveys were performed in the 44 quadrats that were established in 2004; an additional three quadrats established in 2006; and an additional three ecotone and upland quadrats established in 2007.

Quadrat survey data and photographs of the vegetation composition within the quadrats for both the May and September 2009 surveys are presented in Appendices C and F respectively.

Five[2] of the 50 quadrats are located within tidal mudflats (i.e. Quadrats C-3, C-7, D-2, D-3, and E-1), and were not used in calculating the percent cover of native vegetation for this project standard[3]. Native vegetation cover within each quadrat was calculated by summing the cover class midpoints for each of the native plant species identified.

The total resulting estimated native vegetation cover for 2009 was 81.7 percent. The project standard for Year 5 is "greater than or equal to 80%." Therefore the observed native vegetation cover in 2009 exceeded the annual success criteria by approximately 1.7 percent (Table 3.1).

Table 3.1 Comparison of Target and Actual Cover of Native Vegetation

Project Year	Project Standard	Percent cover of native vegetation (excluding tidal mudflats)
Year 2 (2006):	Greater than or equal to 20% cover of native vegetation	44%
Year 3 (2007):	Greater than or equal to 40% cover of native vegetation	59%
Year 4 (2008):	Greater than or equal to 60% cover of native vegetation	76%
Year 5 (2009):	**Greater than or equal to 80 % cover of native vegetation**	**82%**

[2] Note: In 2008 nine quadrats were recorded as mudflats. In the 2009 the distribution of pickleweed and associated low and mid marsh plant species expanded resulting in only 5 of the quadrats supporting mudflats.
[3] The WSMRP Monitoring Plan 2004 (Table 2) stipulates that vegetative cover calculations should exclude tidal mudflats.

Pickleweed was the dominant species observed in these areas in 2009, with an additional 18 native plant species also recorded within the quadrats (the same number as observed in 2008). Species observed in 2009 included California aster (*Aster chilensis*), California sagebrush (*Artemisia californica*), marsh heliotrope (*Heliotopium curassavicum*), marsh gumplant, Pacific cordgrass, salty Susan (*Jaumea carnosa*), and alkali heath (*Frankenia salina*).

The total estimated non-native vegetation cover within the quadrats (excluding the tidal mudflats) in 2009 was 4 percent, a 30 percent reduction from 2008. As was recorded in 2007 and 2008, the quadrats located in the ecotone and upland areas supported a higher coverage of non-native vegetation than the marsh quadrats. The dominant invasive non-native species observed in 2009 were annual grasses: ripgut brome (*Bromus diandrus*), Italian wildrye (*Lolium multiflorum*), rattail fescue (*Vulpia myuros*) and little sickle grass (*Parapholis incurva)*. No high priority targeted invasive non-native plants including: Russian thistle (*Salsola soda*), birdsfoot trefoil (*Lotus corniculatus*), or perennial pepperweed (*Lepidium latifolium*) were observed in any of the quadrats in 2009. This is significant as Russian thistle was recorded in one quadrat in 2008 and in 3 quadrats in 2007. Birdsfoot trefoil was recorded in one quadrat in 2008 and 4 quadrats in 2007.

3.2 Vegetation Mapping Results

Vegetation mapping activities were performed on September 26 and 27, 2009. Overall percent vegetative cover and percent cover by dominant vegetation groups were both calculated using GIS. The acreage of habitat dominated[4] by pickleweed within the WSMRP in 2009 was approximately 1.71 acres. The distribution[5] of pickleweed in 2009 is illustrated in Figure 3.2.1. The acreage of pickleweed recorded in 2009 exceeds the 1.5 acres target acreage. All of the pickleweed within the marsh has colonized naturally and is not the result of active planting. Additionally, the alkali heath (*Frankenia salina*), marsh heliotrope (*Heliotopium curassavicum*), marsh lavender (*Limonium californicum*), and *Triglochin maritima* plantings from 2005-7 are well established, with the majority exhibiting excellent vigor and recruitment. In the northern section of the marsh, the majority of salty Susan patches have expanded by more than 50 percent. The above observed site conditions demonstrate that the low and middle marsh habitats are evolving and support a diverse number of species.

The total acreage of the native vegetation within the WSMRP is approximately 4 acres, an increase of approximately 0.5 acres from 2008. Pickleweed is the dominant vegetation group within the WSMRP site. Salt grass, Pacific cordgrass, salty Susan, ecotone and upland vegetation groups were also mapped. The results are depicted on Figure 3.2.2. The ecotone habitat covers approximately 0.6 acres; upland habitat constitutes approximately .37 acres; salt grass dominates 0.29 acres, salty Susan dominates 0.19 acre and Pacific cordgrass has spread into 1.12 acres. Pacific cordgrass mapping is described in greater detail in Section 3.2 below. Additionally, mudflats comprise approximately 1.36 acres.

[4] Note: pickleweed also integrades within the vegetation assemblages demarcated as supporting salty Susan, salt grass and Pacific cordgrass. While it dominates the middle salt marsh zone, it intergrades at its lower limits with Pacific cordgrass at elevations below MHW and extending into the high marsh zone, above MHHW.

[5] Note: pickleweed is found throughout the low and mid marsh areas, Figure 3.2.1 notes where the species is dominant for the purpose of assessing the achievement of performance measures.

Figure 3.2.1. Distribution of Pickleweed in the WSMRP

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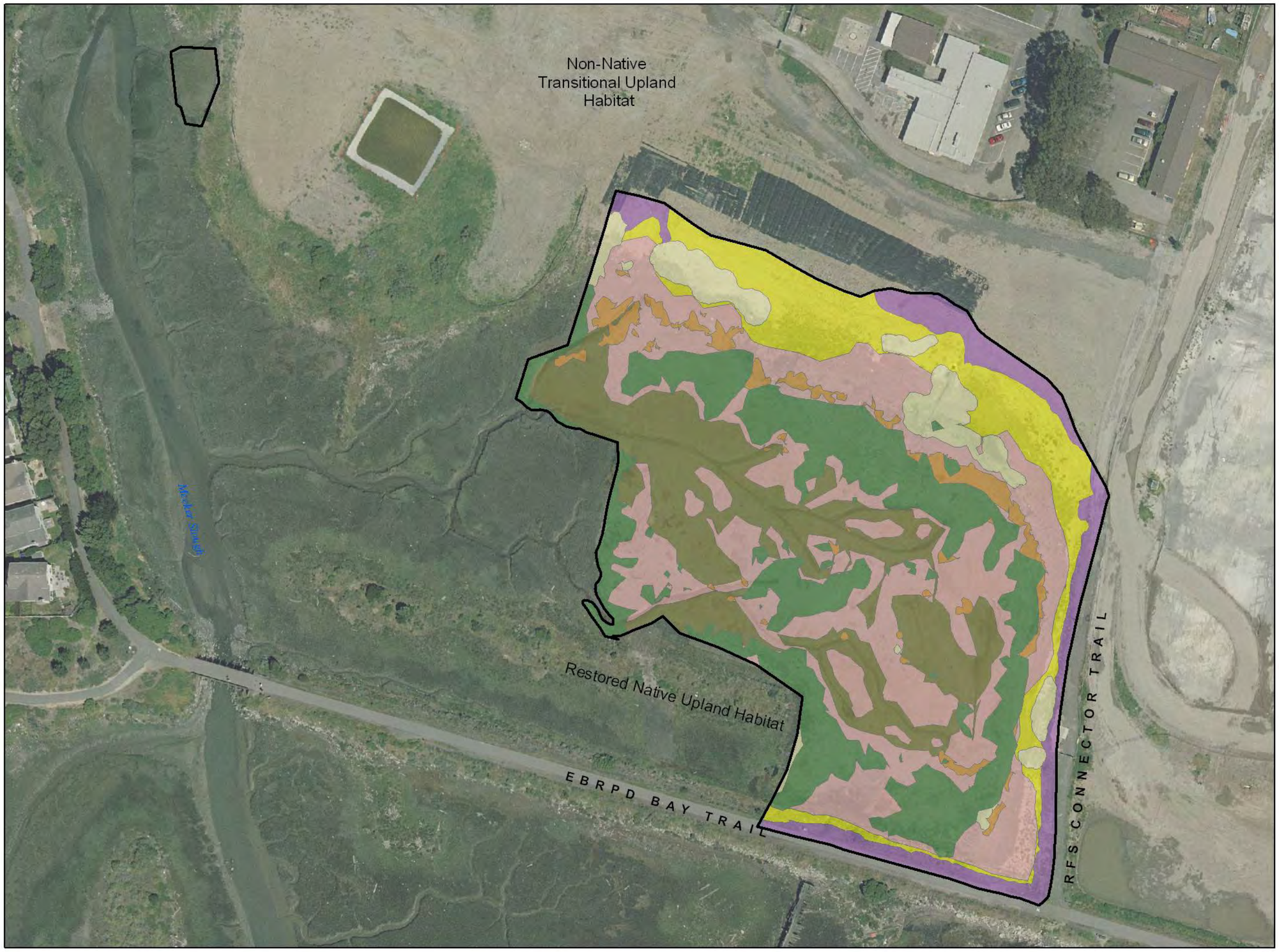
11/4/2009 CC
C:\rfs_spartina_10_2009\mxds\
Fig_3_2_1_dist_pickleweed_11x17_20091106.mxd

Figure 3.2.2 Vegetation Mapping, 2009



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C:\rfs_spartina_10_2009\mxds\
Fig_3_2_2_veg_mapping_wsmrp_20091106.mxd

3.3 Pacific Cordgrass Mapping Results

The Pacific cordgrass colonies within the WSMRP have spread vegetatively via rhizomes from the original divisions that were planted at the site in 2003 and in 2006. Approximately 65 percent of the 2003 plantings and 90 percent of the 2006 plantings survived to 2009, and exhibited healthy growth (*Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2007*).

The 2009 mapping efforts utilized the same methodology that was performed in 2007 and 2008. Appendix D presents the cover class, actual estimated cover, and associated species found within every mapped Pacific cordgrass polygon in Year 5 (2009). Thirty-one[6] discreet polygons were mapped, with an average absolute cover of 40.6 percent for Pacific cordgrass within each polygon, an average increase in cover of approximately 21 percent from 2008 results. All of the mapped polygons contained pickleweed; 8 polygons contained salty Susan; and 7 polygons contained salt grass.

The leading edge of the of the existing intact Pacific cordgrass stand on the western edge of the project area was also mapped in 2009 using GPS. This was compared to the location of the leading edge in 2004[7]. The results of the analysis indicate that Pacific cordgrass has expanded an additional 0.15 acres vegetatively into the restoration project area, an increase of 0.07 acres from the 2008 mapping results.

A total of 1.12 acres of Pacific cordgrass was mapped in 2009 within the WSMRP site. Figure 3.3.1 illustrates the distribution and cover class of the Pacific cordgrass polygons as mapped in 2009. Figure 3.3.1a is found in Appendix D, and depicts the polygons as labeled during the field mapping activities.

The distribution of cover classes within the mapped Pacific cordgrass polygons varies throughout the site, with more than half of the colonies supporting a cover class of 26-45 percent vegetative cover or higher. The plantings exhibit excellent vigor; more than 4650 new shoots were observed emerging on the exterior edges of the mapped polygons on September 26, 2009, this is an increase of approximately 30 percent from 2008.

The original Year 5 performance standard for Pacific cordgrass standard was 2.2 acres. The acreage observed in 2009 was 1.12 acres, or approximately 51% of the original target measurement. In 2007, the Pacific cordgrass acreage was only 0.38, representing only 29% of the target measurement and in 2008 the observed acreage was 0.65 acres, representing only 38% of the target measurement. While the 2008 to 2009 acreage of Pacific cordgrass has almost doubled, it still falls short of the original performance standard of 2.2 acres. However, the acreage meets the recommended revised standard of 1.12 acres. Figure 3.3.3 provides a comparison of the Pacific cordgrass distribution in 2007, 2008, and 2009.

[6] The reduction in the number of polygons from 2008 is the result of approximately 11 of those polygons merging together as the result of healthy growth.

[7] The leading edge was digitized using a high resolution aerial image taken after the remediation activities in 2004.

The combined acreages of pickleweed and Pacific cordgrass documented during the past 4 years are shown in Table 3.3.1 below.

Table 3.3.1 Low and Middle Marsh Performance Standard Measurements

Plant Species Identified in Project Standard	Target Year 2 (2006)	Achieved Year 2 (2006)	Target Year 3 (2007)	Achieved Year 3 (2007)	Target Year 4 (2008)	Achieved Year 4 (2008)	Target Year 5 (2009) a-original b-recommended revised standard	Achieved Year 5 (2009)
Pacific Cordgrass (*Spartina foliosa*)	0.8 acres	0.01 acres	1.3 acres	0.38 acre	1.7 acres	0.65 acre	a) 2.2 acres b) 1.12 acres	1.12 acres
Pickleweed (*Salicornia virginica*)	0.5 acres	2.1 acres	0.9 acres	1.92 acres	1.1 acres	1.84 acres	1.5 acres	1.71 acres
Combined Pacific cordgrass & pickleweed	1.3 acres	2.11 acres	2.2 acres	2.3 acres	2.8 acres	2.51 acres	3.7 acres	2.97 acres

3.4 Pacific Cordgrass Seedling Mapping Results

Newly emerging cordgrass seedlings were mapped on a monthly basis from November 2008 to October 2009. Less than 137 seedlings were found within this period in the Western Stege Marsh restoration area. Mapping was completed by either the RFS Restoration Coordinator or Sharon Farrell. Seedling locations were noted on an aerial map and then digitized. Figure 3.4.1 illustrates the 2009 distribution of the cordgrass seedlings at the WSMRP. Following mapping, these seedlings were immediately removed as it was impossible to discern whether or not they could be Pacific, smooth or hybrid cordgrass seedlings. Removal of seedlings is consistent with the invasive non-native plant control strategy for the WSMRP. A percentage of seedlings were randomly collected and sent to the Invasive Spartina Project (ISP) in September 2009 for testing to determine if they were Pacific, smooth or hybrid cordgrass. The results have not been received as of the date of this report.

Smooth cordgrass and hybrids that were growing in the outboard marsh were mapped in August 2007 by the Invasive Spartina Project (ISP). The results of the ISP 2007 and 2008 tests in the vicinity of the RFS are provided in Figure 3.4.2. The ISP inventoried and mapped additional sections of the outboard marsh that were not completed prior to July 2008 and collected samples for genetic testing. One sample taken from the outboard portion of the marsh (outside the WSMRP) on City of Richmond property was confirmed as a hybrid. In 2008, the ISP obtained permission from the US Fish and Wildlife Service

(USFWS) to treat invasive cordgrass hybrids in the spring during active growth and before seed set. Eight colonies outside, but in proximity to the WSMRP area were treated by the ISP in early July 2009, including the 5 colonies that have been controlled since 2004 and three additional colonies that were discovered by the Restoration Coordinator. In September 2009, the Restoration Coordinator clipped inflorescences from the adjacent outboard hybrid stand which was not sprayed by ISP in July 2009.

Figure 3.3.1. Distribution and Cover Class of Pacific Cordgrass (Spartina foliosa)

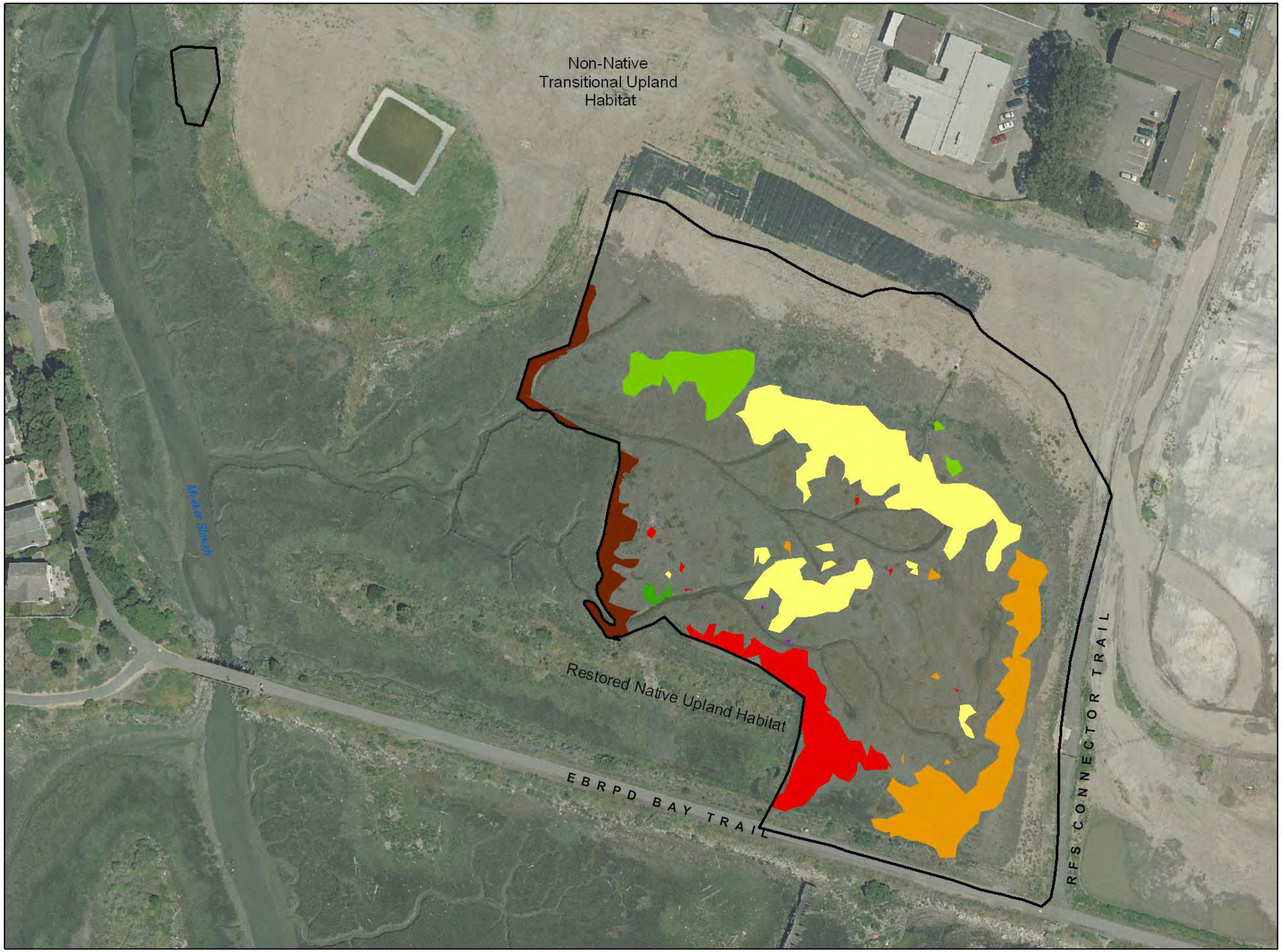

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Fig_3_3_1_dist_cov_cordgrass_11x17_20091104.mxd

Figure 3.3.2 Distribution of Pacific Cordgrass (Spartina foliosa) Polygons and Individuals

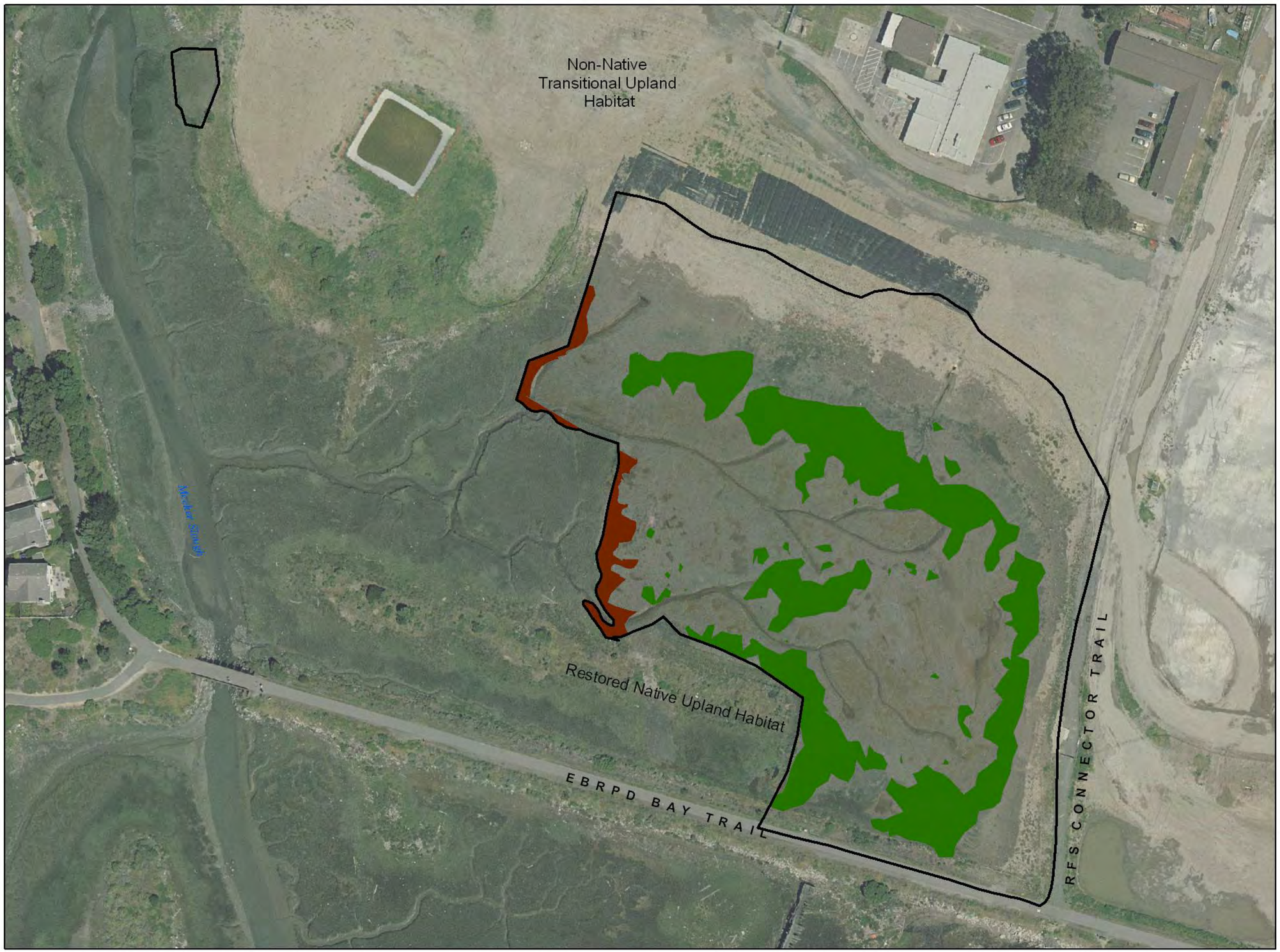

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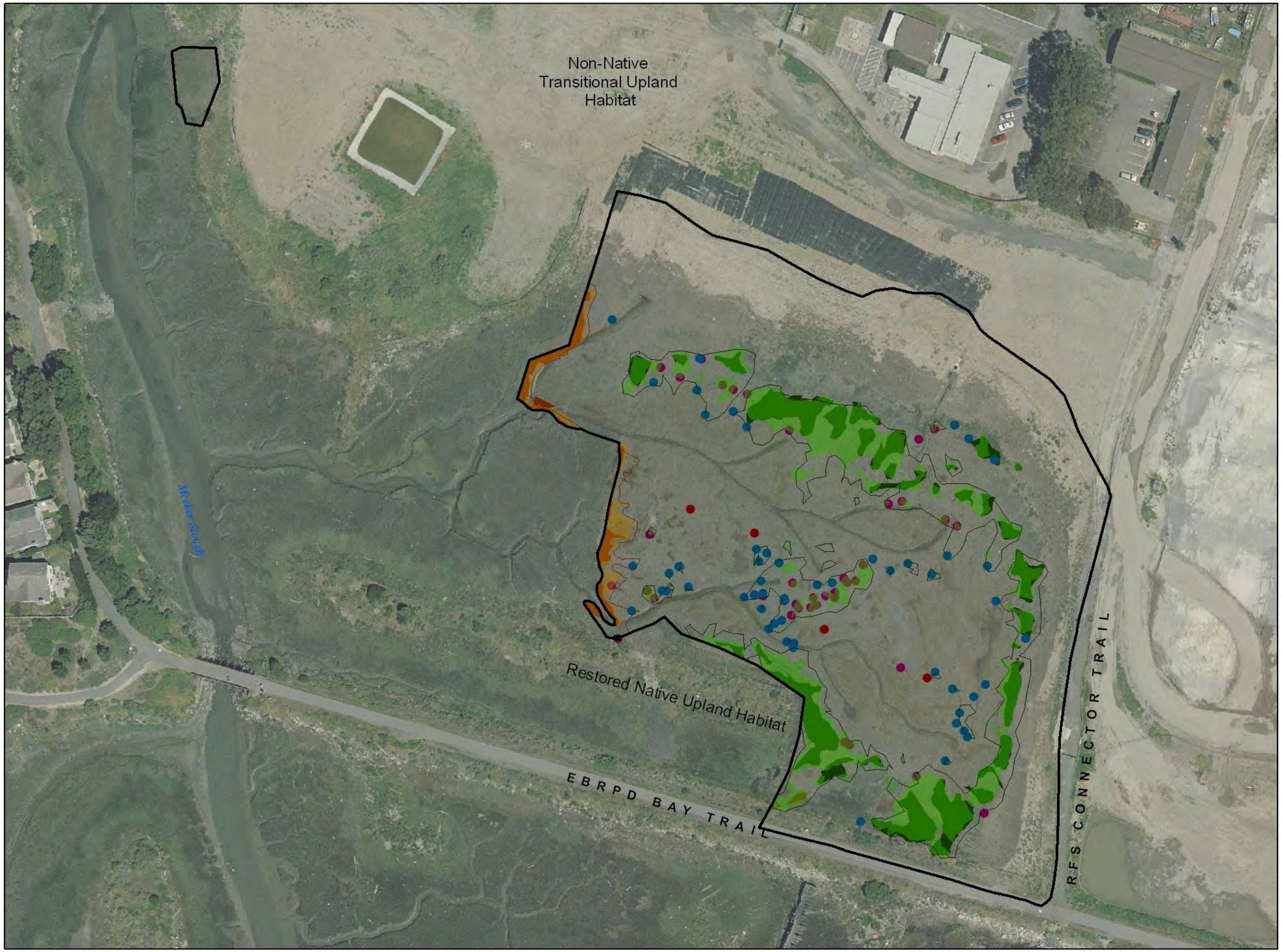
Fig_3_3_2_dist_cov_cordgrass_poly_ind_11x17_20091010.mxd

Figure 3.3.3. Comparison of Distribution of Pacific Cordgrass (Spartina foliosa) Polygons and Individuals in 2007, 2008, and 2009



2009 Cordgrass Individuals

Project Area

2009 Cordgrass Patches

(1.001 acres)

2009 Cordgrass expansion

(0.116 acres)

2008 Cordgrass Individuals

2008 Cordgrass Individuals

2008 Cordgrass Patches

(0.564 acres)

2008 Cordgrass Expansion

(0.083 acres)

2007 Cordgrass Individuals

2007 Cordgrass Individuals

2007 Cordgrass Patches

(0.329 acres)

2007 Cordgrass Expansion

(0.051 acres)

0 5 10 20 30 40
Meters

N
W E
S

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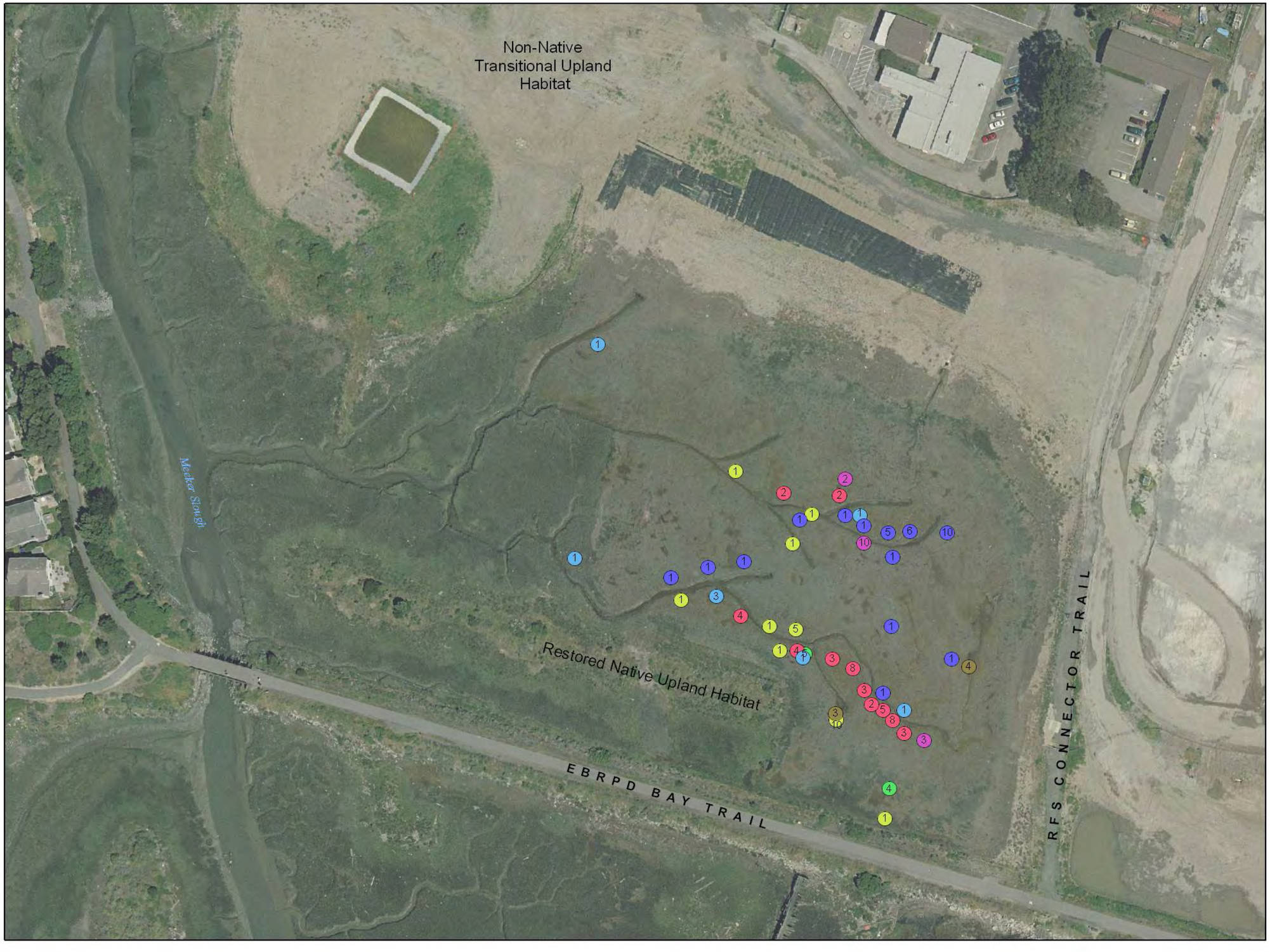
Fig_3_3_3_dist_cordgrass_poly_ind_2007_2008_2009_11x17_20091010.mxd

Figure 3.4.1. Distribution of Removed Cordgrass Seedlings in 2009



Cordgrass Seedlings

Month

- August
- December
- January
- July
- May
- October
- September

0 5 10 20 30 40
Meters

N
W E
S

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Fig_3_4_cordgrass_seedlings_11x17_20091104.mxd

Figure 3.4.2 San Francisco Estuary Project Invasive Spartina Project - Genetic Testing Results

3.5 Plant Vigor Results

Plant vigor was recorded in 34[8] of the 50 quadrats in 2009. These quadrats were selected because they had planted material. The remaining 16 quadrats did not contain planted material, and were either located in tidal mudflat habitat or supported vegetation that has established from natural recruitment. Vigor was measured qualitatively using the scale presented in Table 2.2.1.2 (See Sect. 2.2.1, above). Only the dominant planted species were assessed for vigor.

In 2009, only one quadrat exhibited "fair" vigor for the dominant vegetation; 2 quadrats exhibited "good" vigor; and 31 quadrats exhibited "excellent" vigor.

The measurement for this performance standard is that *"greater than or equal to 80 percent of vegetation plots assessed exhibit "good" or "excellent" vigor."* Thirty-three (97%) of the 34 quadrats assessed in 2009 exhibited either "good" or "excellent" vigor. Therefore, the project target of *80 percent of the quadrats with planted stock showing "good" or "excellent" vigor* was met in Year 5 (2009). This is a 3 percent increase over the 2008 results.

[8] The number of quadrats evaluated under this performance measure increased to 34 in 2009 from 27 in 2008 due to implanting within WSMRP.

4.0 CONCLUSIONS

May and Associates Inc. completed the Year 5 spring and fall 2009 WSMRP vegetation monitoring requirements in accordance with the WSMRP Monitoring Plan. May and Associates Inc. analyzed and interpreted the monitoring data to determine whether or not the field indicators/measurements for each performance standard had been met. This section discusses the conclusions.

Overall, 2009 site observations indicate that the WSMRP is supporting a diverse, ecologically viable, functioning marsh habitat. The species richness of the low, middle and high marsh, ecotone and associated upland was high in 2009. The native plant species cover within the transect quadrats was approximately 81.7 percent. Nonnative plant cover in 2009 was estimated to be 4 percent–the highest percentage of native plant species and lowest percentage of non-native plant species recorded in the past four monitoring seasons.

Three of the four original performance standard measurements established for Year 5 have been achieved, and the recommended revised fourth measurement has also been achieved. This original performance measure for Pacific cordgrass cover was determined in 2008 to be improbable to achieve given site conditions (described in more detail in the *Western Stege Marsh Restoration Project Vegetation Monitoring Report – 2008 (May & Associates, Inc 2008.)*. The recommendation in the 2008 report was to revise to the performance standard to a more realistic ecologically sustainable measure of 1.12 acres. The 2009 findings, and the 2008 revised performance standard and rationale are described in more detail below in Section 4.2.

4.1 Percent Cover of Native Vegetation

The vegetation monitoring quadrats in 2009 (excluding those located in tidal mudflats) supported an average of 81.7 percent native vegetation cover. The project standard measurement of "*greater than or equal to 80 percent cover*" has been met.

The percent cover of native vegetation varied in ecotone quadrats exhibited a steady and continuous increase in the native vegetation from 2004 to 2009 (as noted in the 2008 data) and the expansion of pickleweed throughout the project area from 2004 to 2009, especially in the southeastern and middle sections of the low and mid marsh habitats. The highest percentage of native cover was recorded in the marsh quadrats.

Native cover in upland quadrats also improved from 2004 to 2009, with only 4 quadrats supporting less than 50 percent native cover. Within upland quadrats, the per cent native cover has increased by 16% from 2008, likely the result of increased weeding and inplanting. Survivorship varied spatially and by species in the upland habitat areas, with some areas supporting dense native cover and some supporting stunted and limited native cover. Early plantings conducted in 2005-6 had low survivorship due to soil compaction, poor drainage and possible high levels of salinity. Plantings conducted in 2006-7 had higher

survivorship and vigor; with some natural recruitment of California sagebrush, yarrow (*Achillea millifolium*), coyote brush, and California aster observed in 2007 and again in 2008. In 2009, natural recruitment of yarrow, California sagebrush, bush lupine, grindelia, and frankenia increased. However, rhizomatous species such as California aster, mugwort, creeping wildrye (*Leymus triticoides*) and yarrow and bunch grasses had both the highest observed survivorship and increased overall cover.

Much of the increased native cover in the upland and ecotone quadrats can be directly attributed to the more aggressive and consistent weed control program implemented by the RFS Restoration Coordinator, U.C. Berkeley internship program and Shelterbelt Builders Inc. As recommended in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2008* (May & Associates, Inc 2008), weed control efforts were focused on bur clover (*Medicago polymorpha*), birdsfoot trefoil (*Lotus corniculatus*), Russian thistle (*Salsola soda*), stinky tarweed (*Dittrichia graveolens*), and prickly ox-tongue (*Picris echiodes*). Control techniques, including flaming and herbicide application, augmented the previous hand removal program, resulting in substantial reduction of cover of these target non-native species. Flaming was undertaken early in the season in December 2008 and January 2009 which resulted in reduced establishment of bur clover and increased spring growth of the native flora.

In areas that were dominated by birdsfoot trefoil and bur clover, rhizomatous species were planted densely in winter 2008-2009 to help reduce the re-colonization by these species. Planting occurred both before and after the initial flaming treatments in these areas. As recommended, approximately 10% of the planting palette in 2008-2009 was shrubs and forbs; the remaining planting palette primarily consisted of fast growing rhizomatous species including: aster, yarrow, creeping wildrye. Overall these in-plantings performed well; ocular estimates in 2009 indicate that the survival rate exceeded 70 percent.

4.2 Total Acreage of Pacific Cordgrass (*Spartina foliosa*).

The observed 2009 Pacific cordgrass patch size was almost double the area measured in 2008. Thirty-one (31) patches of Pacific cordgrass occupying a total of approximately 1.12 acres of the WSMRP low and mid marsh habitat were mapped in 2009 using the modified mapping and assessment method, as described above in Section 2.2.3. Refer to Appendix D for polygon data and Figure 3.1.1.a for the 2009 polygon distribution. The vigor of the transplanted colonies and the vegetative growth from the existing stand is excellent, with no disease or pathogens observed. Despite great increases in patch size, overall acres of Pacific cordgrass, and excellent health and vigor of observed plants in 2009, the total acreage of pacific cordgrass (1.12 acres) fell short of the original project performance standard of 2.2 acres, but met the recommended modified performance standard (May & Associates, Inc. 2008).

The 2009 observations reveal a steady colonization and spread of Pacific cordgrass throughout the site, resulting in 1.12 acres present by the end of the project. This acreage shortfall (i.e. less than the original target acreage of 2.2 acres) was predicted in 2008 and discussed in *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2008* (May & Associates, Inc. 2008). . The rationale for the projected acreage shortfall, are as follows:

- In 2008, we noted that the project performance standard likely over-estimated the possible annual growth rates of planted Pacific cordgrass during early years of establishment. For example, the maximum annual radial expansion rate documented at a marsh restoration project in the Tijuana Estuary varied between 3.7 and 4.3 feet, a rate of spread that was not achieved in several other Bay Area restoration projects until the third or fourth year after planting (Ward, pers. comm.., 2007). In 2009, we observed a higher growth rate than in previous years. For example, we estimated that the radial expansion of Pacific cordgrass stands on the southern section of the project area exceeded 5 feet in several locations. As a result, Pacific cordgrass acreage roughly doubled from 2008 to 2009. It is anticipated that the accelerated growth rates observed in 2009 will continue now that the Pacific cordgrass stands are established, provided environmental conditions permit.

- A second consideration is plant competition patterns. Pickleweed is a quick colonizer, and has already established in both the low and middle marsh habitats. However, over time, due to the rhizomatous nature of the Pacific cordgrass, the cordgrass will likely out-compete pickleweed, reducing the cover of the pickleweed in the low marsh over time. This pattern of spread is seen in the intact stands located west of the WSMRP, and in 2009, Pacific cordgrass acreage increases exceeded pickleweed acreage increases. Also, Pacific cordgrass substantially increased in cover in the northwestern and southeastern pickleweed patches, indicating that conversion of pickleweed areas to Pacific cordgrass will continue over time. Third, salinity within the marsh may also affect the distribution and vigor of Pacific cordgrass growth within the WSMRP.

- A fourth contributing factor affecting the rate and pattern of establishment of Pacific cordgrass in the WSMRP, (specifically the eastern section, and to a lesser extent several northern sections) could be the period of inundation, the rate and level of sediment accretion, and/or scouring patterns (Ward, pers. comm., 2008). The limited number of seedlings that were removed from the edges of these sections of the marsh have displayed poor vigor and exhibited minimal growth during all monitoring years; this continued to be true in 2009. Additionally, less than approximately 1% of the plantings in 2003 and 2006 in this area established, compared to more than 70-80% in other areas. It is likely that these areas will continue to show patterns of no or low levels of Pacific cordgrass into the future.

- Finally, based on the aerial extent and distribution patterns of Pacific cordgrass observed in 2007, 2008 and 2009, it is likely that there is less available potential habitat with the optimal saline, elevation, and tidal inundation characteristics favored by Pacific cordgrass than was originally planned for the site. GIS was used to calculate the approximate area (e.g. potential habitat where Pacific cordgrass could establish based solely on elevation data) between the average upper and lower land elevations within the WSMRP, using the two different low land elevations - 2.25 and 2.0 feet. The calculated areas are 2.08 acres and 2.59 acres respectively, see Figure 4.2.3.

For Pacific cordgrass to meet original Year 5 performance standard (2.2 acres), at the lower land elevation of 2.25 or 2.0 feet, the species would have to colonize 80-90 percent of the area currently occupied by mudflats, and approximately 45 percent of the area currently dominated by pickleweed. This appears unlikely to occur for the reasons outlined above. To date, minimal pickleweed colonization and growth has been observed in the mudflat areas, with no cordgrass seedlings having colonized and no planted Pacific cordgrass divisions surviving in these areas (Figure 4.2.4). Further, loss of all unvegetated mud flat habitat would considerably reduce areas of high wildlife value habitat for foraging wildlife, an undesirable outcome (Cannon, pers. comm. 2008).

In the 2008 report, we also noted that if Pacific cordgrass were to become the dominant species throughout the potential habitat areas bound by either the 2.25 or the 2.0 feet low land elevation (which for the most part are either pickleweed-dominated or mudflats), the total cover of pickleweed within the WSMRP would be reduced to 0.96 and 0.81 acres respectively. Therefore under either of these scenarios, the ability for the WSMRP to achieve the pickleweed long-term target performance standard would be improbable, resulting in the failure to meet the Year 5 performance measure of 1.5 acres of pickleweed in the future under any growth scenario.

In 2008, we concluded that based upon the above, it appears that the performance standards and annual target measurements for Pacific cordgrass were simply too high to be achievable within the performance period, and even if achieved, would result in loss of valuable unvegetated mud flat foraging habitat and loss/conversion of pickleweed habitat, two undesirable project outcomes. We also proposed that given the less-than-anticipated amount (acreage of) "optimal habitat areas" available for Pacific cordgrass establishment (e.g. exclusion of areas illustrated in Figure 4.2.4, etc.), that a more feasible Year 5 performance measure is 1.12 acres. This figure was reached by delineating the potential habitat that could be successfully colonized within the elevation band defined by 2.25 feet (low land elevation) and 3.25 feet (high land elevation).

We suggested two possible strategies for ensuring the success of the project as it relates to the establishment of Pacific cordgrass under the amended performance measure:

1. Reduce the Year 5 performance measure for pacific cordgrass acreage to 1.12 acres to reflect more accurately the amount of optimal habitat that was actually created on site (i.e. "as-built" conditions), the average annual radial growth rates and the anticipated effects of inter-specific competition associated with early establishing marshes.

2. Actively plant Pacific cordgrass from approved collection sites, as groupings of divisions in all of the areas identified within Figure 4.2.5.

These two strategies were presented to UC Berkeley staff and its consultants on December 5, 2008 for consideration and discussion. The feasibility and timing for additional plantings was evaluated in coordination with the ISP to ensure that no hybrid materials would be inadvertently introduced. On

December 16, 2008, Peggy Olson (Director of the ISP) requested that no additional plantings occur within the WSMRP because hybrid individuals had been discovered southwest of the WSMRP site. She and her field staff concurred that the current marsh vegetation was performing well, and that the introduction of additional spartina plantings could increase the probability of future hybridization.

Based upon the ISP feedback, we recommended in 2008 that UC Berkeley engage in discussion with USFWS staff to revise the original Pacific cordgrass standard from 2.2 acres to 1.12 acres. On September 3, 2009 UC Berkeley staff met with Nina Cavett, the Army Corps of Engineers and a follow-up meeting along with the USFWS staff is being planned for early spring 2010 (Hans, pers. comm.., 2009).

The mapped acreage of Pacific cordgrass within the WSMRP in 2009 was 1.12 acres, ironically the same acreage that was predicted in 2008 using the GIS model and assumptions presented in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2008.* While the acreages are numerically the same, the actually locations of increased growth are different from the 2008 modeling and the actual rate of growth of the lateral shoots observed in 2009 was greater than predicted in 2008. In 2008 we projected the average radial expansion to be 3-4 feet, however we believe that the rate of radial expansion was greater than predicted, as 2009 observations of Pacific cordgrass in several locations was over 5 feet. We also predicted that the radial expansion of the existing colonies would merge into a continuous band of cordgrass within the marsh. This prediction was observed to be true in 2009 except in 3 locations: (a small segment (approximately 10-feet wide) on the northwestern side; a small segment (approximately 12 feet wide) on the northeastern side; and a segment (approximately 15 feet wide) to the south (see Figure 3.3.1). Lastly, we predicted that Pacific cordgrass would dominate no less than 50% of the picklewed habitat in the middle marsh. Field surveys conducted in 2009 substantiate this prediction.

Based on the above, and the 2009 monitoring data results which indicate greater than 81.7 percent native vegetation cover combined within the low and middle marsh habitats have, a rich diversity of marsh species and vegetative structure with good to excellent vigor, we believe that the marsh has met all of the intended performance measures, including the modified performance measure for Pacific cordgrass and the value of the marsh in providing California clapper rail habitat.

Over time, we also believe that the marsh will continue to evolve, including the continued expansion of the Pacific cordgrass colonies. In addition to the radial expansion of the colonies, Figure 4.2.1 identifies anticipated future areas of colonization over time. As described in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2008,* this was developed:

- Using the 2007-2008[9] cordgrass seedling colonization data to model areas of future potential establishment;
- Using the lower land elevation data for predicting successful cordgrass colonization depending upon past seedling and planting performance at different locations within the WSMRP;

[9] This was also cross-checked with the 2009 monitoring results to ensure consistency.

- Using the spatial distribution of new pickleweed colonization to predict areas where the vegetation is successfully establishing and seedling colonization is not limited by scouring or accretion; and
- Maintaining enough habitat within the 2.0 – 3.25 foot elevation band for pickleweed colonization to meet the stated Year 5 performance measure.

Figure 4.2.1. Predicted Potential Pacific Cordgrass Colonization Areas within the WSMRP as Identified in 2008

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Fig_4_2_1_predicted_cordgrass_colonization_20091202.mxd

4.3 Total Acreage of Pickleweed (*Salicornia virginica*)

The 2008 pickleweed cover exceeds the required performance standard measurement by 0.25 acres, with pickleweed colonizing soils within the center sections of the marsh as well as the southeastern corner. Additionally, the middle and high marsh habitats support both high species diversity and cover. Patches of salt grass, salty Susan, marsh rosemary, alkali heath and other species are well distributed throughout the marsh system. The cover of salty Susan plantings increased to 0.19 acres, and the majority of alkali heath plantings demonstrated excellent vigor.

4.4 Vigor of Planted Stock

The measurement for this performance standard is that *"greater than or equal to 80 percent of vegetation plots assessed exhibit "good" or "excellent" vigor."* Thirty-three (97%) of the 34 quadrats assessed in 2009 exhibited either "good" or "excellent" vigor. Therefore, the project target of *80 percent of the quadrats with planted stock showing "good" or "excellent" vigor* was met in Year 5 (2009). This is a 3 percent increase over the 2008 results.

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APPENDIX A. VEGETATION TRANSECT MONITORING DATA SHEET - FALL 2009.

UC Berkeley RFS Western Stege Marsh Restoration Project
Vegetation Monitoring Data

Quadrat #: _____ Survey Date: _____ Surveyed by: _____

Height (inches, average of dominant species): _____ Photo #: _____

Percent cover within quadrat (if present)

Scientific Name	Common Name	< 1	1- 5	6- 15	16-25	26 - 45	46 –75	76 –90	> 90	Vigor
Achillea millefolium	Yarrow									
Artemisia californica	Common sagebrush									
Artemisia douglasiana	Mugwort									
Aster chilensis	California aster									
Atriplex triangularis	Saltbush, Spearscale									
Baccharis pilularis	Coyote brush									
Bromus diandrus	Ripgut brome									
Bromus carinatus	California brome									
Castilleja affinis	Coast Indian paintbrush									
Castilleja ambigua	Johnny nip									
Cotula coronopifolia	Brass buttons									
Danthonia California	California oatgrass									
Distichlis spicata	Saltgrass									
Dittrichia graveolens	Stinky tarweed									
Elymus glaucus	Blue wild rye									
Epilobium ciliatum	Fireweed, willow herb									
Eriophyllum staechadifolium	Lizard tail									
Grindelia hirsutula var. hirsutula	Gumplant									
Grindelia stricta var. angustifolia	Marsh gumplant									
Heliotopium curassavicum	Marsh heliotrope									
Heteromeles arbutifolia	Toyon									
Hordeum brachyantherum	Meadow barley									
Jaumea carnosa	Salty susan									
Limonium californicum	Marsh rosemary									
Lotus corniculatus	Birdsfoot trefoil									
Lupinus arboreus	Bush lupine									
Medicago polymorpha	Bur clover									
Melilotus										
Mimulus aurantiacus	Sticky monkeyflower									
Nasella pulchra	Purple needlegrass									
Parapholis incurva	Little sickle grass									
Picris echiodes	Bristly ox-tongue									
Plantago disectum	Cut-leaf plantain									
Polypogon monspliensis	Rabbits foot grass									
Rhamnus californica	Coffeeberry									
Salicornia virginica	Pickleweed									
Salsola soda	Russian thistle									
Sonchus asper	Prickly sow thistle									
Sisyrinchium bellum	Blue-eyed grass									
Spartina foliosa	Pacific cord grass									
Spartina alterniflora										
Spergula marina	Annual sand spurry									
Stellaria arvensis	Chickweed									
Vulpia myuros	Rat-tail fescue									
Algal mat										
Dead plant material										
Drift material										
Bare ground										

Qualitative Score for Assessing the Vigor of Planted Stock

Score	Description of Score
E- Excellent	No evidence of stress. Minor pest or pathogen damage may be present
G- Good	Some evidence of stress. Pest or pathogen damage present.
F- Fair	Moderate level of stress. High levels of pest or pathogen damage.
P- Poor	High level of stress. High levels or pest or pathogen damage.

Other Wildlife Observations (insects, birds, etc.) & Notes:

APPENDIX B. INVASIVE NON-NATIVE SPARTINA CONTROL SUMMARY.

Appendix B Summary of Invasive Smooth Cordgrass Control Efforts (2003-2009)

Date	Activity
Sep-03	Install Tarp over clones
Oct-07 to Dec-03	Monthly Monitoring and Maintenance of Tarp
Dec-03 to Feb-04	Monthly Monitoring and Maintenance of Tarp, Monitoring of Adjacent Marsh
Mar-04	Detection of satellite clone area adjancet to tarped area. Control of new infestation.
Mar- 04 to Jun 04	Monthly Monitoring and Maintenance of Tarp, Monitoring of Adjacent Marsh
Jun-04	Removed tarp for inspection, most plants dead, a few still green.
Jul-04 to Dec-04	Monthly Monitoring and Maintenance of Tarp, Monitoring of Adjacent Marsh. Inspected Tarp, all plants dead
Dec-04	Remove Tarp. Genetic Testing of possible new infestations
Jan-05	Confirmation of hybrids in marsh- control of new hybrid colonies south and west of tarped area.
Apr-05	Monthly Monitoring, Detection of some sprouts in previously tarped area
Apr-05 to Jul-05	Monthly Monitoring
Aug-05	Detection of new infestation by pier, plants in flower. Removal of 18 sq. feet of plants, herbicide application
Aug-05 to Nov-05	43 seedling removed
Dec-05, Feb-06, Mar-06, and Jun-06	3575 Pacific cordgrass plugs installed at site.
Jun-06	Removed seedlings (# unknown)
Jul-06 to Aug-07	Monthly Monitoring, Annual Inventory
'Oct-07	Collection of suspected hybrid seedlings for genetic testing, center of marsh
Oct 07 - Sept 08	Monthly seedling monitoring - removed total of 263 seedlings
Oct 07 - Oct 08	Sent 6 seedlings to ISP for genetic analysis - 4 completed, all Pacific cordgrass. Still waiting for results of analysis for last 2.
Jul-08	ISP treated 4 outboard colonies of hybrid with Imazapyr. Three additional colonies detected and treated.
Aug 08	1 seedling removed
Sept. 08	26 seedlings removed
Oct. 08	20 seedlings removed
10/28/2008	ISP inventoried sections of the outboard marsh that were not completed in July. Samples collected.
Dec. 08	9 seedlings removed. Samples collected in Oct came back as hybrid. The population is located in the outboard portion of the marsh on City of Richmond property.
Jan-09	7 seedlings removed
Feb. 09	Monthing monitoring. No seedlings new seedlings detected.
March 09	Monthing monitoring. No seedlings new seedlings detected.
April 09	Monthing monitoring. No seedlings new seedlings detected.
May 09	22 seedlings removed
July 09	45 seedlings removed. ISP conducted annual inventory. They collected samples, but are still working on getting a lab. Known hybrid populations were sprayed.
Aug 09	15 seedlings removed
Sept. 09	31 seedlings removed. Clipped inflorescenses from hybrid pop (outboard) that wasn't sprayed in July. Informed ISP of the population and sent in 3 seedlings from the inboard side of the marsh to be tested.
Oct. 09	8 seedlings removed. Clipped inflorescenses from hybrid pop that wasn't sprayed in July.

APPENDIX C. VEGETATION TRANSECT DATA: SPRING AND FALL 2009.

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)

WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings		Scientific Name	Common Name	% Cover							
Transect	Quadrat	Height (in)	Health			<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
A	A-1	0		Bare ground									X
	A-2	18"	G	*Achillea millefolium*	Yarrow				X				
				Aster chilensis	California aster			X					
				Atriplex triangularis	Saltbush, Spearscale		X						
				Bromus diandrus	Ripgut brome		X						
				Drift material			X						
				Bare ground					X				
	A-3	21"	E	*Aster chilensis*	California aster		X						
				Avena sp.		X							
				Bromus diandrus	Ripgut brome	X							
				Grindelia hirsutula var. hirsutula	Gumplant								X
				Bare Ground			X						
	A-4	9"	G	*Aster chilensis*	California aster	X							
				Grindelia stricta var. angustifolia	Marsh gumplant				X				
				Mulch								X	
	A-5	41"	E	*Aster chilensis*	California aster			X					
				Distichlis spicata	Saltgrass			X					
				Lolium multiflorum	Italian wildrye	X							
				Lupinus arboreus	Tree lupine							X	
A'	A'-1'	27"	E	*Bromus diandrus*	Ripgut brome	X							
				Bromus hordeaceous	Soft chess brome	X							
				Distichlis spicata	Saltgrass			X					
				Grindelia stricta var. angustifolia	Marsh gumplant					X			
				Dead plant material			X						
				Drift material				X					
				Bare ground						X			
	A'-2'	9"	E	*Distichlis spicata*	Saltgrass						X		
				Grindelia stricta var. angustifolia	Marsh gumplant					X			

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)
WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings				% Cover							
Transect	Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
				Salicornia virginica	Pickleweed		X						
	A'-3'	5"	E	*Grindelia stricta var. angustifolia*	Marsh gumplant		X						
				Parapholis incurva	Sickle grass			X					
				Salicornia virginica	Pickleweed							X	
				Dead plant material				X					
B	B-1	26"	E	*Aster chilensis*	California aster		X						
				Baccharis pilularis	Coyote brush								X
				Bromus diandrus	Ripgut brome	X							
				Grindelia stricta var. angustifolia	Marsh gumplant		X						
				Mulch			X						
	B-2	8"	E	*Distichlis spicata*	Saltgrass					X			
				Salicornia virginica	Pickleweed						X		
				Bare ground			X						
	B-3	8"	E	*Jaumea carnosa*	Salty susan		X						
				Salicornia virginica	Pickleweed							X	
				Bare ground				X					
	B-4	10"	E	*Salicornia virginica*	Pickleweed							X	
				Spartina foliosa	Pacific cord grass		X						
	B-5	9"	E	*Salicornia virginica*	Pickleweed								X
				Spartina foliosa	Pacific cord grass	X							
	B-6	9"	G	*Salicornia virginica*	Pickleweed						X		
				Algal mat				X					
				Bare ground						X			
	B-7	11"	E	*Salicornia virginica*	Pickleweed								X
				Spartina foliosa	Pacific cord grass				X				
C	C-0	25"	F	*Achillea millefolium*	Yarrow				X				
				Aster chilensis	California aster		X						
				Bromus diandrus	Ripgut brome		X						
				Parapholis incurva	Sickle grass		X						
				Salicornia virginica	Pickleweed			X					

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)

WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings				% Cover							
Transect	Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
	C-1	7"	E	*Jaumea carnosa*	Salty susan			X					
				Salicornia virginica	Pickleweed						X		
				Bare ground				X					
	C-2	7"	E	*Salicornia virginica*	Pickleweed					X			
				Algal mat					X				
				Bare ground					X				
	C-3	0		Algal mat								X	
				Mulch			X						
	C-4	9"	E	*Salicornia virginica*	Pickleweed						X		
				Vulpia myuros	Rat-tail fescue					X			
	C-5	6"	E	*Salicornia virginica*	Pickleweed			X					
				Vulpia myuros	Rat-tail fescue							X	
	C-6	8"	E	*Salicornia virginica*	Pickleweed							X	
				Algal mat				X					
D	D-0	15"	E	*Baccharis pilularis*	Coyote brush					X			
				Grindelia stricta var. angustifolia	Marsh gumplant				X				
				Lolium multiflorum	Italian wildrye			X					
				Salicornia virginica	Pickleweed		X						
				Dead plant material				X					
	D-1	2"	E	*Frankenia*					X				
				Salicornia virginica	Pickleweed					X			
				Bare ground					X				
	D-2	7"	E	*Salicornia virginica*	Pickleweed			X					
				Bare ground								X	
	D-3	2"		*Spartina foliosa*	Pacific cord grass		X						
				Algal mat						X			
				Bare ground						X			
	D-4	9"	E	*Jaumea carnosa*	Salty susan		X						
				Salicornia virginica	Pickleweed								X
	D-5	10"	E	*Salicornia virginica*	Pickleweed								X
				Bare ground			X						

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)
WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings				% Cover							
Transect	Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
	D-6	9"	E	*Salicornia virginica*	Pickleweed							X	
				Algal mat				X					
	D-7	18"	E	*Distichlis spicata*	Saltgrass				X				
				Salicornia virginica	Pickleweed					X			
				Spartina foliosa	Pacific cord grass						X		
E	E-0	6"	E	*Hordeum murinum*	Foxtail	X							
				Paraphalus incurva	Sickle grass			X					
				Salicornia virginica	Pickleweed					X			
				Mulch				X					
	E-1	3"	E	*Salicornia virginica*	Pickleweed				X				
				Bare Ground							X		
	E-2			*Salicornia virginica*	Pickleweed							X	
				Spartina foliosa	Pacific cord grass			X					
				Bare ground			X						
	E-3	11"	E	*Distichlis spicata*	Saltgrass		X						
				Salicornia virginica	Pickleweed							X	
				Spartina foliosa	Pacific cord grass					X			
	E-4	8"	E	*Distichlis spicata*	Saltgrass							X	
				Jaumea carnosa	Salty susan	X							
				Spartina foliosa	Pacific cord grass			X					
	E-5	19"	E	*Distichlis spicata*	Saltgrass		X						
				Grindelia stricta var. angustifolia	Marsh gumplant					X			
				Salicornia virginica	Pickleweed					X			
				Dead plant material				X					
	E-6	5"	E	*Distichlis spicata*	Saltgrass						X		
				Salicornia virginica	Pickleweed		X						
				Drift material			X						
				Bare ground					X				
	E-7	5"	E	*Atriplex triangularis*	Saltbrush, Spearscale			X					
				Avena sp.			X						
				Distichlis spicata	Saltgrass				X				

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)
WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings				% Cover							
Transect	Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
				Grindelia stricta var. angustifolia	Marsh gumplant		X						
				Jaumea carnosa	Salty susan					X			
				Salicornia virginica	Pickleweed		X						
	E-8	26"	E	*Avena sp.*		X							
				Baccharis pilularis	Coyote brush	X							
				Bromus hordeaceous	Soft chess brome	X							
				Distichlis spicata	Saltgrass				X				
				Grindelia stricta var. angustifolia	Marsh gumplant						X		
				Jaumea carnosa	Salty susan	X							
				Salicornia virginica	Pickleweed				X				
	E-9	38"	E	*Baccharis pilularis*	Coyote brush			X					
				Bromus diandrus	Ripgut brome	X							
				Distichlis spicata	Saltgrass			X					
				Grindelia stricta var. angustifolia	Marsh gumplant			X					
				Heteromeles arbutifolia	Toyon							X	
	E-10	8"	E	*Avena sp.*			X						
				Baccharis pilularis	Coyote brush						X		
				Bromus hordeaceous	Soft chess brome	X							
				Distichlis spicata	Saltgrass							X	
F	F-1	7"	E	*Grindelia stricta var. angustifolia*	Marsh gumplant		X						
				Salicornia virginica	Pickleweed			X					
				Dead plant material	Annual grasses						X		
	F-2	6"	E	*Salicornia virginica*	Pickleweed								X
	F-3	9"	E	*Distichlis spicata*	Saltgrass	X							
				Salicornia virginica	Pickleweed							X	
				Spartina alterniflora				X					
	F-4	8"	E	*Salicornia virginica*	Pickleweed								X
				Bare ground			X						

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)
WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings				% Cover							
Transect	Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
G	G-1	9"	E	*Distichlis spicata*	Saltgrass					X			
				Grindelia stricta var. angustifolia	Marsh gumplant			X					
				Limonium californicum	Marsh rosemary			X					
				Toxicodendron diversilobum	Poison Oak				X				
				Drift material			X						
				Bare ground				X					
	G-2	20"	E	*Distichlis spicata*	Saltgrass				X				
				Grindelia stricta var. angustifolia	Marsh gumplant					X			
				Jaumea carnosa	Salty susan				X				
				Limonium californicum	Marsh rosemary		X						
				Drift material				X					
				Bare ground				X					
	G-3	8"	E	*Artemisia californica*	Common sagebrush			X					
				Distichlis spicata	Saltgrass							X	
				Grindelia stricta var. angustifolia	Marsh gumplant			X					
				Jaumea carnosa	Salty susan		X						
				Salicornia virginica	Pickleweed		X						
	G-4	3"	E	*Bromus diandrus*	Ripgut brome	X							
				Distichlis spicata	Saltgrass				X				
				Grindelia stricta var. angustifolia	Marsh gumplant		X						
				Heliotopium curassavicum	Marsh heliotrope	X							
				Jaumea carnosa	Salty susan				X				
				Limonium californicum	Marsh rosemary	X							
				Salicornia virginica	Pickleweed		X						
				Dead plant material					X				
				Drift material				X					

Appendix C: Vegetation Survey Results and Vigor of Planted Stock for the Western Stege marsh Restoration Project Site (Fall 2009)

WSMRP - Vegetation Transect Monitoring - Sept 18th & 26th, 2009

Location		Vigor of Plantings		Scientific Name	Common Name	% Cover							
Transect	Quadrat	Height (in)	Health			<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90

APPENDIX D. PACIFIC CORDGRASS MONITORING DATA 2009

Appendix D: Pacific Cordgrass Cover Class Data

UC Berkeley RFS Western Stege Marsh Restoration Project
Spartina Monitoring Data

Survey Date: 9-26-09 & 9-27-09 **Surveyed by: Loran May, Sharon Farrell, Christina Crooker**

Polygon #	Other Species Inter-mixed (absolute cover)				Spartina Absolute Cover							
	Disp	Jaca	Savi		< 1	1- 5	6- 15	16-25	26 - 45	46 –75	76 –90	> 90
1	10	10	65				15					
2	5	5	70					20				
3			15							70		
4	60		30				10					
5		25	60				15					
6	5		65						30			
7			70					25				
8	5	15	45						40			
9		40	25						30			
10									40			
11			30							70		
12	10		25							65		
13			80					20				
14			40							60		
15			60						30			
16										75		
17			30							70		
18		5	70					25				
19			60						40			
20			15								85	
21			20								80	
22			80					20				
23			60					20				
24		5	60						40			
25			60					25				
26	15		50						35			
27			50							50		
28			25							75		
29		10	60					25				
30			35							65		
31**												

***** Note – 31 is a single plant***

APPENDIX E. WSMRP PERMANENT PHOTOMONITORING POINTS (SPRING AND FALL 2009 IMAGES).

Appendix E

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07

10-28-07

PHOTOPOINT: 1 West (240 degrees)

Appendix E

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 1 West (240 degrees)

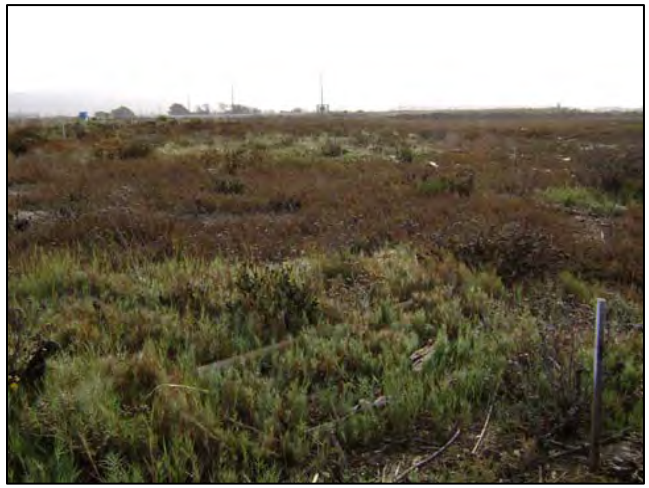
Appendix E

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

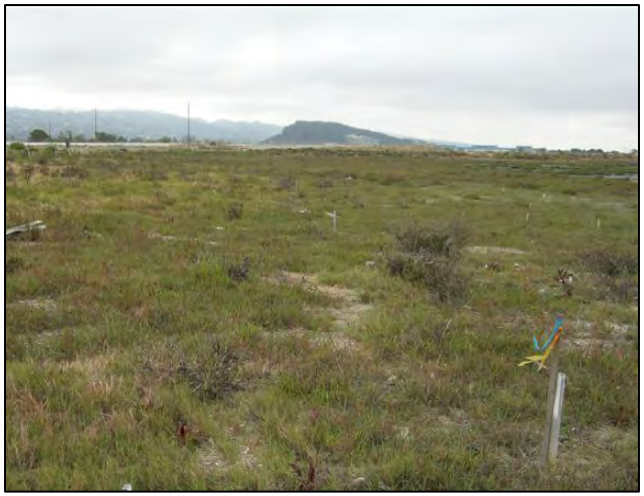
6-18-07



10-28-07

PHOTOPOINT: 2 East (124 degrees)

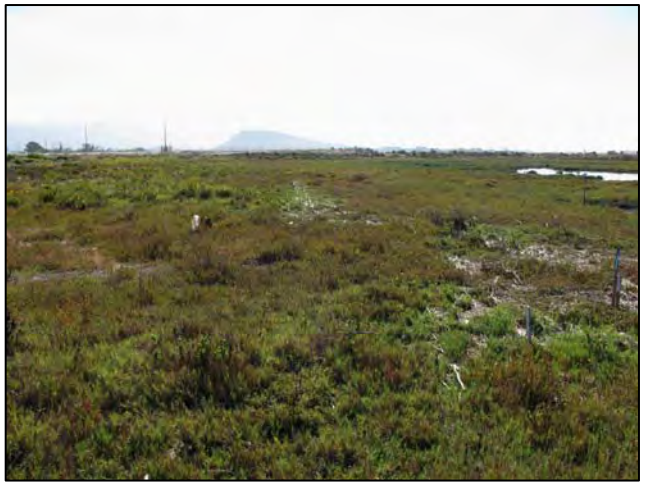
Western Stege Marsh Restoration Photopoints: 2005-2009



5-30-08

11-7-08

5-16-09



9-18-09

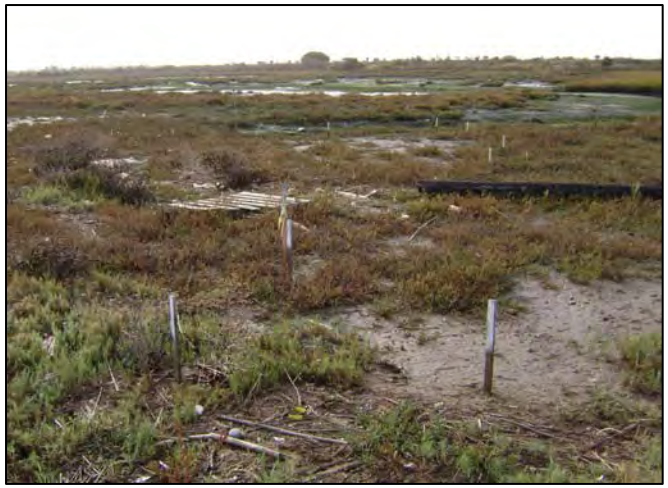
PHOTOPOINT: 2 East (124 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07



10-28-07

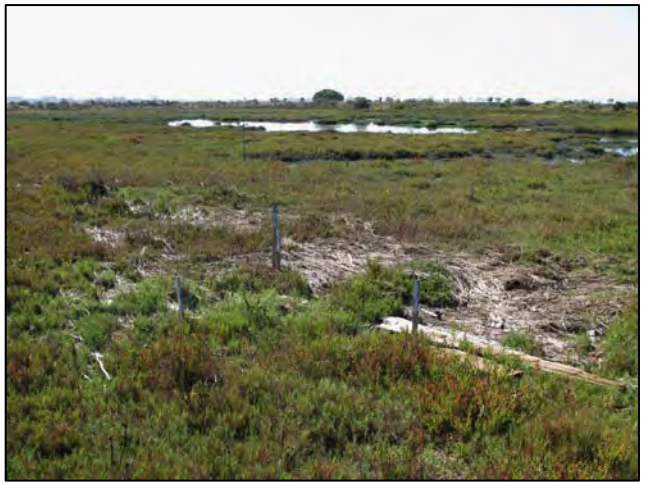
PHOTOPOINT: 2 Southeast (148 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09



9-18-09

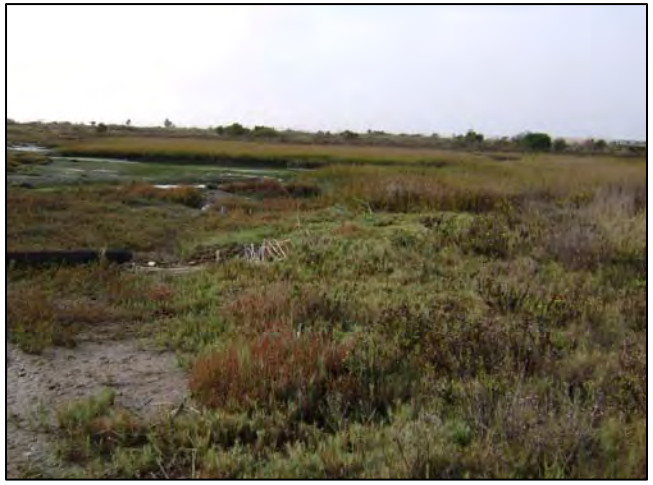
PHOTOPOINT: 2 Southeast (148 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07



10-28-07

PHOTOPOINT: 2 South (190 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 2 N (296 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

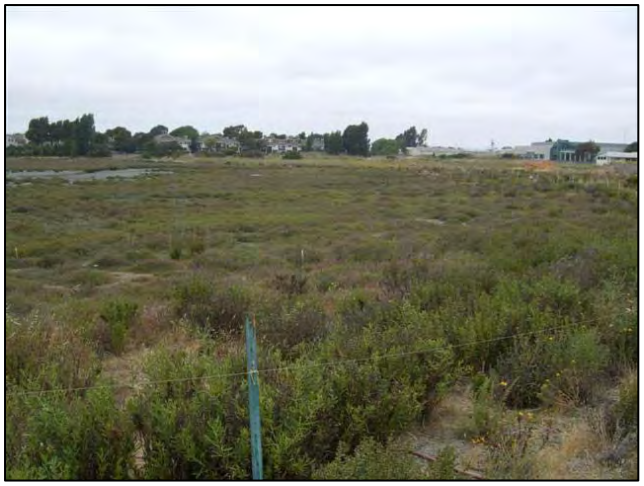
9-26-06

6-18-07

10-28-07

PHOTOPOINT: 3 Northwest (296 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009



5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 3 Northwest (296 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

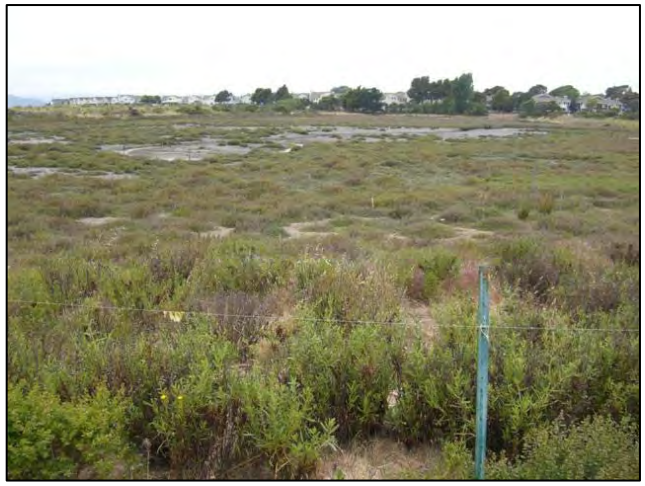
9-26-06

6-18-07

10-28-07

PHOTOPOINT: 3 West (280 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009



5-30-08

11-7-08

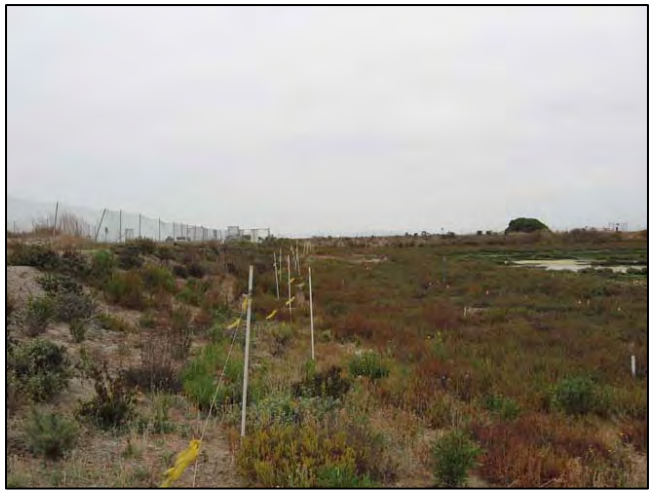
5-16-09

9-18-09

PHOTOPOINT: 3 West (280 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05



9-26-06

6-18-07

10-28-07

PHOTOPOINT: 3 South (190 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

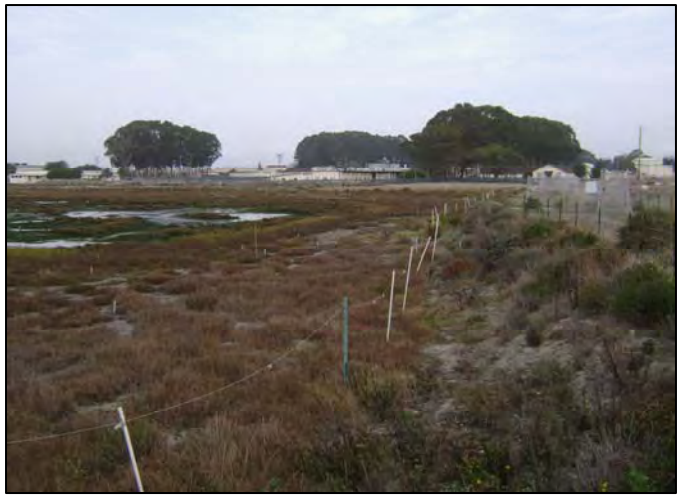
PHOTOPOINT: 3 South (190 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-14-07



10-28-07

PHOTOPOINT: 4 North (0 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

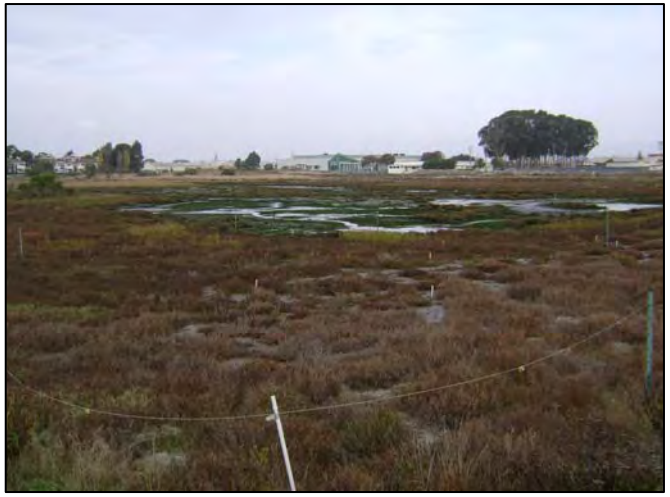
PHOTOPOINT: 4 North (0 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-14-07

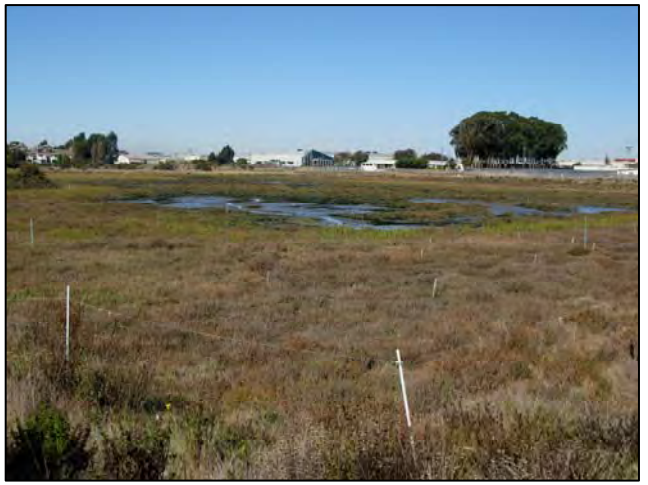


10-28-07

PHOTOPOINT: 4 Northwest (330 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08



11-7-08

5-16-09

9-18-09

PHOTOPOINT: 4 Northwest (330 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-14-07

10-28-07

PHOTOPOINT: 4 West (292 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 4 West (292 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07

10-28-07

PHOTOPOINT: 5 East (106 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 5 East (106 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07

10-28-07

PHOTOPOINT: 5 Northeast (32 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 5 Northeast (32 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

1-17-05

9-26-06

6-18-07

10-28-07

PHOTOPOINT: 5 West (306 degrees)

Western Stege Marsh Restoration Photopoints: 2005-2009

5-30-08

11-7-08

5-16-09

9-18-09

PHOTOPOINT: 5 West (306 degrees)

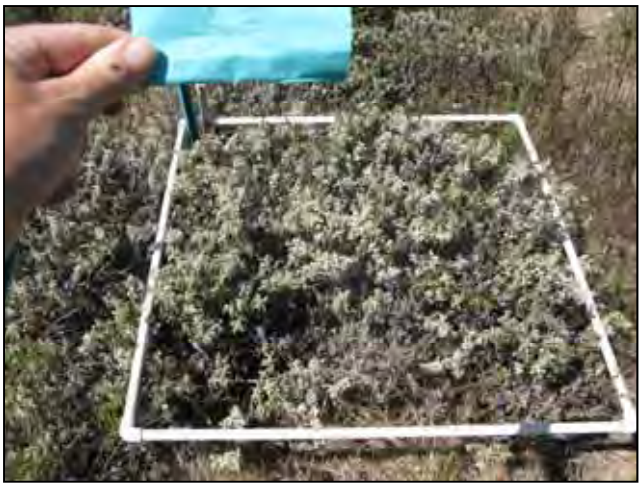
APPENDIX F. VEGETATION QUADRAT PHOTODOCUMENTATION - FALL 2009.

May & Associates, Inc.
182 Seal Rock Drive
San Francisco, CA 94121

Appendix F

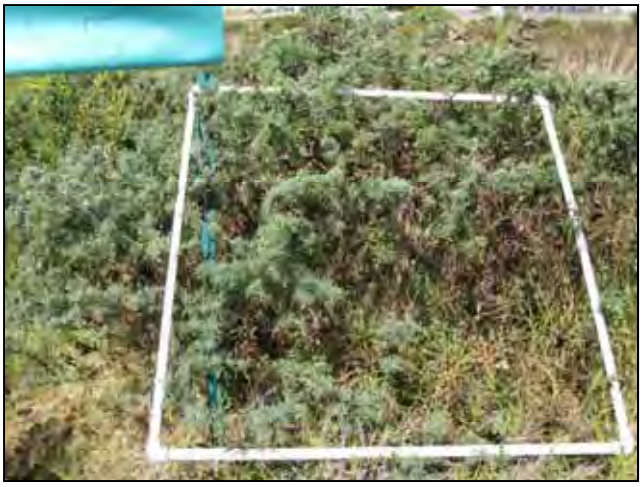
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: A-2



Transect: A-3

Transect: A-4



Transect: A-5

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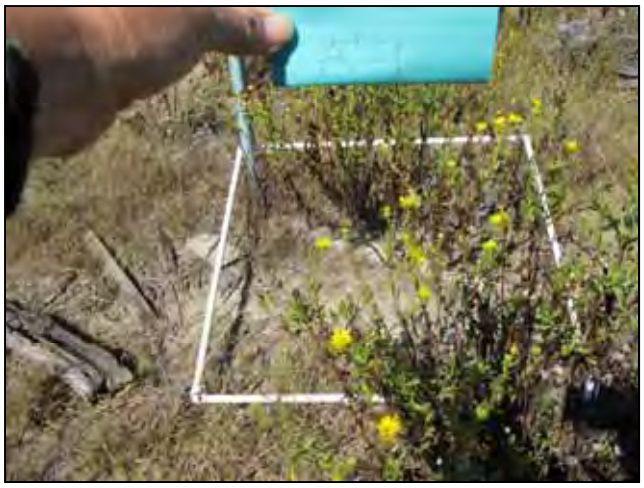
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009



Transect: A'-1

Transect: A'-2

Transect: A'-3

Transect: B-1

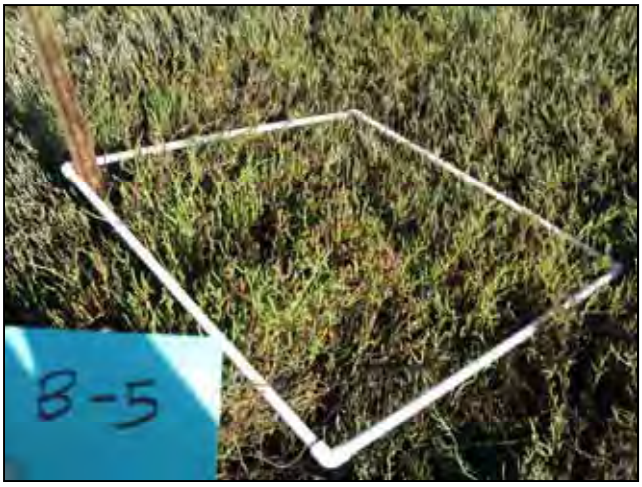
Appendix F

West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: B-2

Transect: B-3

Transect: B-4



Transect: B-5

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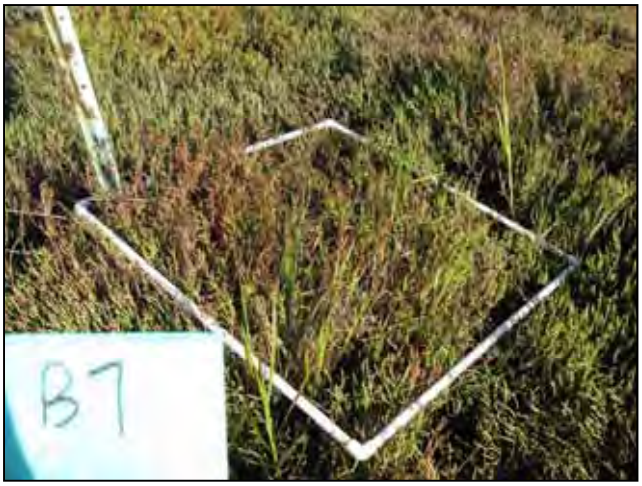
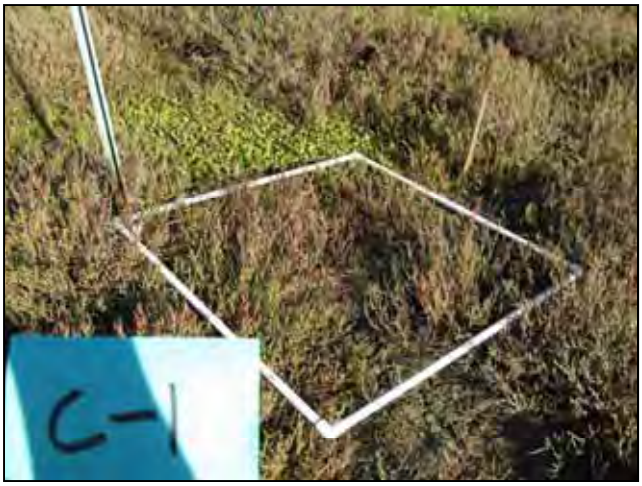
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: B-6



Transect: B-7

Transect: C-0



Transect: C-1

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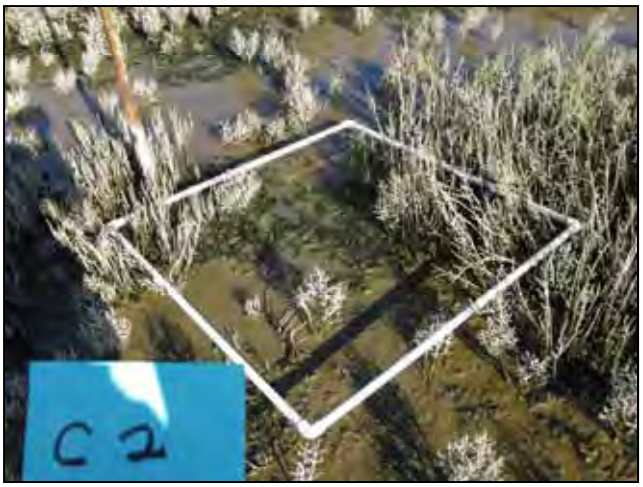
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009



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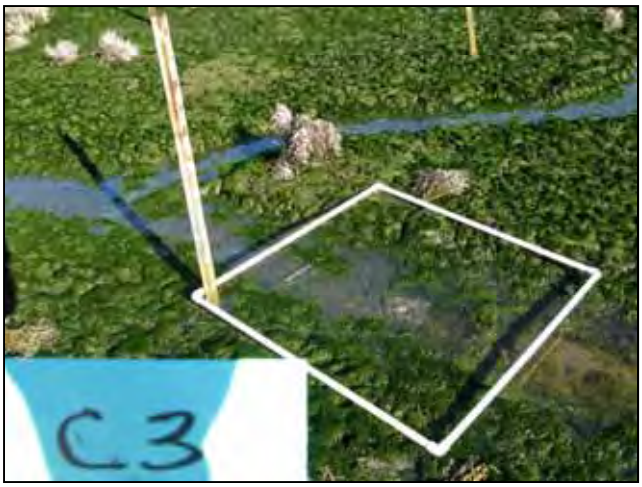

Transect: C-3

Transect: C-4

Transect: C-5

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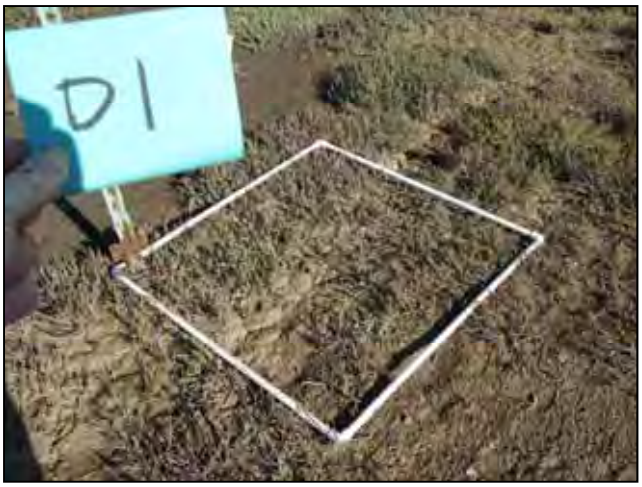
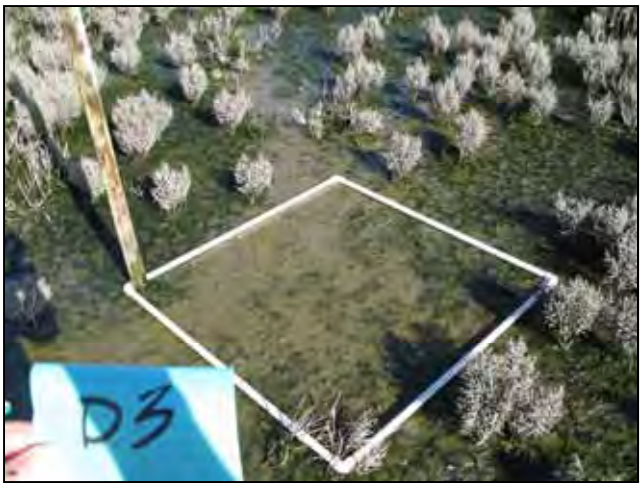
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: C-6

Transect: D-0



Transect: D-1

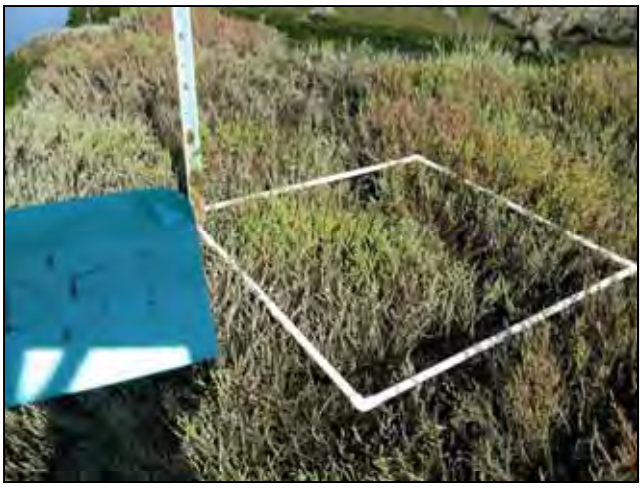


Transect: D-3

Appendix F

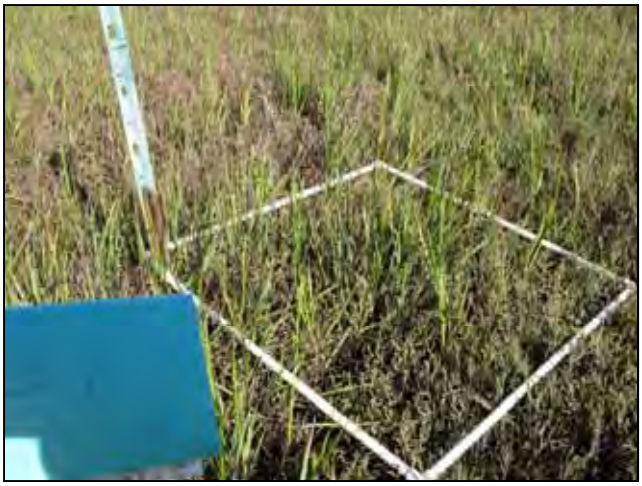
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: D-4



Transect: D-5

Transect: D-6



Transect: D-7

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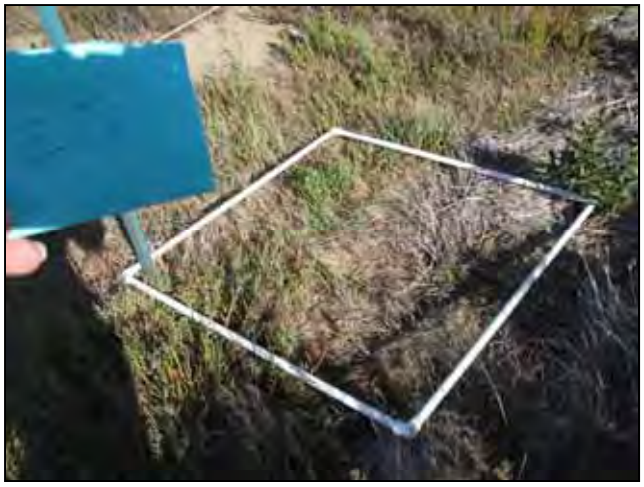
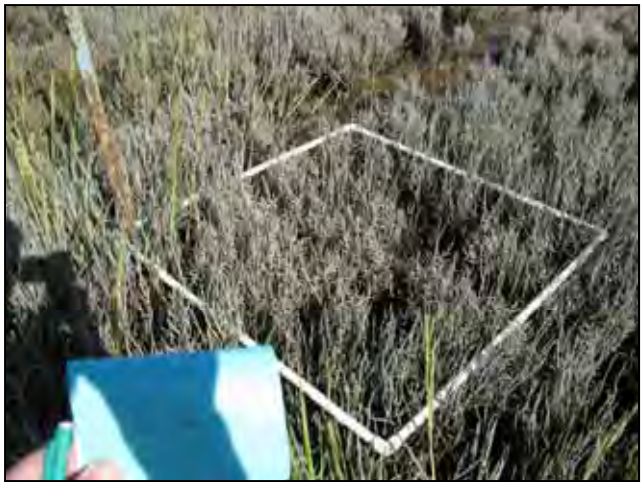
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

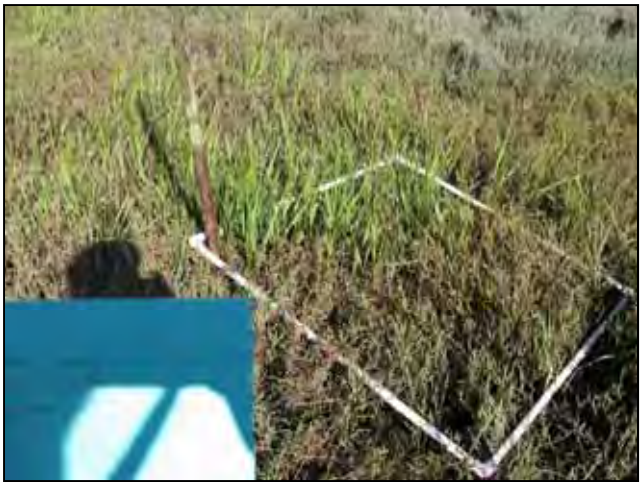


Transect: E-0

Transect: E-1



Transect: E-2



Transect: E-3

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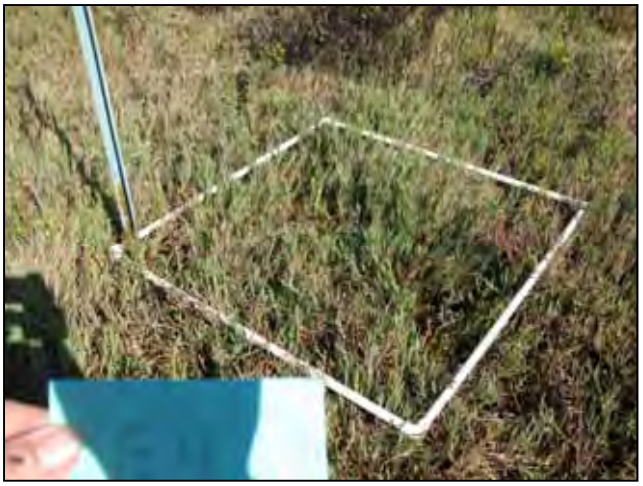
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009



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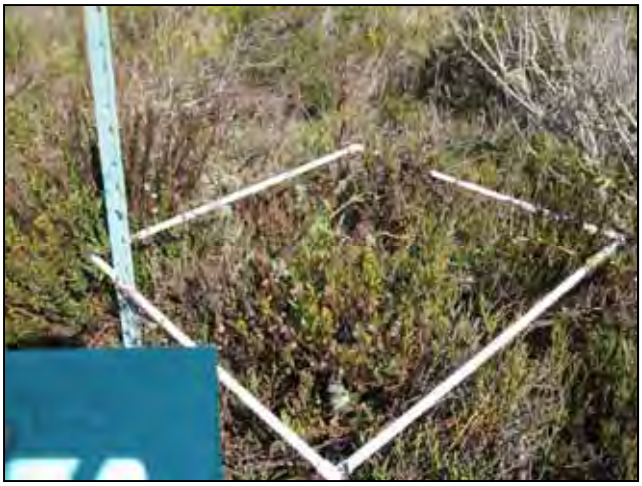

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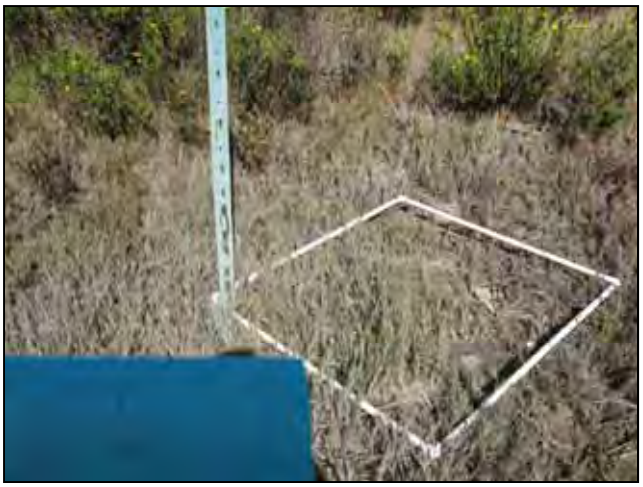

Transect: E-6

Transect: E-7

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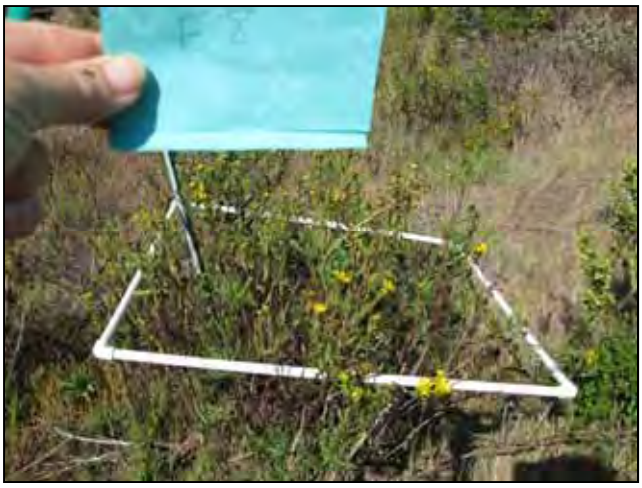
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009



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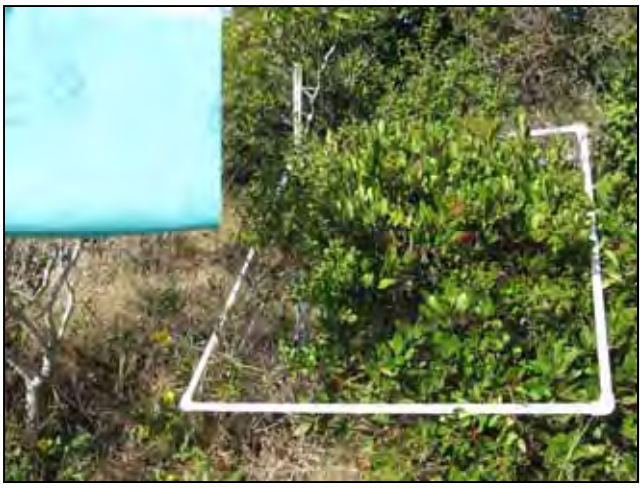
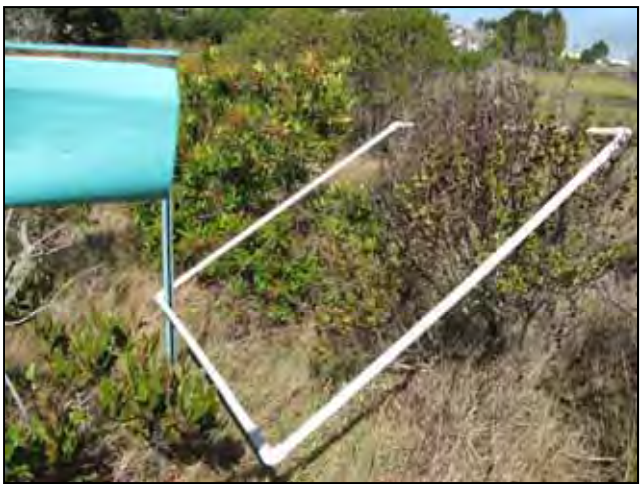


Transect: E-9



Transect: E-10

Transect: F-1

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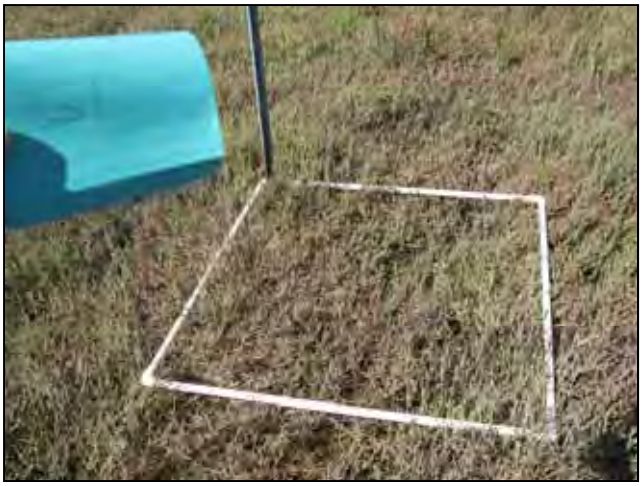
West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: F-2

Transect: F-3



Transect: F-4

Transect: G-1

Appendix F

West Stege Marsh Restoration Project
Vegetation Transect Images – September 2009

Transect: G-2

Transect: G-3

Transect: G-4

APPENDIX G. WESTERN STEGE MARSH AND UPLAND FLORA - 2009

Appendix G: Western Stege Marsh Flora (recorded June & October 2009)				
Scientific Name	**Common Name**	**Native or Non-Native**	**Marsh**	**Marsh Upland**
Acacia baileyana	blackwood acacia	non-native		X
Achillea millefolium	yarrow n	ative		X
Aira caryophyllea	silver hairgrass	non-native		X
Anagallis arvensis	scarlet pimpernel	non-native		X
Anthemis cotula	mayweed n	on-native		X
Artemisia californica	California sagebrush	native		X
Artemisia douglasiana	mugwort nat	ive		X
Aster chilensis		native		X
Aster subulatus var. lingulatus		native		X
Atriplex semibaccata		non-native		X
Atriplex triangularis	fat hen	native	X	X
Avena barbata	slender wild oats	non-native		X
Avena fatua	wild oats	non-native		X
Avena sp.	Wild oats	non-native		X
Baccharis pilularis	coyote bush	native	X	X
Bassia hyssopifolia		non-native	X	X
Beta vulgaris	Beet/Wild Chard	non-native		X
Brassica rapa		non-native		X
Brassica raphanistrum	Mustard n	on-native		X
Briza maxima	Rattlesnake grass	non-native		X
Bromus carinatus	CA Brome	native		X
Bromus catharticus	rescue grass	non-native		X
Bromus diandrus	ripgut brome	non-native		X
Bromus hordeaceus	soft chess	non-native	X	X
Bromus madritensis ssp. *rubens*	red brome	non-native	X	X
Bromus stamineus		non-native		X
Cakile maritima	sea rocket	non-native		X
Cardamine hirsuta	bitter cress	non-native		X
Carduus pycnocephalus	Italian thistle	non-native		X
Carduus sp.		non-native		X
Carex densa		native		X
Carex subbracteata		native		X
Carpobrotus chilensis	iceplant n	on-native	X	
Carpobrotus edulis	iceplant n	on-native		X
Centaurea solstitialis	yellow star-thistle	non-native		X
Centranthus ruber	red valerian	non-native		X
Centranthus ruber		non-native		X
Cerastium glomeratum	mouse ear chickweed	non-native		X
Chamomilla suaveolens	pineapple weed	non-native		X

Appendix G: Western Stege Marsh Flora (Continued)				
Scientific Name	**Common Name**	**Native or Non-Native**	**Marsh**	**Marsh Upland**
Chlorogalum pomeridianum var. divaricatum	soap plant	native		X
Cichorium intybus	chicory n	on-native		X
Cirsium vulgare	bull thistle	non-native		X
Contoneaster pannosa		non-native		X
Contoneaster sp.	contoneaster no	n-native		X
Conyza bonariensis	South American horseweed	non-native		X
Coronopus didymus	wart cress	non-native		X
Cortaderia jubata	pampas grass	non-native		X
Cotula australis		non-native		X
Cotula coronopifolia	brass-buttons no	n-native	X	X
Cuscuta salina var. *major*	salt marsh dodder	native	X	
Danthonia californica var. californica	CA oatgrass	native		X
Distichlis spicata	saltgrass n	ative	X	X
Dittrichia graveolens	tarweed n	on-native		X
Ehrharta erecta	Stebbins' grass	non-native		X
Eleocharis macrostachya		native		X
Elymus glaucus ssp. glaucus	blue wild rye	native		X
Elymus multisetus	big squirreltail	native		X
Epilobium brachycarpum	panicled willowherb	native		X
Epilobium sp.	Fireweed	non-native		X
Eriogonum latifolium				X
Eriophyllum staechadifolium	seaside woolly sunflower	native		X
Erodium botrys	long-beaked filaree	native		X
Eryngium armatum	coyote thistle	native		X
Eschscholzia californica	California poppy	native		X
Foeniculum vulgare	sweet fennel	non-native		X
Frankenia salina	alkali heath	natve	X	
Galium sp.	bedstraw n	on-native		X
Genista monspessulana	French broom	non-native		X
Geranium dissectum	cutleaf geranium	non-native		X
Geranium sp.	Geranium	non-native		X
Gnaphalium californicum	CA cudweed	native		X
Gnaphalium sp.	cudweed n	ative or non-native		X
Gnaphalium sp.	Cudweed n	on-native		X
Grindelia hirsutula var. hirsutula	gum plant	native		X
Grindelia stricta var. *angustifolia*	marsh gumplant	native	X	X
Heliotropium curassavicum	marsh heliotrope	native	X	

Appendix G: Western Stege Marsh Flora (Continued)				
Scientific Name	**Common Name**	**Native or Non-Native**	**Marsh**	**Marsh Upland**
Heracleum lanatum	cow parsnip	native		X
Heteromeles arbutifolia	toyon n	ative		X
Hirschfeldia incana	short pod mustard	non-native		X
Hordeum brachyantherum ssp. *brachyantherum*	meadow barley	native		X
Hordeum murinum ssp. *leporinum*	foxtail barley	non-native		X
Hypochaeris radicata	rough cat's-ears	non-native		X
Jaumea carnosa	jaumea nat	ive	X	X
Juncus balticus	Baltic rush	native		X
Juncus bufonius var. *bufonius*	toad rush	native		X
Juncus occidentalis		native		X
Juncus patens		native		X
Lactuca serriola	prickly lettuce	non-native		X
Leymus triticoides	creeping wild rye	native		X
Limonium californicum	marsh rosemary	native	X	X
Lolium multiflorum	Italian ryegrass	non-native	X	X
Lotus corniculatus	birdsfoot trefoil	non-native		X
Lupinus arboreus	yellow bush lupine	native		X
Madia sativa	coast tarweed	native		X
Malva sp.	mallow n	on-native		X
Medicago polymorpha	California burclover	non-native		X
Melica californica				X
Melilotus alba		non-native		X
Melilotus indica		non-native		X
Mimulus aurantiacus				X
Myrica californica (planted)		native		
Nassella pulchra	purple needlegrass	native		X
Parapholis incurva	sickle grass	non-native	X	X
Phalaris aquatica	Harding grass	non-native		X
Picris echioides	bristly ox-tongue	non-native		X
Plantago lanceolata	English plantain	non-native		X
Poa annua		non-native		X
Polygonum arenastrum	common knotweed	non-native		X
Polygonum lapathifolium	willow weed	native	X	X
Polygonum sp.	Knotweed no	n-native		X
Polypogon monspeliensis	rabbitfoot grass	non-native	X	X
Ranunculus californicus	CA buttercup	native		X
Raphanus sativus	wild radish	non-native		X
Rhamnus californica				X
Ribes menziesii				X
Ribes sanguineum				X

Appendix G: Western Stege Marsh Flora (Continued)				
Scientific Name	**Common Name**	**Native or Non-Native**	**Marsh**	**Marsh Upland**
Ricinus communis	castor bean	non-native		X
Rubus discolor	Himalayan blackberry	non-native		X
Rumex crispus	curly dock	non-native	X	X
Salicornia virginica	pickleweed n	ative	X	X
Salsola soda	alkali Russian thistle	non-native		X
Sanicula crassicaulis				X
Scirpus maritimus	prairie rush	native	X	
Scrophularia californica	California figwort	native		X
Senecio vulgaris	common groundsel	non-native		X
Silene gallica		non-native		X
Silybum marianum	milk thistle	non-native		X
Sisyrinchium bellum	blue-eyed grass	native		X
Sonchus asper ssp. *asper*	prickly sow thistle	non-native		X
Sonchus oleraceus	common sow thistle	non-native		X
Spartina foliosa	Pacific cordgrass	native	X	
Spergula arvensis ssp. *arvensis*	stickwort no	n-native		X
Spergularia macrotheca var. *macrotheca*		native	X	
Spergularia marina	sand-spurrey native		X	
Tetragonia tetragonioides	New Zealand spinach	non-native		X
Toxicodendron diversilobum	poison oak	native		X
Trifolium dubium	hop clover	non-native		X
Triglochin concinna var. *concinna*	slender arrow-grass	native	X	
Triglochin maritima		native	X	
Trioglochin concinna			X	
Typha angustifolia	narrow-leaved cattail	native	X	
Vicia sp.	Vetch n	ative or non-native		X
Vicia villosa ssp. varia	winter vetch	non-native		X
Vulpia bromoides		non-native	X	X
Wyethia angustifolia	slender mule's ears	native		X

ATTACHMENT 3

PROTOCOL SURVEYS FOR CALIFORNIA CLAPPER RAIL (RALLUS LONGIROSTRIS OBSOLETUS) AT THE WESTERN STEGE MARSH RICHMOND FIELD STAION: THE 2010 NESTING SEASON, AVOCET RESEARCH ASSOCIATES

PROTOCOL SURVEYS FOR CALIFORNIA CLAPPER RAIL (*RALLUS LONGIROSTRIS OBSOLETUS*) AT THE WESTERN STEGE MARSH RICHMOND FIELD STATION: THE 2010 NESTING SEASON.

California Clapper Rail with two chicks at Western Stege Marsh, Aug. 21, 2008.

photograph by Denise Wight

Prepared for:

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1999 Harrison Street, Suite 500
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Prepared by:

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Avocet Research Associates LLC
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May 26, 2010

Introduction

The Western Stege Marsh property, owned by the University of California, is the subject of the Richmond Field Station's Western Stege Marsh Remediation Project, located in Contra Costa County, California. Meeker Slough, which runs through the site and drains the marsh, is the property of the City of Richmond. A requirement of the permitting phase of the remediation project was to evaluate potential effects of the project to the California Clapper Rail *(Rallus longirostris obsoletus)*, a federally endangered species associated with tidal-marsh habitat in San Francisco Bay.

Avocet Research Associates (ARA) assessed the status of the California Clapper Rail (CCR) in the lower reaches of Meeker Slough known as "Western Stege Marsh" during the 2010 nesting season. The 2010 effort followed a series surveys that we have conducted annually, beginning in 2005 (ARA 2005), prior to the initiation of the Western Stege Marsh Remediation Project, and continuing after remediation. (ARA 2007, 2008, 2009).

Methods

Five listening stations (census points) were established on surveys conducted by ARA during the 2005 protocol survey period (ARA 2005). The locations of two of these stations were adjusted in 2009 and 2010 to provide more direct coverage of the restoration area of the site. The locations of these stations are indicated in Figure 1. Stations are located approximately 150 meters apart to afford full coverage of the tidal marsh habitat and the restoration area.

Listening stations were occupied by an observer for a total of 5.6 twilight hours, the period of maximum vocal activity by clapper rails (Eddleman and Conway 1998). Each station was occupied for a minimum of 10 minutes on each survey, or for 20 minutes when time and conditions allowed. Each survey was "passive," that is, the observer simply stood at the station and relied on spontaneous vocalizations to detect rails. An "active survey," involves broadcasting rail vocalizations with a tape recorder to elicit responses. Active surveys are permitted only when no detections have been made using passive methods on three previous census efforts (USFWS 2000, CDFG-MOA,2010). Because rails were detected on the second passive survey (2/10/10), it was not within the guidelines of our permit to conduct active surveys thereafter. The purpose of this

restriction is to avoid disturbance to nesting rails. All survey methods conformed to the USFWS protocols.

The dates and times of the surveys are provided in Table 1, below.

Table 1. Clapper rail surveys at Western Stege Marsh, 2010

Date	Time (hrs)	Survey type	Tide	Observer †
Jan 27	1630-1750	passive	low	JE
Feb 10	1627-1743	passive	low	JE
Mar 13	0530-0715	passive	mod	MAF
Apr 01	0615-0730	passive	low	JE

†Observers: Jules Evens (JE), Mary Anne Flett (MAF)

All avian species detected during the course of the surveys were recorded on data sheets during each survey. A list of avian species is provided in Appendix A.

Findings and Discussion

Clapper Rails were present in Western Stege Marsh during the 2010 nesting season, however, detection levels were very low, with one detection of two or three birds calling simultaneously on one date. Those calls were emanating from the outboard marsh at 1730-1733 hrs on the February 10 census (Figure 2). The 2010 results of 2-3 birds heard during 5.6 hrs of observation (0.36-0.54 detections/hr) compare with a single detection of a duetting pair in 2009 (0.15 detections/hr), 3-4 detections during 5.8 hours of observation in 2008 (0.52-0.69 detection/hr) and 23 detections during 4.5 hours of observation in 2007 (5.1 detection/hr).

Detection rates in 2008, 2009 and 2010 are relatively comparable and suggest that a single pair was resident in the Western Stege marsh complex each year. The higher detection rate in 2007 suggests that two pair were present that year. As discussed in the 2009 monitoring report (ARA 2009), vocal activity of the California Clapper Rail tends to be density dependent, that is, the more birds present (the higher the density) in a given marsh, the greater the frequency of vocalization (JE, pers. obs.). Vocalization poses a predation risk to ground-nesting birds like CCR, therefore individuals tend to be

quiet unless the benefits derived from defense of territory outweigh the risks of predation.

The vocalization rates over the past four seasons suggest that there were two pairs of rails on territory within Western Stege Marsh in 2007—one pair associated with the inboard marsh, one with the outboard marsh—and that the proximity of their territories triggered counter vocalizations. In subsequent years (post-restoration), the resident birds have been mostly silent, suggesting only a single territorial pair. However, survey detections in 2010, coupled with serendipitous observations by others (Karl Hans, pers., comm.) indicate that the birds are using the tidal marsh both inboard and outboard of the Bay Trail. Also, sightings to the east of the study area in the marshes at the mouth of Baxter Creek (Fig 4), indicate that that section of marsh, 500-m from Western Stege, is also used by CCRs. Whether those sighting represent a different rail territory or the same pair detected in Western Stege is moot. However an observation of a bird walking along the outboard shoreline between the two marsh parcels in the past (K. Hans, pers. comm. Mar. 17, 2010) suggest that CCRs travel between these two marshlands. Additionally, visual observations at both Western Stege (JE, pers. obs.) and Baxter Creek (Allison Nelson, pers. comm. May 18, 2010) document CCRs traveling between the inboard and outboard marshes at each location. Based on our current understanding and the results of our cumulative field studies, as well as anecdotal observations, the current habitat occupied by CCRs is outlined in Figure 4. As prescribed by the Army Corps of Engineers, 200-foot buffer zone on the upland side of the marsh on University property is delineated in Figure 5.

The reasons for the apparent decline in numbers of clapper rails at Western Stege marsh after 2007 are unknown. The two most likely contributing factors are; (1) the COSCO Buscan oil spill, 7 November 2007 which may have entered the marsh, and, (2) the restoration effort which caused temporary disturbance and removed vegetation from the eastern portion of Western Stege. Also, predation pressure by terrestrial mammals is a major contributing factor to rail mortality in general (Albertson and Evens 2000) and is a likely contributing factor at Western Stege. Feral cats continue to be seen frequently at the site and, as mentioned in an earlier report (ARA 2009), local residents subsidize the cat population with feeding stations. (“Local residents” does not include U.C. Berkeley or Richmond Field Station staff, rather people living in a residential development adjacent

to Western Stege Marsh.) Cat feeding stations have been identified as the cause for mortality at other Bay Area sites (e.g. San Bruno Marsh, J. Albertson, USFWS, pers. comm.).

Perhaps more relevant than apparent short-term declines is the evidence that CCRs are nesting successfully at Western Stege. That evidence was provided by a serendipitous encounter of an adult with chicks in August 2008 (D. Wight, cover photo) and again with in September 2, 2009, when Alex Navarro reported three adults and two chicks still covered in black down in Meeker Slough (K. Hans and A. Navarro, pers. comm.).[1] We now have evidence of CCR fledglings using habitat in both the inboard and outboard marshes associated with Meeker Slough following restoration.

Other species of concern

Several species detected in the course of this study are recognized as "Bird Species of Special Concern" (CDFG & PRBO 2001) or "Birds of Conservation Concern" (USFWS 2002). These special status species are vulnerable to predation at the site by feral cats, house cats and other mesopredators.

(1) "Saltmarsh" Common Yellowthroat (*Geothylypis trichas sinuosa*) was detected on each census in 2006, none in 2007, on 75% of surveys in 2008, and 60% of surveys in 2009. In 2009, and again in 2010, one individual was singing on territory and apparently nesting near Station #1 (Fig. 1).

(2) "Alameda" Song Sparrow (*Melospiza melodia pusillula*): Song Sparrows, presumably of this local race, were present on each census. This obligate saltmarsh race is apparently resident in emergent tidal marsh habitat (ARA 2005), but in relatively low densities.

(3) Peregrine Falcon (*Falco peregrinus anatum*): In previous years, a single peregrine was seen on most censuses, roosting nearby and apparently foraging over adjacent tidal flats. In 2009 and 2010 we had no Peregrine detections.

Interestingly, with the exception of a single Cooper's Hawk and a distant Red-tailed Hawk, few raptors were noted in 2010.

[1] http://www.pbase.com/alxnavarro/recent

Conclusions

Based on the results of four protocol-level surveys conducted at Western Stege Marsh and Meeker Slough, late-January through early April 2010, we estimate that a single pair of California Clapper Rails was present at the site. Sightings of three adult birds on two occasions suggest that an additional unmated adult was also present, at least intermittently.

We heard 0.36-0.54 calls per hour of observation in 2010. This is a higher detection rate than in 2009 (0.15 calls/hr), similar to 2008 (0.5 to 0.7 calls/hr), but much lower than 2007 (5.1 calls/hr). During the 2010 field season, rails were heard or seen in both the inboard and outboard marshes at Western Stege. Rails also observed in both the inboard and outboard marshes at the mouth of Baxter Creek, 500-m east of the study site.

The census methodology prescribed by USFWS (2000) provides no means to determine reproductive success of the rails and we can make no judgment regarding nesting success in 2010. Herein we document continued presence of CCR during the 2010 nesting at Western Stege and the use of adjacent marshlands to the East. We intend to visit the site intermittently during the summer to see if breeding success can be documented as it was in August 2008 (cover photograph) and again in September 2009.

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Permits (Jules Evens, Avocet Research Associates)

Federal Fish and Wildlife Permit TE786728-3

California Dept. Fish & Game Scientific Collecting Permit #6708

Acknowledgements

Fieldwork assistance was provided by Mary Anne Flett and Emilie Strauss, both of ARA. Earlier drafts of this report were improved by comments from Karl Hans, U.C. Berkeley Richmond Field Station, and Jason Broderson and Carolyn Ferlic, both of Tetra Tech Inc. Non-protocol field observations provided by Karl Hans and Alex Navarro were greatly appreciated.

Figure 1. Western Stege Marsh: clapper rail listening stations, 2009-10

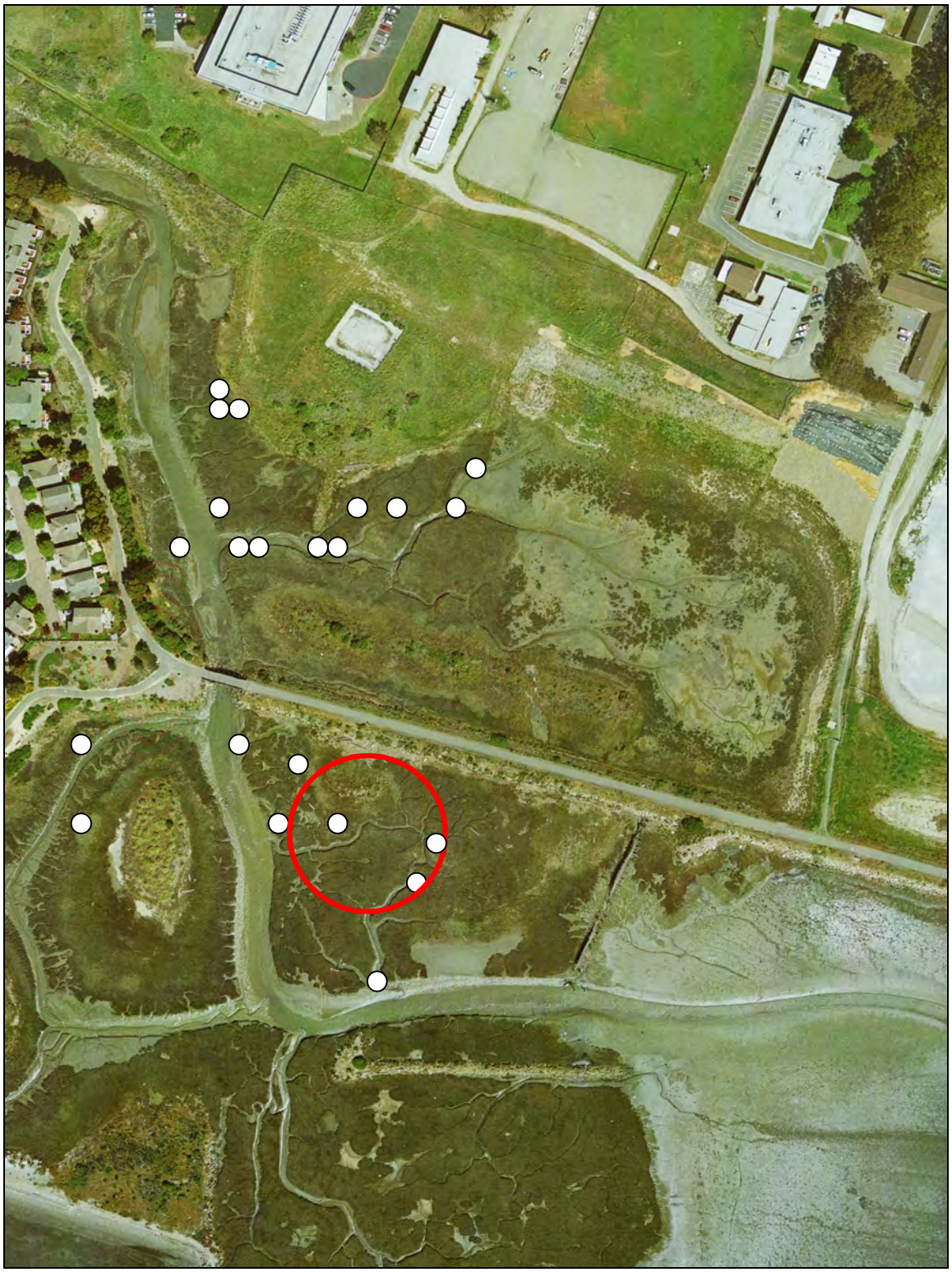

Figure 2. Western Stege Marsh: clapper rail protocol-survey detections: 2007-2010. White dots represent locations of detections in previous years (2007-2009), following remediation. The larger red circle encompasses the locations of a double clatter and a possible third bird heard on February 10, 2010 (JE) at 1730-1733 hrs. This area has been an activity center in three of the last four years of coverage.

Figure 3. Locations of incidental visual detections of CCRs within the inboard marsh on non-survey occasions, provided by Karl Hans. Observers: Stacy Haines, Feb 24, 2010 (10:30 AM) and Karl Hans, Mar. 15, 2010 (7:45 AM).

Figure 4. Location of a visual sightings of a CCR east of Western Stege Marsh at Baxter Creek (500-m ESE of Western Stege Marsh): one individual seen March 15, 2010 by Karl Hans; another seen at the same spot on May 13, 2010 by Allison Nelson. Ms. Nelson saw the bird walking 50-60 meters up the slough (NE) into the marsh inboard of the Bay Trail.

Figure 5. Recent observations and field surveys have indicated that the tidally influenced marshes enclosed within the red outline were occupied by CCRs in 2010.

Figure 6. The red line delineates a 200-foot buffer around suitable habitat that is on University property as required by Army Corps Nationwide Permit 38, which states: “To minimize and mitigate impacts to the clapper rail UC Berkeley will conduct remediation activities outside of the clapper rail’s breeding season. All work within 200 feet of suitable clapper rail habitat will be completed between September 1 and January 31 of any given year.”

APPENDIX A.

Aves detected during the course of the rail surveys in the vicinity of Western Stege Marsh 2005-2010. Species directly associated with the tidal marsh and associated channels are in **bold** type**.** Species names followed by an asterisk were first detected in 2010.

Canada Goose
Gadwall*
Mallard*
American Wigeon
Eurasian Wigeon*
Northern Shoveler*
Green-winged Teal
Canvasback
Greater Scaup
Bufflehead
Common Goldeneye
Ruddy Duck
Pied-billed Grebe
Western Grebe
Clark's Grebe
Brown Pelican
Double-crested Cormorant
Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night-Heron
Turkey Vulture
Cooper's Hawk*
Red-tailed Hawk
American Kestrel
California Clapper Rail
Sora
American Coot
Black-bellied Plover
Killdeer
Black Oystercatcher
American Avocet
Greater Yellowlegs
Willet•
Whimbrel
Long-billed Curlew
Marbled Godwit
Sanderling
Western Sandpiper
Least Sandpiper
Dunlin
Long-billed Dowitcher
Wilson's Snipe
Mew Gull
Ring-billed Gull
California Gull
Western Gull
Glaucous-winged Gull
Caspian Tern
Forster's Tern
Mourning Dove
Anna's Hummingbird
Belted Kingfisher
Northern Flicker*****
Black Phoebe
American Crow
Common Raven
Tree Swallow
Bushtit
Marsh Wren
House Wren
Ruby-crowned Kinglet
American Robin
Northern Mockingbird
European Starling
American Pipit
Yellow-rumped Warbler
San Francisco Common Yellowthroat
California Towhee
Savannah Sparrow*
Song Sparrow
Lincoln's Sparrow
White-crowned Sparrow
Golden-crowned Sparrow
Red-winged Blackbird
Western Meadowlark
Brewer's Blackbird
House Finch
American Goldfinch
<u>Introduced species</u>
Feral Pigeon
House Sparrow*

Total: 81 species

APPENDIX B.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

DRAFT SURVEY PROTOCOL

California Clapper Rail (*Rallus longistrostris obsoletus*)

January 21, 2000

Below is a description of the standard methodology used to detect presence or absence of clapper rail breeding activity. Surveys should be conducted once a week for a minimum of four weeks. The optimal time to conduct call count surveys is mid-January through March. Once a survey protocol has been developed, it should be sent to the Service for final approval prior to implementation. After the results are compiled and submitted to us, we will make a final decision on the possibility of doing any work as described.

Methodology

Surveys should be conducted from January through mid-April, which encompasses the optimum time period of mid-January through March when the frequency of calls is typically highest. Surveys should not be conducted when tides greater than 4.5 feet NGVD as predicted at the Golden Gate occur at the marsh during the survey period or during full moon periods.

Listening stations should be established no more than 150 meters apart along transects in or adjacent to marsh areas. Stations should be established so that the entire marsh is covered by 75 to 100-meter radius circular plots. Listening stations should be placed near marsh features, such as sloughs, but not along slough edges to minimize disturbance to rails. Surveys should be conducted from levee crowns or boardwalks to minimize disturbances to marsh areas where possible. A detailed map depicting sloughs and other marsh landmarks or features should be developed.

Surveys should be conducted at sunset or sunrise. Surveys conducted at sunrise should begin 45 minutes before sunrise and continuing until 1 1/4 hours after sunrise. Surveys conducted at sunset should begin 1 1/4 hours before sunset and continue until 45 minutes after sunset.

An observer should be assigned to each listening station for the duration of each survey. Observers should locate key marsh landmarks or features on a map in relation to teach listening station location.

All rail vocalizations should be recorded, noting the call type, location, and time on a detailed map of the marsh. The call types are coded as C = clapper, D = duet, K = kek, B=kek-burr with a V representing a visual sighting. Other unusual calls also should be noted. The calls of one bird or pair should be marked by circling the calls together. If a rail is moving during the survey, several locations may be noted for the same bird(s). Attention should be focused on accurately mapping the birds that are nearby, especially between observers or towards the edge of the marsh if the station is positioned at the marsh's edge.

At the end of each survey, observers should compare maps to determine overlap in detections and to create a master map showing all pairs and individuals located during the survey. Another master map should be developed once all surveys are completed, showing the dates and locations of detections.

Weather information, including wind velocities and direction, should be recorded. Call count surveys should not be conducted when wind velocities exceed 10 mph or wind gusts exceed 12 mph, or during moderate to heavy rains. Information on disturbances (e.g., dogs or cats in marsh and aircraft flyovers) occurring during the surveys should be recorded.

If a survey of a marsh is conducted over more than one night, observers should be assigned to stations adjacent to their previous night's station if at all possible.

New observers should be trained by an experienced observer. Trainees should familiarize themselves with various calls and with estimating distances to calls before training in the field. In-field training should include ways to minimize disturbance to rails and marsh vegetation. Trainees should be stationed with an experienced observer during a call count for a minimum of 2 nights to assess the trainee's ability to accurately detect and map calls in the field. The Palo Alto Baylands is a marsh with many rails typically calling in the evening and easy access via a boardwalk, thus providing an excellent training opportunity for new observers and their instructors. A recording of clapper rail calls is available for training purposes at the U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Suite W2605, Sacramento, California 95825.

ATTACHMENT 4

SUMMARY OF FERAL ANIMAL TRAPPING ACTIVITIES, GARY BEEMAN, AVAIN PEST CONTROL

Attachment 4: Matrix Summary of Gary Beeman Trapping Results

Results of mammal trapping at Richmond Field Station in Richmond, CA 2009/2010

	Feral Cat	Fox	Opossom	Racoon	Skunk
3/24/2009	1				1
3/25/2009			1		2
3/26/2009					1
3/27/2009				1	
Total	**1**	**0**	**1**	**1**	**4**
5/27/2009					1
5/28/2009				1	
5/29/2009					1
5/30/2009	1			1	
Total	**1**	**0**	**0**	**2**	**2**
7/7/2009			2		1
7/8/2009			1		2
7/9/2009				3	
7/10/2009	1		1		
7/11/2009			1		2
7/12/2009			2		
Total	**1**	**0**	**7**	**3**	**5**
9/29/2009	1		2		3
9/30/2009	1				1
10/1/2009			1	1	
10/2/2009				2	1
Total	**2**	**0**	**3**	**3**	**5**
11/17/2009	2		1	1	
11/18/2009			2		3
11/19/2009			1	1	
11/23/2009	1		1		2
Total	**3**	**0**	**5**	**2**	**5**
3/22/2010	1		1		2
3/23/2010			1	1	1
3/24/2010		1	2		
3/25/2010					1
3/26/2010			2		
3/27/2010	1				
3/28/2010			1		1
3/29/2010					2
Total	**2**	**0**	**7**	**1**	**7**
5/4/2010	1			1	1
5/5/2010					2
5/6/2010					
5/7/2010				1	
5/8/2010			1		
5/9/2010	1				
5/10/2010			1		
Total	**2**	**0**	**2**	**2**	**3**
2009-2010 Total	**10**	**0**	**23**	**12**	**28**

AVIAN PEST CONTROL

GARY A. BEEMAN

WILDLIFE RESCUE & CONTROL BIOLOGIST

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Unusual Pest Problems (humanely solved) - Pigeons, ducks, starlings, bats, tree squirrels, skunks, raccoons, snakes, etc.
(Also Pest Control Equipment - Sales and Rentals)

March 27, 2009

University of California
% Karl E. Hans
317 University Hall #1150
Berkeley, CA. 94720-1150
(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND MARCH 23-27, 2009

March 23, 2009
Set eight large live catch mammal traps.

March .24, 2009
1 - adult male grey & white tabby feral cat
1 - adult female skunk

March 25, 2009
1 - adult pregnet female skunk
1 - adult female skunk
1 - adult male opossom

March 26, 2009
1 - adult male skunk

March 27, 2009
1 - adult ♂ Raccoon

Total mammals trapped March 23 - 27, 2009
Skunks - 4 Opossoms - 1
Raccoons - 1 Feral cats - 1

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May 30, 2009

University of California
% Karl E. Hans
317 University Hall #1150
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(510) 643-9574

RE: **RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND MAY 26-30, 2009**

May 26, 2009
Set eight large live catch mammal traps.

May 27, 2009
1 – adult female skunk

May 28, 2009
1 – adult female raccoon

May 29, 2009
1 – adult male skunk

May 30, 2009
1 – adult ♀ Grey tabby cat
1 – adult ♂ Raccoon

Total mammals trapped March 23 – 27, 2009
Skunks – 2 Opossoms – 0
Raccoons – 2 Feral cats – 1

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July 12, 2009

University of California
% Karl E. Hans
317 University Hall #1150
Berkeley, CA. 94720-1150
(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND July 6-12, 2009

July 6, 2009
Set eight large live catch mammal traps.

July 7, 2009
1 - adult female skunk
2 - subadult female opossom

July 8, 2009
1 - adult female opossom
1 - subadult female skunk
1 - adult female skunk

May 9, 2009
2 - subadult male raccoons
1 - " female raccoon

July 10, 2009
1 - adult female black & white cat
1 - subadult male opossom

July 11, 2009
2 - subadult female skunks
1 - " male opossom

July 12, 2009
2 - Subadult ♀ Opossoms

Total mammals trapped July 23 - 27, 2009

Skunks - 5
Raccoons - 3
Opossoms - 7
Feral cats - 1

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October 2, 2009

University of California
% Karl E. Hans
317 University Hall #1150
Berkeley, CA. 94720-1150
(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND Sept. 28 – October 2, 2009

Sept 28, 2009
Set eight large live catch mammal traps.

Sept. 29, 2009
1 – adult male skunk
1 – " female skunk
1 – subadult male skunk
1 – subadult male opossom
1 – " female opossom
1 – subadult male black & white feral cat

Sept. 30, 2009
1 – adult female female black & white cat
1 – adult female skunk

Oct. 1, 2009
1 – adult male raccoon
1 – subadult male opossom

Oct 2, 2009
1 – Adult ♂ Skunk
2 – Sub adult ♂ Raccoons

Animals trapped Sept. 28 – Oct. 2 2009

Skunks – 5
Raccoons – 3
Opossoms – 3
Feral cats – 2

AVIAN PEST CONTROL

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Nov. 23, 2009

University of California
% Karl E. Hans
317 University Hall #1150
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(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND Nov. 16 - Nov. 23, 2009

Nov.16, 2009
Set eight large live catch mammal traps.

Novt.17, 2009
1 - adult male Raccoon
1 - " male Tabby Cat
1 - " female black cat
1 - " female opossom

Novt. 18, 2009
3 - adult male skunks
1- " male opossom
1- " female opossom

Nov. 19, 2009
1 - adult male raccoon
1 - adult female opossom
Closed traps

Nov 22, 2009
Set traps

Nov. 23, 2009
1 Adult ♀ Skunk
1 " ♂ "
1 " ♀ Black & white Cat
1 " ♀ Opossom

Animals trapped Nov. 16 - Nov.23 2009

Skunks - 5
Raccoons - 2
Opossoms - 5
Feral cats - 3

AVIAN PEST CONTROL

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(Also Pest Control Equipment - Sales and Rentals)

March 29, 2010

University of California
% Karl E. Hans
317 University Hall #1150
Berkeley, CA. 94720-1150
(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND March 21 – March 29, 2010

March 21, 2010
Set eight large live catch mammal traps.

March. 22, 2010
2 – adult male skunks
1 – " female feral cat (grey)
1 – subadult male opossom

March.23, 2010
1 – adult female skunk
1 – " male raccoon
1– " female opossom

March. 24, 2010
1 – adult male opossom
1 – " female "
1 – adult Grey fox

March 25, 2010
1– adult female skunk

March 26, 2010
2 – adult male opossoms

March 27, 2010
1– adult crow
1– adult female brown tabby feral cat

March 28, 20010
1- adult female opossom
1- adult male skunk
1- adult crow

March 29, 2010

1 Adult ♀ skunk
1 " ♂ "

Animals trapped March. 21 - March 29 2010

Skunks - 8	Opossoms - 6
Raccoons - 1	Feral cats - 2
Grey Fox - 1	Crows - 2

AVIAN PEST CONTROL

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Unusual Pest Problems (humanely solved) - Pigeons, ducks, starlings, bats, tree squirrels, skunks, raccoons, snakes, etc.
(Also Pest Control Equipment - Sales and Rentals)

May 10, 2010

University of California
% Karl E. Hans
317 University Hall #1150
Berkeley, CA. 94720-1150
(510) 643-9574

RE: RESULTS OF MAMMAL TRAPPING AT U.C. FIELD STATION IN RICHMOND May 3, - May 10, 2010

May 3, 2010
Set eight large live catch mammal traps.
May 4, 2010
1 - subadult male skunks
1 - " female feral cat (brown tabby)
1 - adult Red fox squirrel
1 - " male raccoon
May 5, 2010
1 - subadult female skunk
1 - " male skunk
May 6, 2010
Nothing trapped
May 7, 2010
1- adult male raccoon
March 8, 2010
1 - adult female opossom
May 9, 2010
1- adult pregnat female brown tabby feral cat
May 10, 2010
1 - Juv. ♀ Opossum

Animals trapped May. 3 - May 10, 2010
Skunks - 3 Opossoms - 2
Raccoons - 2 Feral cats - 2
Red Fox squirrel - 1

ATTACHMENT 5

WESTERN STEGE MARSH RESTORATION PROJECT: ANNUAL RESTORATION ACTIVITIES REPORT – 2009, TETRA TECH EM INC.

Western Stege Marsh Restoration Project: Annual Restoration Activities Report – 2009

Prepared for:
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Oakland, CA 94612

July 2010

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ACRONYMS AND ABBREVIATIONS

BT	Bay Trail
CCR	California Clapper Rail
EBRPD	East Bay Regional Park District
ECNA	El Cerrito Natural Area
ISP	Invasive Spartina Project
MK	Miller Knox
NGVD	National Geodetic Vertical Datum
PP	Point Pinole
RFS	Richmond Field Station
Tetra Tech	Tetra Tech EM Inc.
TWP	The Watershed Project
UC Berkeley	University of California, Berkeley
USACE	U.S. Army Corps of Engineers
WSMRP	Western Stege Marsh Restoration Project

1.0 INTRODUCTION

This report presents the 2009 update to the *Final Report for the University of California Berkeley Richmond Field Station Remediation and Restoration Project, Habitat Restoration Progress Report 2003-2007* (The Watershed Project 2007). This update summarizes restoration activities between October 2008 and September 2009 in Western Stege Marsh, its surrounding uplands, and the adjacent coastal terrace prairie habitat located on the University of California, Berkeley's (UC Berkeley) Richmond Field Station (RFS). Restoration activities were performed by Tetra Tech EM Inc., (Tetra Tech), contractors, and UC Berkeley interns.

This report includes a summary of revegetation efforts (Section 2.0), invasive non-native plant control activities (Section 3.0), monitoring activities (Section 4.0), details regarding the internship program in support of the project activities (Section 5.0), and references used to prepare this report (Section 6.0). Figures and tables are presented after their first mention in the text of the report, and appendices appear following Section 6.0.

2.0 REVEGETATION

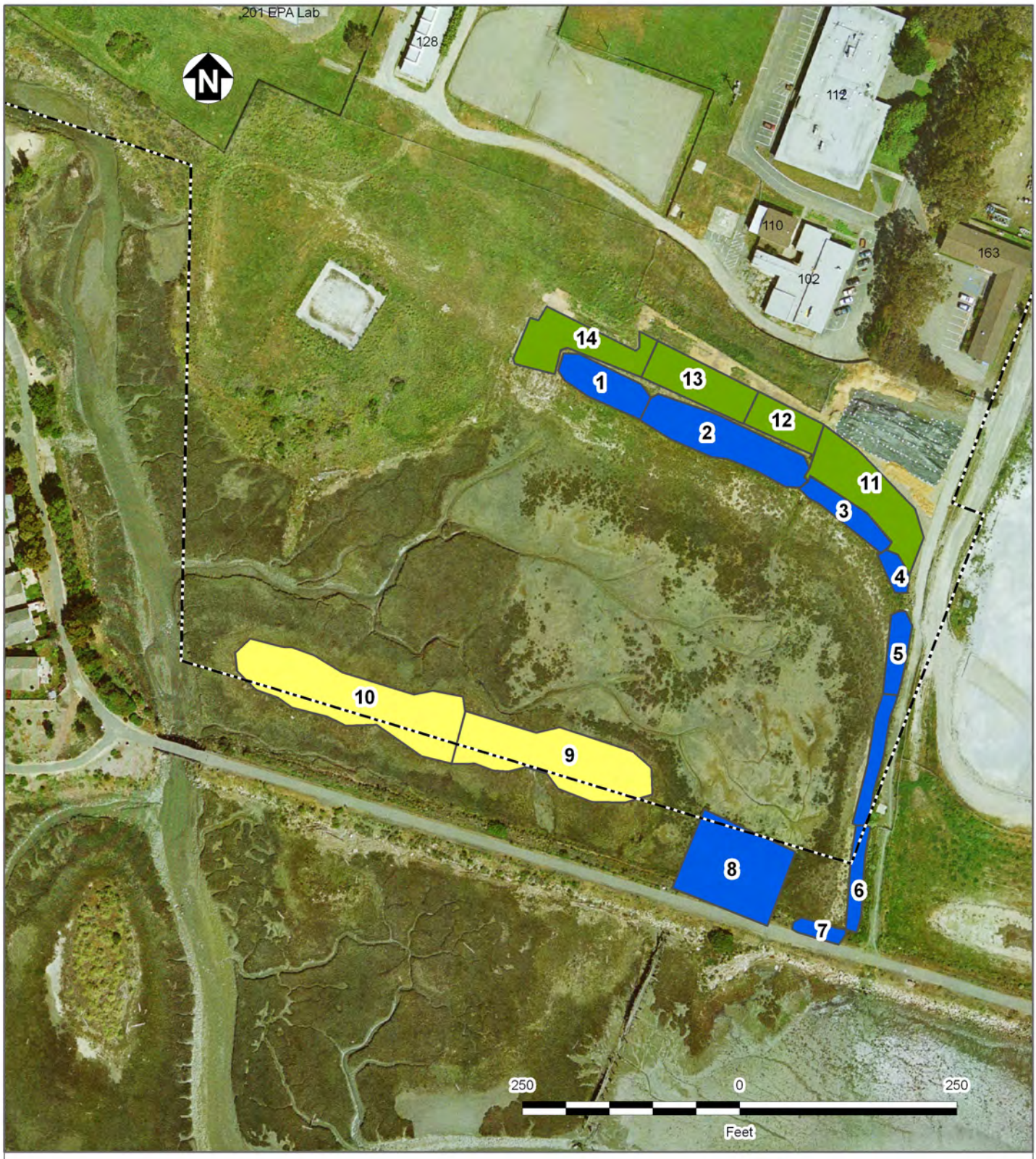
Revegetation efforts continued in the Western Stege Marsh Restoration Project (WSMRP) area but did not occur in the coastal prairie in 2009. Revegetation focused largely on infill plantings throughout the ecotone and upland, concentrating on areas that have had the poorest native plant survivorship. Two new areas were also included in this year's revegetation plan. Plot 14 was extended east to the border of plot 1 (see Figure 1), and an experimental transect was planted in the remediated area near the Western Storm Drain outfall (see Figure 2).

The planting palette consisted of select species that have exhibited the best survivorship and vigor at the site, species likely to out-compete weeds, and less common species for added diversity. A summary of the species propagated and the number of seedlings planted in 2009 and each year since 2004 is in Appendix A.

All seeds used for propagation had been previously collected by The Watershed Project (TWP) or by Tetra Tech. Seeds had been stored in paper bags or envelopes and put inside plastic Ziplock® bags with a packet of silica to wick away moisture. Seeds had been collected either from the field station or from previously approved nearby sites. Table 1 lists the propagule collection sites for each of the propagated species.

Planting techniques included using hand picks, soil knives, or shovels to dig holes slightly bigger than the nursery container. Half of one 21-gram Healthy Start 12-8-8 Macro Tablet was placed into each hole, along with a small amount (about a tablespoon) of soil from the coastal terrace prairie. The soil was gathered from the grassland area east of Building 280 in order to inoculate the marsh upland soils with native myccorhizae. In previous years, a 7-gram AgSafe 12-8-8 fertilizer tablet had been placed into the planting holes, but this fertilizer is no longer being manufactured. Because the size of the Healthy Start fertilizer tablet was too large for the small plantings, each tablet was cut in half. After a tablet had been cut in half, it tended to crumble, making difficult the measurement of how much fertilizer was placed into each hole. A smaller tablet should be purchased for future plantings to enable more exact fertilizer measurement.

Revegetation took place during the rainy season between December and March, with the goal of limiting need for additional irrigation. However, plantings required watering directly after initial transplanting throughout the months of December and January due to very limited precipitation. Additional watering also occurred several times throughout the spring and early summer. In order to increase soil moisture retention, 4-6 inches of certified weed-free rice straw was placed around the new plantings. Approximately half of the plantings were mulched immediately upon transplanting, and the remaining plantings were mulched throughout the spring as time permitted. All plantings were flagged for spring monitoring purposes. Plantings were installed by Tetra Tech staff, UC Berkeley interns, and Shelterbelt Builders, Inc. Sections 2.1 and 2.2 detail specific revegetation activities within the marsh and upland areas.



Property Boundary

Upland Plots

Island Plots

Ecotone Plots

Source:
Aerial photo taken by Point Co., April 09, 2008

TETRA TECH EM INC.

Richmond Field Station
University of California, Berkeley

FIGURE 1
WESTERN STEGE MARSH RESTORATION PLOTS

Western Stege Marsh Restoration Project:
Annual Restoration Activities Report – 2009

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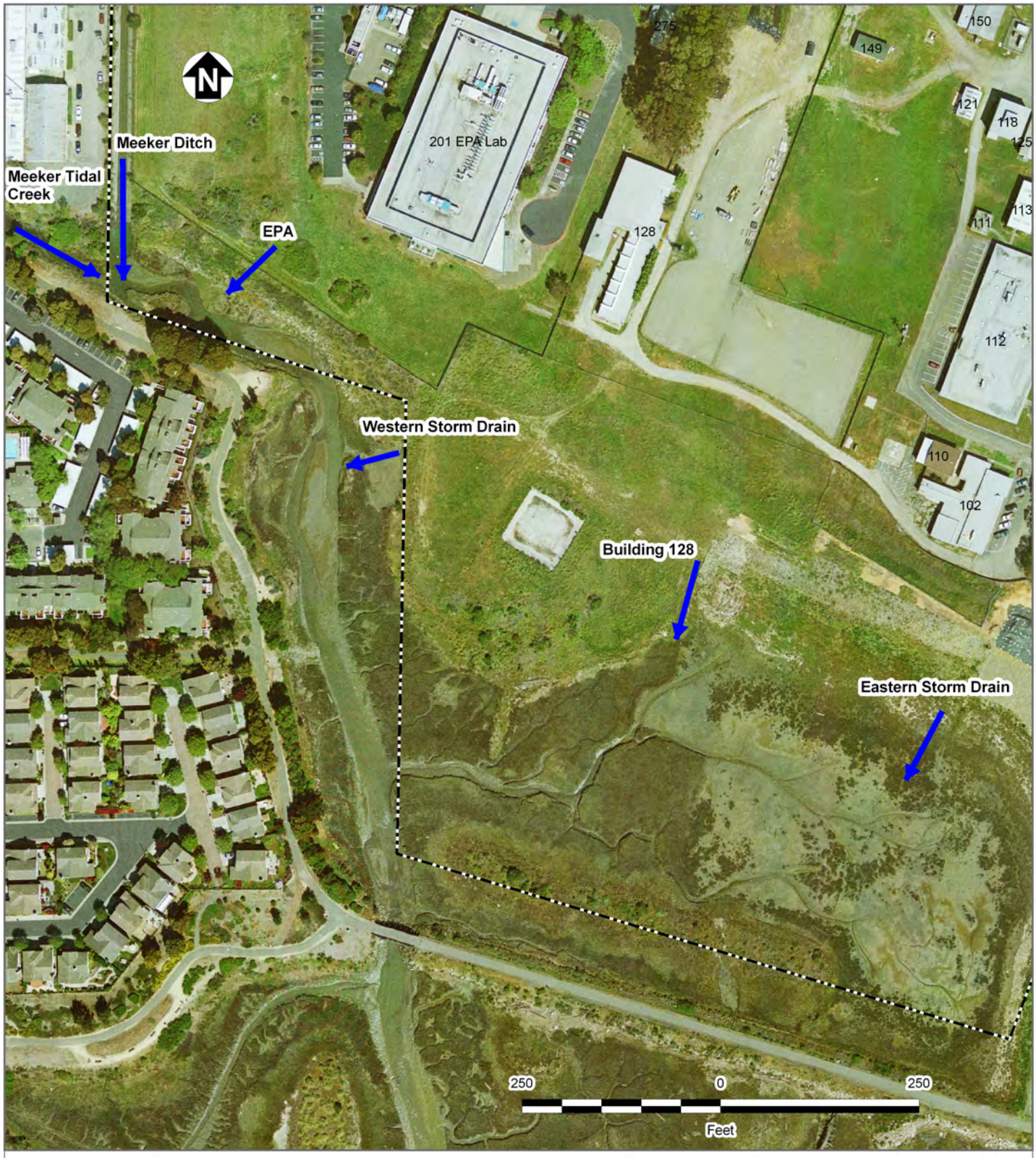


Property Boundary

Stormwater Outfall

TETRA TECH EM INC.

Richmond Field Station
University of California, Berkeley

FIGURE 2
RFS STORMWATER OUTFALLS

Western Stege Marsh Restoration Project:
Annual Restoration Activities Report – 2009

Source:
Aerial photo taken by Point Co., April 09, 2008

2010-06-25 V:\Misc_GIS\Richmond_Field_Station\Projects\Marsh_Monitng\year_5\restoration_summary\Fig_2_stormwater_outfalls.mxd TtEMI-OAK CF

TABLE 1
PROPAGULE COLLECTION SITES (2008- 2009 PLANTING SEASON)

Species	Common Name	Collection Sites
Achillea millefolium	common yarrow	ECNA
Artemisia californica	California sagebrush	BT
Artemisia douglasiana	mugwort	ECNA
Aster chilensis	common California aster	RFS Marsh
Baccharis pilularis	coyote brush	BT
Danthonia californica	California oatgrass	RFS Grassland
Elymus trachycaulus	slender wheatgrass	RFS Grassland
Eriophyllum staechadifolium	lizard tail	BT
Eschscholzia californica	California poppy	RFS Grassland
Gnaphalium californicum	California everlasting	MK
Grindelia stricta	marsh gumplant	BT
Hordeum brachyantherum	meadown barley	RFS Grassland
Juncus occidentalis	slender juncus	RFS Grassland
Juncus patens	common rush	RFS Grassland
Lasthenia glabrata	yellow rayed goldfields	Nursery plant
Leymus sp.	creeping wild rye	PP, MK
Lupinus succulentus	succulent lupine	PP
Mimulus aurantiacus	sticky monkey flower	ECNA
Nassella pulchra	purple needle grass	RFS Grassland
Rumex salicifolius	willow dock	RFS Grassland
Scirpus maritimus	bulrush	RFS Marsh
Stachys ajugoides	hedgenettle	RFS Grassland
Triglochin concinna	arrow grass	RFS Marsh
Wyethia angustifolia	mule's ears	RFS Grassland

Notes:

BT	Bay Trail
ECNA	El Cerrito Natural Area
MK	Miller/Knox Regional Shoreline
PP	Point Pinole Regional Shoreline
RFS	Richmond Field Station

2.1 MARSH REVEGETATION

Marsh revegetation occurred below plots 5 and 6 (see Figure 1), and in the remediated area at the Western Storm Drain outfall (see Figure 2). The area below plots 5 and 6 was targeted because past plantings had exhibited limited growth and vigor in comparison to other areas within the WSMRP. Limited plant establishment may be attributed to what appears to be sandier soil; however, this theory has not been fully substantiated because a soil study has not been completed. Arrow grass (*Triglochin consinna*) was selected for planting in the high marsh (5-6 feet above the National Geodetic Vertical Datum 29 [NGVD 29]) because a surplus of this species was available in the nursery and a vigorous population of a closely related species, seaside arrow grass (*Triglochin maritima*), was growing nearby. The arrow grass seedlings were extremely small, although they had been growing in the nursery since 2007. Due to their size, several seedlings were placed into each planting hole. Prior to future propagation of this species, protocols should be reviewed; a different potting soil or watering regimen may result in better growth.

The area around the Western Storm Drain outfall was targeted because active revegetation had not occurred there since the remediation in 2004. Prior to excavation, the area had supported a stand of Pacific cordgrass (*Spartina foliosa*), but since then it had remained a mudflat due to a lack of natural recruitment or active revegetation. The area may have been re-graded at an elevation too high for cordgrass growth. Alkali bulrush (*Scirpus maritimus*), growing nearby at slightly higher elevations than cordgrass, was selected for this reason. The original goal was to plant the bulrush in groups of three over the entire area. However, similar to the arrow grass, the bulrush seedlings were very small despite having grown in the nursery since 2007. For this reason, the seedlings were planted collectively into four holes with approximately 10-12 seedlings in each hole. The planting holes were arranged along a transect perpendicular to an elevational gradient (east to west) in order to determine where the bulrush would be most successful for future plantings. Cages were assembled from chicken wire and zip ties, and placed around each group of seedlings in order to avoid uprooting by geese or other marsh birds. Future plantings of alkali bulrush should consist of divisions, avoiding the issue of poor seedling growth in the nursery.

Table 2 compares marsh propagation goals with the actual outplanting numbers for the 2008-2009 planting season.

2.2 ECOTONE AND UPLAND REVEGETATION

Infill outplanting occurred in the ecotone and uplands surrounding the marsh in areas that had exhibited poor native plant survivorship and natural recruitment. Plot 14 was also expanded to the eastern border of plot 1 (see Figure 1). This area had not been included in TWP's revegetation plan (TWP 2007), perhaps because the area already supported close to 50% native species cover, consisting mostly of pickleweed (*Salicornia virginica*) and alkali heath (*Frankenia salina*). However, invasive annual grasses and non-native brass buttons (*Cotula coronopifolia*) dominated the area between the native plants. Additional native plantings will likely help to outcompete these weeds.

The planting palette was created after conducting a visual assessment of the plants exhibiting good survivorship and vigor in the project area. Based upon the assessment, shrubs such as lizard tail (*Eriophyllum staechadifolium*) and species that self-propagate via rhizomes such as aster (*Aster chilensis*) were selected. Some of the areas requiring infill planting had exhibited poor survivorship in previous years because the soils were too wet during the rainy season to support the species originally planted. For these areas, hydrophyllic (wet-loving) natives were selected such as rushes (*Juncus* spp.*)* and meadow barley (*Hordeum brachyantherum*). Additionally, other species were included for added diversity and color such as California poppy (*Eschscholzia californica*) and goldfields (*Lasthenia glabrata*).

Creeping wild rye (*Leymus* sp.) was selected for the ecotone and upland because the 2006 plantings had proven very successful in quickly forming large patches. Records indicate that *Leymus triticoides* divisions had been transplanted into the restoration plots in 2006 (TWP 2007), but they were likely of a natural hybrid called *L.* x *multiflorus*. A very low percentage of creeping wild rye seeds are viable (East Bay Regional Park District [EBRPD] 2008); therefore, it is necessary to collect divisions of this grass instead of growing it from seed. Point Pinole (PP) Regional Shoreline and Miller/Knox (MK) Regional Shoreline were chosen as collection sites. Collecting permits were obtained from the EBRPD. Creeping wild rye grows abundantly in both parks, but individual populations are fairly small or surrounded by invasive plants. For this

reason, the original goal to collect 1000 divisions was considerably decreased to 362 divisions so as not to put the existing populations at risk. Before transplanting occurred, soil was cleaned from the roots, and aboveground growth was clipped to approximately 6 inches in height. All divisions were transplanted on the same day they were collected.

Plantings in the ecotone and upland were generally arrayed in clusters of three to seven plants of a given species per grouping in order to mimic natural conditions. Shrubs and subshrubs were placed on 1.5- to 2-foot centers. Purple needle grass (*Nasella pulchra*) and other native grasses were planted more densely. A higher density (than natural conditions) was selected for two reasons: first, survivorship in some of these areas had been documented as sub-optimal, therefore encouraging increase in planting density to address anticipated plant mortality; and second, a higher planting density likely would suppress many of the annual weeds following establishment of the plants.

Table 2 compares ecotone and upland propagation goals with the actual outplanting numbers for the 2008-2009 planting season.

TABLE 2
COMPARISON OF PLANNED TO ACTUAL OUTPLANTING NUMBERS
FOR 2008-2009 PLANTING SEASON

Species	Propagation Goal	Actual Outplanting Number	Difference between Propagation Goal and Actual Outplanting Number	Notes
Achillea millefolium	200	268	68	
Artemesia californica	100	49	-51	Low germination
Artemsesia douglassiana	200	259	59	
Aster chilensis	250	309	59	
Baccharis piluaris	50	16	-34	Low germination
Elymus trachycaulus	50	35	-15	Low germination
Eriophyllum staechadifolium	200	267	67	
Eschscholzia californica	--	94	94	For added diversity
Gnaphalium californicum	--	29	29	For added diversity
Grindelia stricta	200	411	211	
Hordeum brachyantherum	100	66	-36	Low germination
Juncus oxidentalis	50	45	-5	Low germination
Juncus patens	50	147	97	
Lasthenia glabrata	--	40	40	For added diversity
Leymus sp.	1000	362	-638	Divisions
Lupinus succulentus	--	85	85	For added diversity
Mimulus aurantiacus	50	87	37	
Nasella pulchra	200	246	46	
Rumex salicifolius	--	69	69	Surplus in nursery
Scirpus maritimus	--	47	47	Surplus in nursery
Stachys ajugoides	--	22	22	Surplus in nursery
Triglochin consinna	--	72	72	Surplus in nursery
Wyethia angustifolia	--	19	19	Surplus in nursery
Total:	**2,700**	**3,044**	**344**	

3.0 INVASIVE NON-NATIVE PLANT CONTROL

Tetra Tech oversaw all invasive non-native plant control activities in 2009. Shelterbelt Builders Inc. continued providing support as a subcontractor to UC Berkeley for larger invasive plant control tasks and herbicide application. Shelterbelt Builders Inc. was managed on site by Tetra Tech's Restoration Coordinator. Additionally, UC Berkeley students and interns conducted weeding throughout the year. Below is a summary of activities performed to achieve the goal of reducing the cover, richness, and distribution of targeted invasive non-native plant species within the WSMRP site and the coastal terrace prairie.

3.1 WEED BUFFER ZONES

Buffer zones previously established north and west of plots 11-14 required maintenance in 2009. In 2008, the buffer zones were covered with 6 to 8 inches of wood chips after herbicide application. By mid- summer, weeds were growing where natural degradation had reduced the wood chip layer to about 4 inches deep. Additional wood chips were obtained from local tree trimming companies, and the most efficient method of spreading the chips was found to be the following: first, the driver delivering the chips slowly drove forward as the chips were being emptied from the truck; next, the chips were further spread using a skip loader; finally, the small piles created by the skip loader were smoothed out using rakes or hoes.

Requirement of additional wood chips is expected annually in order to maintain the weed buffer zones. A depth of at least 8 inches is suggested to accomplish a full year of adequate weed suppression. Chips should be delivered and spread in September or October. This time period occurs after California Clapper Rail (CCR) breeding season, so that nesting is not disturbed by loud machinery, and before heavy rainfall, when the soil becomes saturated and may immobilize vehicles in the mud.

3.2 TARGETED INVASIVE REMOVAL

Targeted invasive non-native plant removal continued throughout the year, and methods used were consistent with those used in 2007-2008. Where feasible, the Tetra Tech Restoration Coordinator and interns monitored and controlled infestations of targeted weeds such as Russian thistle (*Salsola soda*), stinky tarweed *(Dittrichia graveolens*), bristley ox-tongue (*Picris echiodes*), five-hooked bassia (*Bassia hyssopifolia*), birds foot trefoil (*Lotus corniculatus*), and several other species. Shelterbelt Builders Inc., managed by the Restoration Coordinator, worked on priority large-scale weed control actions. Shelterbelt Builders Inc. continued to selectively utilize chemical-based integrated pest management strategies for adaptively treating targeted invasive weeds such as perennial pepperweed (*Lepidium latifoium*). Other treatment techniques included blanching (using a propane torch) bur clover (*Medicago polymorpha*) and systematic, repeated, hand removal of birdsfoot trefoil.

Table 3 provides a detailed summary of the targeted species controlled during 2009, including the treatments used, estimated removal volumes, and treatment areas.

TABLE 3
SUMMARY OF CONTROL TECHNIQUES UTILIZED IN 2009 FOR SELECTED PRIORITY INVASIVE PLANT SPECIES

Scientific Name	Common Name	Preferred Control Period (Quarter)	Estimated Amount Removed	Control Techniques & Estimated Cover Reduction Following Control Implementation
Bassia hyssopifolia	Bassia, Five Hook Bassia	Q3,Q4	Less than 50 plants.	**Technique Used:** Hand pulling was found very effective because the root is very short. **Observations:** This plant has been effectively controlled in the project site and is currently not a threat. However, *Bassia* exists in Eastern Stege Marsh. It is expected to continue to colonize along the access road between the two properties. **Estimated Cover Reduction:** Cover has been reduced from approximately 85 percent on the upland staging area at the beginning of the restoration project to less than 50 plants along the access road in 2009. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns.
Centaurea solstitialis	Yellow Star Thistle	Q2,Q3	--	**Observations:** Zero plants were observed growing on RFS in 2009. This species has been observed growing nearby in past years. Annual monitoring should continue.
Cortaderia jubata	Pampas Grass, Jubata Grass	Q2,Q3	Approximately 12 seedlings from the upland and ecotone areas of the marsh. Approximately 6 30-gallon bags of flower stalks from the bulb and Heron Dr. Two clones were cut down on the Island.	**Technique Used:** Small plants were grubbed out with a hand pick or pulaski. Large clones were removed with a frontloader. Flower stalks were cut using pruners. **Observations:** This species continues to colonize the upland and ecotone plots in the marsh. Tetra Tech communicated with the City of Richmond regarding removing the large stand in the outboard marsh. They supported the idea but do not have the financial means for the removal effort. **Estimated Cover Reduction:** The two large stands (southwest of the U.S. Environmental Protection Agency Region 9 Laboratory building) that were removed last year exhibited 5% regrowth after one application of glyphosate. An additional application of glyphosate was applied to the resprouts in fall 2009. A larger effort was made this year to prevent seed set in stands growing outside of the project area. Flower stalks were cut from large clones growing along Heron Dr. (north of the restoration) and on the bulb. RFS facilities staff later removed the large clones growing along Heron Dr. They have committed to continued maintenance of this area. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns controlled small plants. Contractors applied herbicide. RFS staff used a frontloader to remove large clones.
Cotula coronopifolia	Brass Buttons	Q2,Q3	Less than one 5- gallon bucket.	**Technique Used:** Plants were hand pulled when the ground was soft, and grubbed out with a hand pick when the ground was dry. **Observations:** Cover increased approximately 25% compared to 2008, mostly in the new area of plot 14. Individuals were found growing in plot 11, and small patches grew along the access road adjacent to the bay mud stockpile. **Estimated Cover Reduction:** There was no evidence of the previous infestation in plots 6 and 7. Shrubs were planted in the new area of plot 14 in order to create competition for this weed. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff, interns, and contractors.
Cynara cardunculus	Artichoke Thistle	Q2,Q3	--	**Estimated Cover Reduction:** Six plants in the prairie were treated with glyphosate in 2008. Zero plants were detected in 2009. This species is growing on adjacent sites. Monitoring should continue.
Cynodon dactylon	Bermuda Grass	Q2,Q3	Approximately two 5-gallon buckets were removed from plot 2.	**Technique Used:** Plants were grubbed out with soil knives or treated with glyphosate. **Observations:** In 2008, Bermuda grass appeared to have expanded in the prairie restoration plot 3 (see Figure 3). Past records (TWP 2007) indicated this weed was present in the area, but the extent of the invasion was not noted. This population was treated with glyphosate in December 2008. Resprouts from previously treated populations in the ecotone and upland restoration plots were sprayed again in 2009. Small populations were discovered growing in plot "Claire" in the prairie. Populations in plot "Claire" and marsh ecotone plot 2 were grubbed out because a licensed applicator was not available. **Estimated Cover Reduction:** In some areas, glyphosate treatment resulted in approximately 80% efficacy, but in other areas efficacy was as low as 25%. One population in plot 2 tripled in size compared to 2008. Two additional populations were discovered in the marsh upland, and small populations were growing in plot "Claire" in the prairie. **Primary Means for Control (Contractor, Volunteer, etc.):** Licensed contractor-applied herbicide.

TABLE 3
SUMMARY OF CONTROL TECHNIQUES UTILIZED IN 2009 FOR SELECTED PRIORITY INVASIVE PLANT SPECIES

Scientific Name	Common Name	Preferred Control Period (Quarter)	Estimated Amount Removed	Control Techniques & Estimated Cover Reduction Following Control Implementation
Dipsacus fullonium	Teasel	Q2,Q3	Approximately 2.5 30-gallon bags were removed from the prairie.	**Technique Used:** Trenching shovels proved the most effective means of control, as they were able to remove several inches of the taproot. Grubbing with a handpick was also used; however, resprouts occurred more commonly with this method. **Observations:** Teasel continues to encroach upon the restoration plots in the prairie. Timely mowing events will prevent seed set. **Estimated Cover Reduction:** Efforts in 2009 concentrated on removing plants growing in or around the restoration plots in the prairie. **Primary Means for Control (Contractor, Volunteer, etc.):** Tetra Tech staff and interns.
Dittrichia graveolens	Stinky Tarweed	Q3,Q4	Approximately two 5-gallon buckets from the bulb and an additional 100 plants from other areas.	**Technique Used:** Hand pulling proved effective. **Observations:** Populations of stinky tarweed continued on the bulb, along Heron Dr., and in the fenced-in area north of plots 12 and 13. Similar to last year, isolated plants were found in plots 1 and 2 (and below) and in plots 12-14. Stinky tarweed was also growing in plot 11 this year for the first time. The bulb was not mowed this year, increasing the number of hours spent hand weeding. Monitoring of this species should remain a priority as it continues to expand its territory. **Estimated Cover Reduction:** The rigorous control program implemented in 2008 for stinky tarweed has successfully thwarted establishment of this species in the restoration project area. The entire upland and ecotone areas continued to be monitored at least once every other week in 2009. Isolated individuals and small populations grew in roughly the same areas and numbers as in the previous year except for the new population in plot 11. More plants were removed in the bulb than in 2008, but this likely resulted because the bulb was not mowed this year. Although Tetra Tech attempted to coordinate with the RFS staff, mowing did not occur. Approximately 98% of known populations were removed before seed set. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns.
Foeniculum vulgare	Fennel	Q2,Q3	Approximately 5 cubic yards of plant material was removed from both sides of the Bay Trail, and 25 seedlings were removed from ecotone and upland restoration plots.	**Technique Used:** Small plants were grubbed out using hand picks; larger plants required use of heavier tools such as pulaskis. Glyphosate, an herbicide, was applied during calm conditions. **Observations:** Fennel continues to dominate both sides of the Bay Trail. The soil here is rocky fill and an extremely harsh environment for plants, although poison oak is very successful and is outcompeting fennel in a few areas. Fennel seedlings also continue to sprout in the ecotone and upland restoration plots. **Estimated Cover Reduction:** Approximately 75 percent regrowth occurred after control efforts in 2008. In 2009, herbicide was applied to approximately two-thirds of the fennel growing on the north side of the Bay Trail (within the fence). Herbicide could not be applied to all of the fennel due to overly windy conditions. Over 90% of seed set was controlled. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff, interns and licensed contractors.
Lepidium latifolium	Perennial Pepperweed	Q2,Q3,Q4	Approximately five 30-gallon bags were removed.	**Technique Used:** Populations were grubbed out with handpicks, removing roots as far down as 6 inches. Resprouts were treated with one application of glyphosate. **Observations:** See section 4.4 for a full account of observations and control efforts. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns grubbed out stems. Licensed contractor treated resprouts.
Lotus corniculatus	Birdsfoot Trefoil	Q2,Q3	Staff and interns removed approximately 12 30-gallon bags. Approximately 48 contractor hours were spent removing this weed.	**Technique Used:** Blanching (late November, early January, and mid-February); hand pulling or grubbing out with hand picks. **Observations:** Despite the earlier blanching event in 2009, this method did not prove effective for controlling *Lotus*. **Estimated Cover Reduction:** Cover was greatly reduced in the marsh ecotone compared to 2008. Half the number of contractor hours were needed to control this weed. However, cover substantially increased in plot 9 and in the prairie restoration plots. **Primary Means for Control (Contractor, Volunteer, etc.):** Contractors, staff, and interns.

TABLE 3
SUMMARY OF CONTROL TECHNIQUES UTILIZED IN 2009 FOR SELECTED PRIORITY INVASIVE PLANT SPECIES

Scientific Name	Common Name	Preferred Control Period (Quarter)	Estimated Amount Removed	Control Techniques & Estimated Cover Reduction Following Control Implementation
Lythrum tribracteatum	Loosestrife	Q2,Q3	Records do not indicate amount removed.	**Technique Used:** Grubbing out with hand picks; mulching. **Observations:** This weed was not observed in the ecotone and upland marsh in 2008, but it invaded previously blanched areas in 2009. Blanched areas should be heavily mulched to prevent future invasion. Populations continued in the prairie plots "Claire" and "Connie." **Estimated Cover Reduction:** There were not enough contractor hours for removal of this weed. Populations were heavily mulched in Plot “Claire” and the marsh ecotone. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns.
Medicago polymorpha	Burr Clover	Q1,Q2	Staff and interns removed approximately 17 30-gallon bags. Approximately 180 contractor hours were spent removing this weed.	**Technique Used:** Blanching (in late November, early January and mid-February); hand pulling or grubbing out with hand picks. **Observations:** Efficacy of blanching improved with the first event occurring in early January 2009 compared to late January in 2008. Results were best when seedlings were very small. Control efforts should begin in December if possible. When larger seedlings were blanched, regrowth usually occurred. **Estimated Cover Reduction:** *Medicago* cover increased approximately 25% compared to 2008 despite extensive hours spent weeding. This may be due to the decrease in *Lotus* cover, exposing more *Medicago* seed to sunlight. Blanching reduced this year’s cover by approximately 30 percent. **Primary Means for Control (Contractor, Volunteer, etc.):** Contractors, staff, and interns.
Melilotus sp.	Sweet Clover	Q2,Q3	Staff and interns removed approximately 2.5 30-gallon bags. Approximately 10 contractor hours were spent removing this weed.	**Technique Used:** Hand pulling or grubbing out with handpicks. **Observations:** Cover increased slightly compared to 2008. Populations were largest in plots 2 and 3. **Estimated Cover Reduction:** Approximately 95 percent was removed prior to seed set. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns.
Phalaris aquatica	Harding Grass	Q2,Q3	Staff and interns removed approximately 10 plants from the ecotone and upland restoration plots. Approximately 72 contractor hours were spent removing or treating this weed in the prairie.	**Technique Used:** Staff and interns grubbed out isolated individuals growing within the ecotone and upland restoration plots. Contractors grubbed out or cut down plants growing in and around prairie restoration plots and applied glyphosate strategically to pioneer infestations. RFS maintenance staff mowed the greater part of the prairie throughout the summer. **Observations:** This species is re-invading the prairie restoration plots where it has repeatedly been removed. Additional support by contractors is needed for effective control. **Estimated Cover Reduction:** Tetra Tech scheduled mowing events in order to prevent seed set, but mowing did not occur according to schedule. **Primary Means for Control (Contractors, Volunteers, etc.):** Contractors and RFS maintenance staff.
Rubus discolor	Himalayan Blackberry	Q2,Q3	Approximately 24 contractor hours were spent removing this weed from the island plots (see Figure 1).	**Technique Used:** Small patches were grubbed out with hand picks or soil knives. Large patches were removed with chainsaws. Most of the removal occurred on the Island plots. Resprouts were treated with glyphosate in March and May. **Observations:** Resprouts occurred after two applications of glyphosate. **Estimated Cover Reduction:** Cover was reduced approximately 70 percent. **Primary Means for Control (Contractor, Volunteer, etc.):** Contractors.

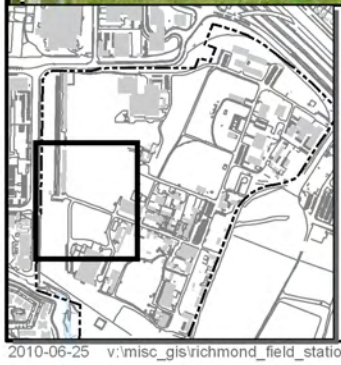
TABLE 3
SUMMARY OF CONTROL TECHNIQUES UTILIZED IN 2009 FOR SELECTED PRIORITY INVASIVE PLANT SPECIES

Scientific Name	Common Name	Preferred Control Period (Quarter)	Estimated Amount Removed	Control Techniques & Estimated Cover Reduction Following Control Implementation
Salsola soda	Russian Thistle	Q3,Q4	Approximately three 30-gallon bags were removed from outboard marsh and two 30-gallon bags were removed from the inboard marsh, mostly from the bulb and Meeker Slough. About 232 stems were pulled in the ecotone restoration plots.	**Technique Used:** Hand pulling proved effective, as the roots on this plant are extremely short. **Observations:** Removal from the inboard marsh occurred in the island and ecotone plots, on the bulb, and along the left bank of Meeker Slough. Populations in the island plots expanded since 2008. This area should be closely monitored next year because about 10 percent of plants set seed before removal. **Estimated Cover Reduction:** Rigorous control efforts succeeded in reducing the number of seedlings growing in the ecotone by 42 percent. Cover in other inboard areas (the bulb and Meeker Slough) was reduced 75 percent. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff and interns.
Senecio vulgares	Purple Ragwort	Q1	Approximately 60 contractor hours were spent removing this weed.	**Technique Used:** Hand pulling occurred when the soil was moist. Picks were used to grub out the roots when the soil was dry. **Observations:** This species first invaded the ecotone areas in 2007-8, and cover increased by approximately 50 percent in 2009. The largest populations occurred in plots 1 and 2 and in the tidal marsh directly south of these plots. Plants were often difficult to remove when they were growing within dense patches of grass. A new population was found covering approximately 5 percent of plot 3 in the prairie. **Estimated Cover Reduction:** Weeding efforts in 2009 prevented approximately 75 percent seed set in the marsh ecotone and 50 percent in prairie plot 3. **Primary Means for Control (Contractor, Volunteer, etc.)** Staff and Contractors.
Spartina alterniflora	Smooth Cordgrass	Q2,Q3	137 seedlings were pulled from within the restored marsh.	**Technique Used:** Volunteer seedlings within the WSMRP site were removed by hand. Imazapyr, an herbicide, was applied to smooth cordgrass populations in the outboard marsh; populations not treated with herbicide were clipped to the ground. **Observations:** See above. For a full account of smooth cordgrass control, see Section 4.3. **Estimated Cover Reduction:** Populations treated with Imazapyr in July were reduced by approximately 80% cover. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff conducted monthly monitoring. The ISP performed the annual inventory, mapped hybrid populations, and applied herbicide.
Tragopogpn porrifolius	Salsify	Q2,Q3	Approximately one 30-gallon bag was removed from the prairie.	**Technique Used:** Hand pulling or grubbing with hand picks. **Observations:** Control efforts were concentrated within and around restoration plots in the prairie (see Figure 3). The largest populations were effectively controlled by mowing before seed set. **Estimated Cover Reduction:** Approximately 50 percent seed set was controlled. **Primary Means for Control (Contractor, Volunteer, etc.):** Staff, interns, and RFS maintenance staff.

Notes:

Q1 – January through March
Q2 – April through June
Q3 – July through September
Q4 – October through December

ISP	Invasive Spartina Project
RFS	Richmond Field Station
Tetra Tech	Tetra Tech EM Inc.
WSMRP	Western Stege Marsh Restoration Project



Property Boundary

Harding Grass Control Plots:

- Hand Removal Mulch
- Hand Remove
- Herbicide
- Herbicide Mulch
- Scrape

Source: Aerial photo courtesy of Point Co., 2008

TETRA TECH EM INC.

Richmond Field Station,
University of California, Berkeley

FIGURE 3
COASTAL TERRACE PRAIRIE RESTORATION PLOTS

Western Stege Marsh Restoration Project:
Annual Restoration Activities Report - 2009

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According to the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2009* (May and Associates Inc. 2009), dominant invasive non-native species observed during the fall vegetation monitoring efforts were annual grasses: ripgut brome (*Bromus diandrus*), rabbit's foot grass (*Polypogon monspeliensis*), and little sickle grass (*Parapholis incurva*). No targeted invasive species were detected in the survey quadrats. This represents a significant reduction of the dominant weeds observed in fall 2007 and 2008. The most noteworthy changes in cover were Russian thistle, reduced from occuring in one quadrat in 2008 and three quadrats in 2007; and birdsfoot trefoil, reduced from occurring in one quadrat in 2008 and four quadrats in 2007. The addition of contractor support in 2008 and 2009 was essential in significantly reducing cover of these target non-native species.

3.3 SMOOTH CORDGRASS CONTROL

UC Berkeley was directed to control invasive smooth cordgrass (*Spartina alterniflora*) in the US Fish and Wildlife Service Biological Opinion to the U.S. Army Corps of Engineer's (USACE) Nationwide Permit issued for the RFS Remediation and Restoration Project (USACE 2003). Tetra Tech continued implementing the smooth cordgrass control protocols that had been developed by TWP in collaboration with the Invasive Spartina Project (ISP). Under these protocols, all cordgrass seedlings that established in the restored portion of the marsh through natural recruitment were assumed to be smooth cordgrass and were mapped and pulled. Monitoring of seedling establishment occurred monthly.

Approximately 137 seedlings were identified and removed from the WSMRP site from November 2008 – October 2009. Figure 3.4.1 in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2009* shows locations of all seedlings pulled. The Restoration Coordinator sent a random sample of these seedlings to the ISP for genetic testing to determine if they were Pacific, smooth, or hybrid cordgrass. In October 2008, the ISP completed the annual inventory that had begun in July. Samples of suspect populations were collected for genetic testing and were confirmed as hybrids. Figure 3.4.2 in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2009* identifies the known locations of smooth cordgrass and hybrids as of December 2008.

In July 2009, the ISP conducted a thorough inventory of smooth cordgrass and hybrids in Western Stege Marsh and surrounding areas. Samples were collected from all suspect populations for genetic testing. Treatment of previously mapped hybrid populations with the herbicide Imazapyr was implemented on the same day. The 2009 map is not yet available because analysis of genetic results is still in progress.

In September 2009, it was apparent that one of the established hybrid populations in the outboard marsh had not been treated in July. The population appeared to have excellent vigor compared to all other known hybrids that had been sprayed. The Restoration Coordinator informed the ISP and clipped flowering stalks to the ground.

July treatment of hybrid populations, which began in 2008, resulted in a substantial increase of herbicide efficacy compared to treatment in October. Approximately 80 percent mortality was observed.

A summary of smooth cordgrass control activities is presented in Table 4.

TABLE 4
SUMMARY OF INVASIVE SMOOTH CORDGRASS MONITORING AND CONTROL EFFORTS (2008-2009)

Date	Activity
Oct 2008	Removed 20 seedlings. ISP inventoried sections of the outboard marsh that had not been completed in July. Samples collected and sent to the lab for identification.
Dec 2008	Removed nine seedlings. October samples identified as hybrid.
Jan 2009	Removed seven seedlings.
Feb 2009	Monthly monitoring; no seedlings detected.
Mar 2009	Monthly monitoring; no seedlings detected.
Apr 2009	Monthly monitoring; no seedlings detected.
May 2009	Removed 22 seedlings.
Jul 2009	Removed 45 seedlings. ISP conducted annual inventory. Samples collected and sent to the lab for identification. Known hybrid populations were treated.
Aug 2009	Removed 15 seedlings.
Sept 2009	Removed 31 seedlings. Samples collected and sent to the lab for identification. Flowering stalks clipped from one hybrid population in the outboard marsh.
Oct 2009	Removed 8 seedlings. Flowering stalks clipped from one hybrid population in the outboard marsh.

Notes:
ISP Invasive Spartina Project

3.4 PERENNIAL PEPPERWEED CONTROL

Perennial pepperweed populations continued to expand in the WSMRP site in 2009. Established populations were also discovered on adjacent properties owned by the City of Richmond and the EBRPD. For purposes of monitoring patterns of invasion and coordinating control efforts with adjacent landowners, Tetra Tech and May & Associates, Inc., mapped all known populations of perennial pepperweed growing within the WSMRP site and adjacent areas in May 2009 (see Figure 4). Several established populations were discovered on the outboard side of the marsh, near Meeker Beach. The two largest populations were estimated to contain at least 300 stems.

Additionally, two new populations were discovered within the ecotone of the inboard marsh, and a population in the prairie was discovered growing near the Northern Regional Library Facility. A review of RFS documents revealed that perennial pepperweed had been recorded as present in the prairie in 1993 (Brady and Associates 1993), although the exact locations were not noted.

Populations growing on the RFS were grubbed out and resprouts were treated with glyphosate application. Outboard populations growing closest to the WSMRP were grubbed out with permission from the EBRPD and City of Richmond. Control methods were not implemented for the newly discovered populations in the outboard marsh due to their size and the extent of invasion.

Perennial pepperweed will likely continue to invade the WSMRP area unless a comprehensive and coordinated approach is adopted to control this species within the greater south Richmond shoreline region.

Number of stems in large (< 1 sq. mi) patch

- 1-5
- 6-10
- 16-20
- 26-30
- 36-40
- 46-50
- 51-75
- 76-100
- 176-200
- 301-350

- Property Boundary
- Project Area
- Treated sites with no growth as of May 2009

Aerial photo courtesy of Point Co., 2008

TETRA TECH

Richmond Field Station
University of California, Berkeley

FIGURE 4
DISTRIBUTION OF PEPPERWEED

Western Stege Marsh Restoration Project:
Annual Restoration Activities Report - 2009

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4.0 MONITORING

The Tetra Tech Restoration Coordinator and UC Berkeley interns performed the revegetation and wildlife monitoring activities described below.

4.1 PERMANENT QUADRAT MONITORING, PLOT 11

Plot 11 was initially revegetated during the 2007-2008 planting season (Tetra Tech 2008). For the purposes of monitoring, six permanent points were established within the plot, such that they each randomly captured approximately 10 percent of the original plantings. In 2009, vegetation monitoring took place on May 27 and June 3. Four 1-meter-square quadrats were assessed for each of the six established points, 24 quadrats in total. Quadrat "A" was placed such that the stake was located at the southwest corner of the frame. The frame was then moved clockwise for each subsequent quadrat. All quadrats were lined up along the north-south axis. Species growing within the quadrat were recorded, and cover class was noted. The average height and vigor of the dominant native species was also recorded. Species were identified using the *Jepson Manual: Higher Plants of California* (Hickman 1993). Vigor was assessed using a qualitative scale (see Table 5).

The percentage of bare ground decreased considerably from 2008 to 2009. In 2008, 19 quadrats (79 percent) exhibited a 76 or higher percentage of bare ground. In 2009, only seven quadrats (29 percent) exhibited a 76 or higher percentage of bare ground. Additionally, native species richness increased. In 2008, the average (median) native species richness was two species per quadrat. In 2009, the average native species richness rose to 5.5 species per quadrat. Non-native cover remained low; only one quadrat contained an invasive species with greater than 1 percent cover.

On average, vigor of planted stock remained high. In 2008, the dominant species in all quadrats were found to have either "excellent" or "good" vigor. In 2009, 92 percent of the quadrats exhibited "excellent" or "good" vigor of the dominant species. Eight percent were found to have "fair" vigor: quadrats 4C and 5B.

Abundant natural recruitment of native species was observed throughout plot 11. Species exhibiting high numbers of recruitment include marsh gumplant (*Grindelia stricta*), mugwort (*Artemisia douglasiana*), aster (*Aster chilensis*), meadow barley (*Hordeum brachyantherum*), and purple needle grass (*Nasella pulchra*).

A high frequency of herbivory by Canada geese resulted in California brome plants remaining very short. However, most plants still flowered and set seed. Because of the short culms, the seeds were dispersed very near to the parent plant, creating dense grassy patches that appeared to be resistant to invasion.

Appendix B and Appendix C include the vegetation monitoring data and the photomonitoring records for plot 11. Broader vegetation monitoring data are represented and analyzed in the *Western Stege Marsh Restoration Project: Vegetation Monitoring Report – 2009*.

Table 5 below lists the criteria used to qualitatively assess plant vigor.

TABLE 5
CRITERIA FOR ASSESSING PLANT VIGOR

Health Assessment	Description of Assessment
Excellent Health	No evidence of stress (for example yellowed leaves or sun damage). Minor pest or pathogen damage may be present.
Good Health	Some evidence of stress. Pest or pathogen damage present.
Fair Health	Moderate level of stress. High levels of pest or pathogen damage.
Poor Health	High level of stress. High levels of pest or pathogen damage.

4.2 SURVIVORSHIP MONITORING FOR NEW PLANTINGS

All seedlings and divisions installed in 2009 were flagged for monitoring in spring 2009. Approximately 10 percent (364 plants) of the total number of plantings were evaluated using a qualitative scale to assess vigor (see Table 5). Eighty-nine percent of the plantings survived. Seventy-three percent exhibited "excellent" or "good" vigor. Grasses and rhizomatous species were generally the most successful. Plants that did not survive or had poor vigor tended to be shrubs. It was noted that all arrow grass plantings exhibited poor vigor.

All alkali bulrush seedlings planted in the transect near the Western Storm Drain outfall (see Figure 2) were assessed. Mortality appeared to be high in all four groupings, although underground rhizomes may have survived even if aboveground growth appeared dead, as observed in prior plantings of Pacific cordgrass. The two groupings closest to the upland edge exhibited the highest survivorship, approximately 25 percent. The two groupings farthest from the upland edge exhibited only about 15 percent survivorship. The alkali bulrush seedlings will continue to be observed through the fall. The location of next year's plantings will be determined by which groupings in the elevational transect have the highest amount of growth and the best vigor.

Additional observations regarding the vegetation were noted while performing monitoring activities. Flowers were observed for the first time on soap plant (*Chlorogallum pomeridianum*) and mule's ears (*Wyethia angustifolia*), installed in 2006-07, and gooseberry (*Ribes menziesii*), installed in 2004-05. New plantings of sticky monkey flower (*Mimulus aurantiacus*) generally exhibited poor vigor by late spring, but older plantings were less stressed. Plot 11 was the most successful revegetated upland plot, considering native species cover, planted stock vigor, and natural recruitment.

4.3 WILDLIFE MONITORING

Tetra Tech and UC Berkeley interns continued monitoring birds in the marsh during 2009. In order to capture the entire inboard marsh and uplands, changes were made to the protocols established by TWP (TWP 2007) in 2005. Instead of counting birds at only three census stations, observers counted the number of birds for each species beginning north of plot 14, circling around the marsh, and ending at the Meeker Slough footbridge. At least two monitors worked closely together, with one person recording the data and the other(s) identifying, counting, and observing behaviors of species in the tidal area, upland

area, and overhead. The outboard marsh was not included in the census. Birds were counted for 1 hour during a low and high tide each month. Censuses were scheduled during times when interns were available; therefore, only one monthly census occurred when interns were not available.

Monthly bird monitoring confirmed that the WSMRP area is providing valuable habitat for many species of birds. Forty species were identified within the project site in 2009. Birds were observed using mudflats, marsh vegetation, and uplands for foraging and roosting. A pair of American Avocets nested and hatched two chicks in a small patch of pickleweed (*Salicornia virginica*) that was surrounded by mudflat. Two fledgling Barn Swallows were observed being fed by a parent while perched on a wooden stake within the marsh. A nest was discovered within a large patch of poison oak (*Toxicodendron diversilobium*) on the southern edge of the ecotone. It could not be determined which species made the nest. Killdeer made at least three unsuccessful attempts to nest in the mulched weed buffer zone and on the access road. Evidence of egg predation was observed at each nest. Appendix E contains a summary of the monitoring data recorded.

In addition to the monthly bird monitoring, incidental sightings and aural detections of CCR were compiled and appear below in Table 6. Listed observations do not include the protocol surveys conducted by Jules Evans of Avocet Research Associates.

Many other incidental wildlife sightings occurred throughout 2009. Black-tailed jackrabbits (*Lepus californicus*) were commonly seen in the ecotone and upland areas, and occasionally within the tidal area. Rarely, two and three jackrabbits were observed at the same time. Raccoon tracks were regularly evident on the mudflats and within channels. Rodent burrows were observed in plots 10 and 14 (see Figure 1), and gophers were seen digging along the edge of the access road. Lizard sightings were common occurrences during the summer months. Lizards were frequently seen seeking cover under the shrubs along the access road. Garter snakes were sighted several times in and around plot 6. Abundance of praying mantises throughout the summer also was notable, as these had not been observed in previous years.

TABLE 6
CALIFORNIA CLAPPER RAIL INCIDENTAL SIGHTINGS AND AURAL DETECTIONS

Date	Observations (Observer)
11/18/2008	One CCR foraging in Meeker Slough. (Sheila Dickie and a group of birders)
12/28/2008	One CCR crossing the Slough. (Sheila Dickie)
12/30/2008	One CCR in the Slough on the inboard side of the trail. (Sheila Dickie)
3/5/2009	5:30 p.m. Concurrent observation of 2 CCRs calling simultaneously near the Bulb. (Stacy Haines)
5/1/2009	12:30 p.m. One CCR foraged along the left bank of Meeker Slough, walked from upstream of Bay Trail Bridge, under the bridge to the downstream side where it took a bath and then proceeded downstream and into cordgrass. (Karl Hans and Stacy Haines – video captured on YouTube)
5/26/2009	12:45 p.m. Concurrent aural detection of two CCRs in the outboard marsh. One bird called six or seven times from a fixed location, while the second bird called from within a small channel while moving. (Karl Hans and Stacy Haines)
8/25/2009	8:30-8:50 a.m. One probable juvenile CCR foraged along the right bank of Meeker Slough downstream of Bay Trail Bridge. (Karl Hans – video captured bird walking down right bank for 1 minute, then flying across slough to left bank)

Date	Observations (Observer)
8/25/2009	10:30 a.m. One adult preening, left bank of Meeker Slough upstream of Bay Trail Bridge, downstream of Western Stege Marsh main slough. (Karl Hans – video captured)
9/2/2009	5:45p.m. Three adult CCRs foraged separately, and two CCR chicks on the inboard side of the marsh. Adults were not seen with the chicks. (Alex Navarro – adult photographed) (Jane Kelly also reported sighting an adult CCR)
9/3/2009	8:25-8:50 a.m. Concurrent observation of two CCRs. One juvenile CCR in outboard Meeker Slough 10 to 50 feet downstream of Bay Trail bridge, foraged on left bank, and then clatter called and flew to right bank, continuing clatter call for a short time, and then foraged down Marina Bay slough. 8:45-8:50 a.m. One CCR upstream of Bay Trail Bridge swam from left bank to right bank and then walked into cordgrass, where it called (Karl Hans, first video of a rail call captured on YouTube)
9/3/2009	Early evening. Two CCRs in Meeker Slough. (Karl Hans)
9/3/2009	Evening. "Several adults" observed. (Alex Navarro)
9/6/2009	7:00 p.m. Concurrent observations. One CCR on the inboard side of the trail. Other rails also were vocalizing. (Sheila Dickie)
9/15/2009	6:30 p.m. Concurrent observations. Two CCRs on the inboard side of the trail observed foraging for about 10 minutes and then crossed the Slough. (Sheila Dickie)
9/17/2009	5:05 p.m. Two CCR fledged chicks on inboard left bank of Meeker Slough. (Karl Hans – video captured on YouTube.)
9/21/2009	4:50 p.m. Two CCRs on the inboard side of the trail. (Sheila Dickie)

5.0 INTERNSHIP PROGRAM

Tetra Tech continued to manage an internship program for UC Berkeley students. The internship program was designed to support UC Berkeley's habitat enhancement goals by providing students the opportunity to earn college credits and gain hands-on experience. Students were generally recruited from the College of Natural Resources and the College of Letters and Science. The Restoration Coordinator met with advisors and offered presentations on the WSMRP to students as a vehicle to recruit interested participants. Flyers and program descriptions were also developed, distributed, and posted. The program grew from 17 participating students in 2008 to 30 students in 2009, providing a total of 1037 hours of volunteer support throughout the year.

The internship program afforded students an opportunity to learn about habitat restoration and marsh and grassland ecology. With the focus on vegetation management, the goal of the program was to instruct students on basic plant identification skills and familiarize them with the common native and invasive plants in tidal salt marsh, coastal scrub, and coastal terrace prairie communities in the Bay Area. Interns engaged in a variety of activities such as collecting seed, propagating native plants, transplanting material into restoration plots, removing non-native invasive plants, and monitoring vegetation. They also assisted in trash cleanups in the marsh and the bi-monthly bird census. Bird census data are available in Appendix D.

6.0 REFERENCES

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APPENDIX A

SUMMARY OF SPECIES PROPAGATED AND PLANTED FOR THE RICHMOND FIELD STATION RESTORATION PROJECT 2004-2009

Summary of Species Propagated and Planted for the Richmond Field Station Restoration Project 2004 - 2009

Species	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
Achillea millefolium	353	169	138	438	268
Artemisia californica	202	184	416	127, plus seed	49
Artemisia douglasiana	71	60	95	196	259
Aster chilensis	766	436	547	426	309
Aster subulatus	-	-	-	97, plus seed	
Baccharis pilularis	138	265	581	-	16
Bromus carinatus	286	558	747	352	-
Carex densa	319	107	358	150	-
Carex subbractiata	195	108	198	-	-
Chlorogalum pomeridianum	-	-	24	31	-
Clarkia rubicunda	-	-	98	seed	-
Danthonia californica	1278	644	264	94	seed
Distichlis spicata	-	8	45	25	-
Elymus glaucus	424	627	219	-	-
Elymus hansenii	8	-	50	-	-
Elymus multisetus	-	43	75	15	-
Elymus trachycaulus	20	52	112	172	35
Eriogonum latifolium	-	101	49	-	-
Eriophyllum staechadifolium	433	141	293	122, plus seed	267
Eryngium armatum	12	111	202	-	-
Eschscholzia californica	-	-	31	seed	94
Festuca idahoensis	-	-	-	94	-
Frankenia salina	-	443	94,plus seed	25	-
Gnapthalium californica	-	48	4	-	29
Grindelia hirsutula	173	254	247	33	-
Grindelia stricta	-	338	90,plus seed	233, plus seed	411
Hemizonia congesta	-	-	-	12	-
Heliotropium curassavicum	-	172	104	46	-
Heracleum lanatum	-	-	7	24	-
Heteromeles arbutifolia	49	-	-	-	-
Hordeum brachyantherum	261	447	518	185	66
Jaumea carnosa	-	512	-	-	-
Juncus occidentalis	540	60	288	45	45
Juncus patens	139	83	154	-	147
Juncus phaeocephalus	483	199	306	-	-
Lasthenia glabrata	-	16	-	-	40
Leymus triticoides	-	-	144	-	362

Species	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**
Limonium californicum	-	466	46,plus seed	22	-
Lupinus arboreus	-	102, plus seed	58	-	-
Lupinus formosus	43	-	-	-	-
Lupinus propinquus	40	seed	147	-	-
Lupinus succulentus	-	-	-	-	85
Madia sativa	-	-	-	20	-
Melica californica	-	21	270	56	-
Mimulus aurantiacus	1228	198	522	5	87
Nassella pulchra	560	421	548	94	246
Ranunculus californicus	300	347	62	-	-
Rhamnus californica	32	-	-	-	-
Ribes menziesii	5	-	-	-	-
Ribes sanguineum	21	-	-	-	-
Rumex salicifolius	-	-	52	155	69
Scirpus maritimus	-	-	29	19	47
Scrophularia californica	48	140	283	48	-
Sisyrinchium bellum	197	231	142	18	-
Spartina foliosa	-	3575	-	-	-
Spurgularia macrotheca	-	-	-	216	-
Stachys ajugoides	-	7	33	12	22
Triglochin concinna	-	-	32	4	72
Triglochin maritima	-	519	59	-	-
Wyethia angustifolia	149	255	372	17	19
Total:	**8,773**	**12,468**	**9,153**	**3,628**	**3,044**

APPENDIX B

VEGETATION MONITORING DATA, PLOT 11

MAY 27 & JUNE 3, 2009

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
1A	7"	G	*Achillea millefolium*	yarrow		X						
			Atriplex triangularis	spearscale					X			
			Elymus trachycaulus	slender wheatgrass	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Festuca idahoensis	Idaho fescu		X						
			Hordeum brachyantherum	meadow barley		X						
			Paraphulus incurva	sickle grass	X							
			Polypogon monspeliensis	rabbits foot grass	X							
			Bare ground					X				
1B	24"	E	*Achillea millefolium*	yarrow	X							
			Atriplex triangularis	spearscale		X						
			Elymus trachycaulus	slender wheatgrass		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Festuca idahoensis	Idaho fescu			X					
			Picris echiodes	bristley ox-tongue	X							
			Bare ground							X		
1C	24"	E	*Achillea millefolium*	yarrow			X					
			Artemisia californica	California sagebrush		X						
			Atriplex triangularis	spearscale		X						
			Elymus trachycaulus	slender wheatgrass		X						
			Grindelia strict var. *angustifolia*	marsh gumplant	X							
			Paraphulus incurva	sickle grass	X							
			Bare ground								X	

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
1D	18"	E	*Achillea millefolium*	yarrow	X							
			Atriplex triangularis	spearscale			X					
			Elymus trachycaulis	slender wheatgrass				X				
			Hordeum brachyantherum	meadow barley	X							
			Paraphulus incurva	sickle grass	X							
			Polypogon monspliensis	rabbits foot grass	X							
			Bare ground							X		
2A	18"	E	*Aster chilensis*	California aster						X		
			Elymus mulitsetus	big squirreltail	X							
			Elymus trachycaulis	slender wheatgrass	X							
			Grindelia strict var. angustifolia	marsh gumplant	X							
			Bare ground							X		
2B	30"	G	*Aster chilensis*	California aster				X				
			Elymus trachycaulus	slender wheatgrass	X							
			Grindelia strict var. angustifolia	marsh gumplant							X	
			Bare ground				X					
2C	36"	E	*Aster chilensis*	California aster				X				
			Elymus trachycaulus	slender wheatgrass				X				
			Nasella pulchra	purple needlegrass		X						
			Polygonum arenastrum	common knotweed	X							
			Spergularia sp.	sand spurrey		X						
			Bare ground							X		
2D	30"	E	*Elymus trachycaulus*	slender wheatgrass			X					
			Festuca idahoensis	Idaho fescu			X					
			Paraphulus incurva	sickle grass	X							
			Polypogon monspeliensis	rabbits foot grass	X							
			Bare ground								X	

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
3A	18"	E	*Artemisia californica*	California sagebrush			X					
			Atriplex triangularis	spearscale	X							
			Danthonia californica	California oatgrass			X					
			Elymus trachycaulus	slender wheatgrass		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Eriophyllum staechadifolium	lizard tail			X					
			Grindelia strict var. angustifolia	marsh gumplant	X							
			Hordeum brachyantherum	meadow barley			X					
			Melilotus sp.	sweet clover	X							
			Nasella pulchra	purple needlegrass	X							
			Paraphulus incurva	sickle grass	X							
			Picris echiodes	bristley ox-tongue		X						
			Polygonum arenastrum	common knotweed	X							
			Spergularia sp.	sand spurrey	X							
			Unknown		X							
			Bare ground						X			
3B	12"	G	*Achillea millefolium*	yarrow		X						
			Atriplex triangularis	spearscale	X							
			Elymus trachycaulus	slender wheatgrass		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Eriophyllum staechadifolium	lizard tail						X		
			Grindelia hirsutula var. *hirsutula*	hairy gumplant	X							
			Nasella pulchra	purple needlegrass	X							
			Picris echiodes	bristley ox-tongue	X							
			Polypogon monspeliensis	rabbits foot grass	X							
			Spergularia sp.	sand spurrey	X							
			Bare ground				X					

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
3C	12"	E	*Achillea millefolium*	yarrow	X							
			Artemisia californica	California sagebrush	X							
			Aster chilensis	California aster	X							
			Atriplex triangularis	spearscale	X							
			Elymus trachycaulus	slender wheatgrass	X							
			Eriophyllum staechadifolium	lizard tail				X				
			Grindelia hirsutula var. *hirsutula*	hairy gumplant				X				
			Grindelia strict var. *angustifolia*	marsh gumplant	X							
			Nasella pulchra	purple needlegrass	X							
			Spergularia sp.	sand spurrey	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Bare ground						X			
3D	18"	E	*Achillea millefolium*	yarrow			X					
			Atriplex triangularis	spearscale	X							
			Bromus carinatus	California brome	X							
			Eriophyllum staechadifolium	lizard tail		X						
			Grindelia hirsutula var. *hirsutula*	hairy gumplant	X							
			Grindelia strict var. *angustifolia*	marsh gumplant	X							
			Nasella pulchra	purple needlegrass		X						
			Paraphulus incurva	sickle grass	X							
			Picris echiodes	bristley ox-tongue	X							
			Polygonum arenastrum	common knotweed	X							
			Spergularia sp.	sand spurrey	X							
			Bare ground							X		

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
4A	12"	G	*Artemisia californica*	California sagebrush	X							
			Aster chilensis	California aster				X				
			Atriplex triangularis	spearscale	X							
			Bromus carinatus	California brome	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Hordeum brachyantherum	meadow barley		X						
			Paraphulus incurva	sickle grass	X							
			Bare ground							X		
4B	24"	G	*Aster chilensis*	California aster		X						
			Bromus carinatus	California brome	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia strict var. angustifolia	marsh gumplant					X			
			Melilotus sp.	sweet clover	X							
			Bare ground							X		
4C	9"	F	*Artemisia californica*	California sagebrush				X				
			Aster chilensis	California aster	X							
			Atriplex triangularis	spearscale	X							
			Bromus carinatus	California brome	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia strict var. angustifolia	marsh gumplant		X						
			Sonchus asper	prickly sow thistle	X							
			Bare ground							X		

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
4D	9"	G	*Artemisia californica*	California sagebrush			X					
			Aster chilensis	California aster	X							
			Atriplex triangularis	spearscale	X							
			Bromus carinatus	California brome		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia strict var. *angustifolia*	marsh gumplant	X							
			Melilotus sp.	sweet clover	X							
			Paraphulus incurva	sickle grass	X							
			Picris echiodes	bristley ox-tongue	X							
			Bare ground								X	
5A	12"	E	*Acacia* sp.	acacia	X							
			Artemisia douglasiana	mugwort			X					
			Aster chilensis	California aster	X							
			Baccharis pilularis	coyote brush	X							
			Bromus carinatus	California brome	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia hirsutula var. *hirsutula*	hairy gumplant			X					
			Melilotus sp.	sweet clover	X							
			Nasella pulchra	purple needlegrass	X							
			Picris echiodes	bristley ox-tongue	X							
			Bare ground								X	

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
5B	5"	F	*Anagallis arvensis*	scarlet pimpernel	X							
			Artemisia douglasiana	mugwort			X					
			Baccharis pilularis	coyote brush	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Hordeum brachyantherum	meadow barley	X							
			Nasella pulchra	purple needlegrass	X							
			Picris echiodes	bristley ox-tongue	X							
			Polypogon monspeliensis	rabbits foot grass	X							
			Sonchus asper	prickly sow thistle	X							
			Unknown		X							
			Dead plant material	(*Artemisia californica*)	X							
			Bare ground								X	
5C	6"	G	*Artemisia douglasiana*	mugwort		X						
			Baccharis pilularis	coyote brush	X							
			Bromus carinatus	California brome			X					
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia strict var. *angustifolia*	marsh gumplant		X						
			Heteromeles arbutifolia	toyon	X							
			Lolium multiflorum	Italian ryegrass	X							
			Picris echiodes	bristley ox-tongue	X							
			Bare ground								X	
5D	3"	G	*Achillea millefolium*	yarrow		X						
			Aster chilensis	California aster	X							
			Baccharis pilularis	coyote brush	X							
			Epilobium brachycarpum	panicled willow herb	X							
			Hordeum brachyantherum	meadow barley				X				
			Nasella pulchra	purple needlegrass				X				
			Unknown1		X							
			Unknown2		X							
			Bare ground							X		

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
6A	9"	E	*Aster chilensis*	California aster	X							
			Atriplex triangularis	spearscale		X						
			Baccharis pilularis	coyote brush	X							
			Bassia hyssopifolia	five-hooked bassia	X							
			Bromus diandrus	ripgut brome		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Hordeum brachyantherum	meadow barley			X					
			Juncus patens	rush		X						
			Picris echiodes	bristley ox-tongue	X							
			Polypogon monspeliensis	rabbits foot grass	X							
			Bare ground								X	
6B	12"	G	*Aster chilensis*	California aster					X			
			Atriplex triangularis	spearscale	X							
			Baccharis pilularis	coyote brush	X							
			Epilobium brachycarpum	panicled willow herb		X						
			Geranium dissectum	cutleaf geranium	X							
			Paraphulus incurva	sickle grass	X							
			Picris echiodes	bristley ox-tongue	X							
			Dead plant material	(Geranium dissectum)	X							
			Bare ground							X		

Location	Vigor of Plantings				% Cover							
Quadrat	Height (in)	Health	Scientific Name	Common Name	<1	1 - 5	6 - 15	16 - 25	26 - 45	46 –75	76 –90	> 90
6C	12"	E	*Artemisia douglasiana*	mugwort	X							
			Aster chilensis	California aster			X					
			Epilobium brachycarpum	panicled willow herb	X							
			Grindelia hirsutula var. *hirsutula*	hairy gumplant			X					
			Grindelia strict var. *angustifolia*	marsh gumplant		X						
			Paraphulus incurva	sickle grass		X						
			Picris echiodes	bristley ox-tongue	X							
			Polygonum arenastrum	Common knotweed	X							
			Dead plant material	(*Geranium dissectum*)	X							
			Bare ground							X		
6D	30"	E	*Aster chilensis*	California aster		X						
			Epilobium brachycarpum	panicled willow herb	X							
			Geranium dissectum	cutleaf geranium	X							
			Grindelia strict var. *angustifolia*	marsh gumplant						X		
			Dead plant material	(*Geranium dissectum*)	X							
			Bare ground						X			

APPENDIX C

PHOTOMONITORING, PLOT 11

SPRING 2009

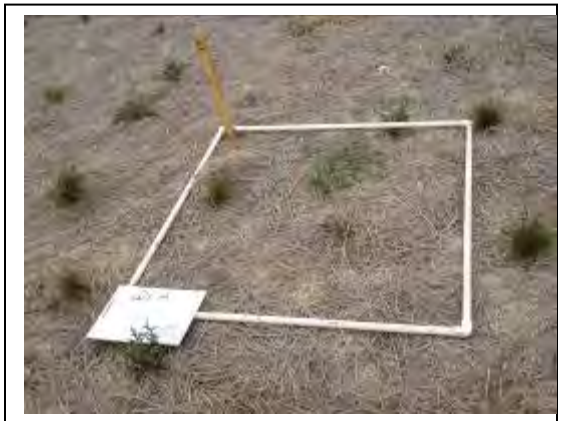
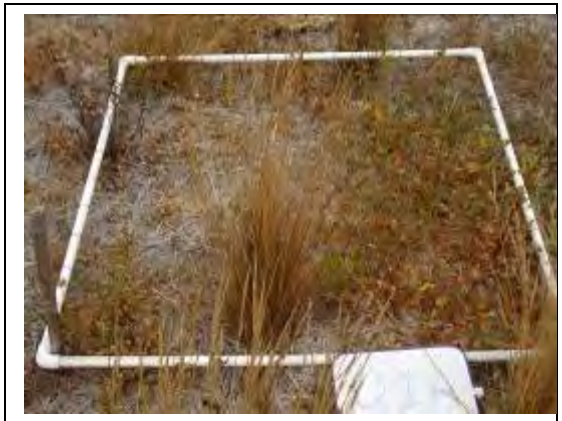


Photo Point 1A BASELINE (2008)

Photo Point 1B BASELINE (2008)

Photo Point 1C BASELINE (2008)



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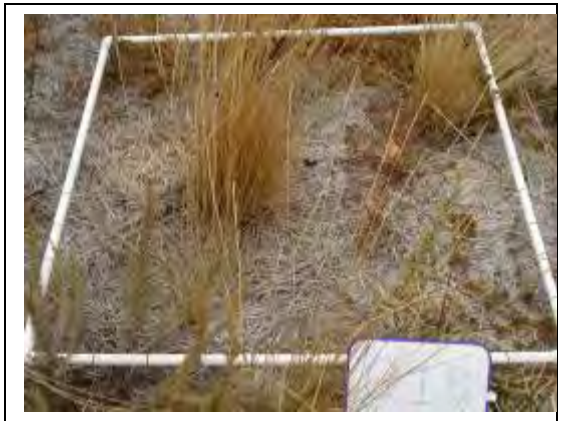


Photo Point 1B (2009)

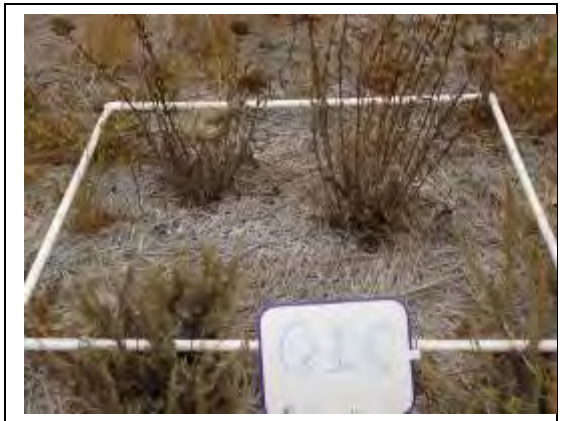


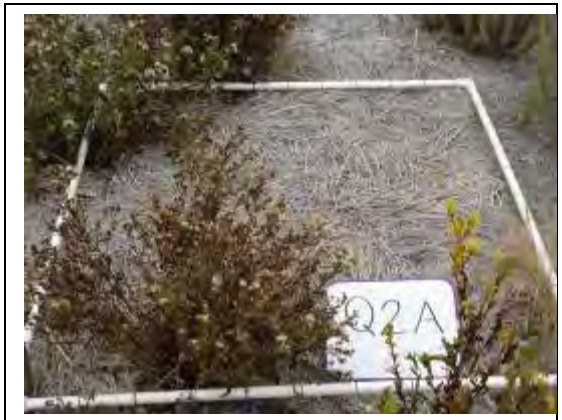
Photo Point 1C (2009)

Photo Point 1D BASELINE (2008)

Photo Point 2A BASELINE (2008)

Photo Point 2B BASELINE (2008)

Photo Point 1D (2009)



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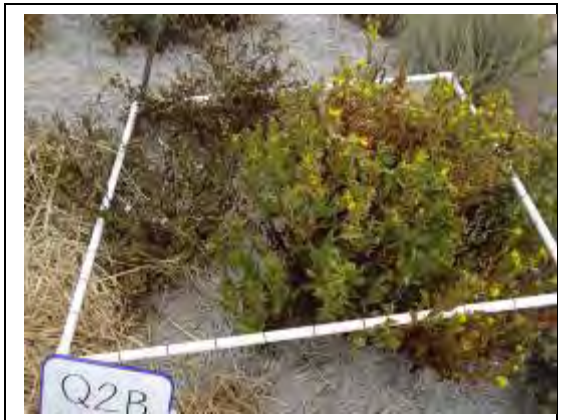

Photo Point 2B (2009)

Photo Point 2C BASELINE (2008)

Photo Point 2D BASELINE (2008)

Photo Point 3A BASELINE (2008)

Photo Point 2C (2009)

Photo Point 2D (2009)

Photo Point 3A (2009)

Photo Point 3B BASELINE (2008)

Photo Point 3C BASELINE (2008)

Photo Point 3D BASELINE (2008)

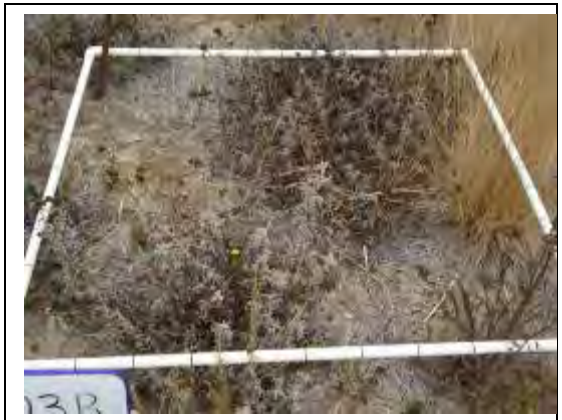

Photo Point3B (2009)

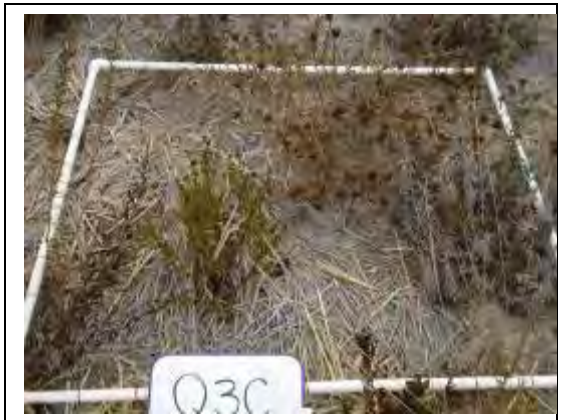

Photo Point 3C (2009)

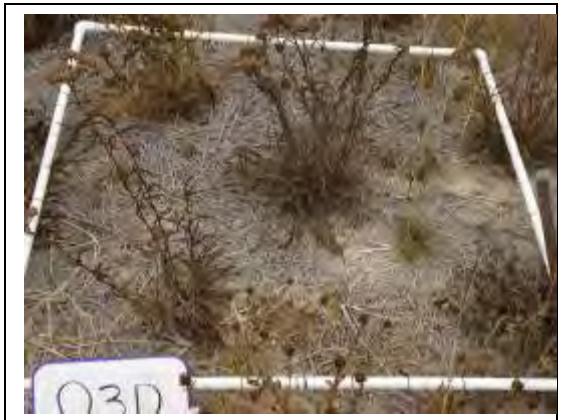

Photo Point 3D (2009)

Photo Point 4A BASELINE (2008)

Photo Point 4B BASELINE (2008)

Photo Point 4C BASELINE (2008)

Photo Point 4A (2009)

Photo Point 4B (2009)

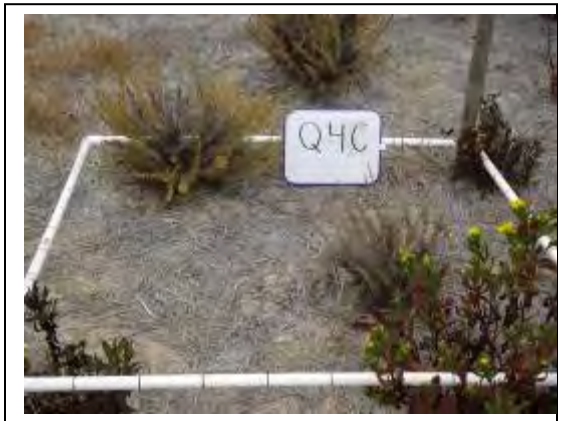

Photo Point 4C (2009)

Photo Point 4D BASELINE (2008)

Photo Point 5A BASELINE (2008)

Photo Point 5B BASELINE (2008)

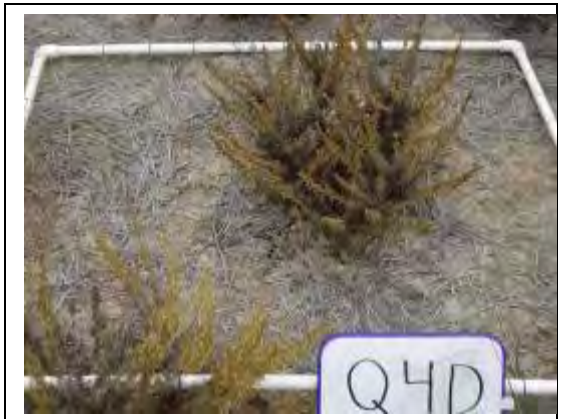

Photo Point 4D (2009)

Photo Point 5A (2009)

Photo Point 5B (2009)

Photo Point 5C BASELINE (2008)

Photo Point 5D BASELINE (2008)

Photo Point 6A BASELINE (2008)

Photo Point 5C (2009)

Photo Point 5D (2009)

Photo Point 6A (2009)

Photo Point 6B BASELINE (2008)

Photo Point 6C BASELINE (2008)

Photo Point 6D BASELINE (2008)

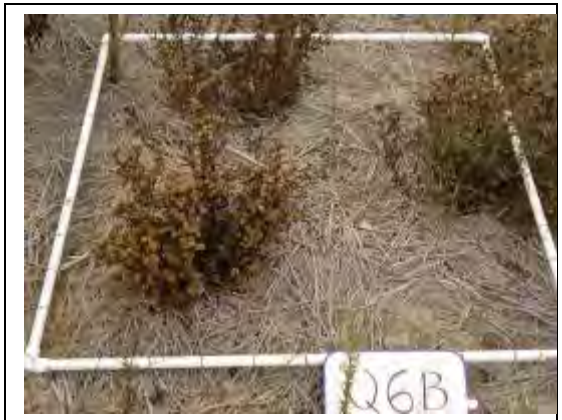

Photo Point 6B (2009)

Photo Point 6C (2009)

Photo Point 6D (2009)

APPENDIX D

SURVIVORSHIP MONITORING FOR 2009 PLANTINGS

MONITORING DATES: MAY 12 & 13, 2009

Species	Planting Survivorship				Health							
	Plants Assessed	Plants Dead	% Alive	% Dead	E	%E	G	%G	F	%F	P	%P
Achillea millefolium	41	1	98	2	16	39	11	27	11	27	2	5
Artemisia californica	7	1	86	14			4	57	2	29		
Artemisia douglasiana	22		100		7	32	10	45	5	23		
Aster chilensis	43		100		11	26	23	53	8	19	1	
Baccharis pilularis	3		100				3	100				
Elymus trachycaulus	2		100				2	100				
Eriophyllum staechadifolium	28	9	68	32	9	32	7	25	2	7	1	4
Eschscholzia californica	8		100		1	13	5	63	2	25		
Gnaphalium californicum	3		100		1	33	1	33	1	33		
Grindelia stricta	38		100		15	39	16	42	5	13	2	5
Hordeum brachyantherum	10		100		9	90	1	10				
Juncus occidentalis	4		100		3	75			1	25		
Juncus patens	16		100		7	44	8	50	1	6		
Lasthenia glabrata	4	1	75	25	3	75						
Leymus triticoides	26	1	96	4	8	31	15	57	2	8		
Lupinus succulentus	15	8	47	53	4	27	3	20				
Mimulus aurantiacus	12	5	58	42			4	33			3	25
Nassella pulchra	23		100		20	87	3	13				
Rumex salicifolius	9		100		3	33	5	56	1	11		
Stachys ajugoides	1		100						1	100		
Triglochin consinna	1		100								1	100
Unknown species	11	11		100								
Total:	327	37	89	11	117	36	121	37	42	13	10	3

Notes:

E Excellent Health. No evidence of stress. Minor pest or pathogen damage may be present.

G Good Health. Some evidence of stress. Pest or pathogen damage present.

F Fair Health. Moderate level of stress. High levels of pest or pathogen damage.

P Poor Health. High level of stress. High levels of pest or pathogen damage.

APPENDIX E

BIRD CENSUS DATA
NOVEMBER 2008 – SEPTEMBER 2009

SPECIES	Nov.08	Dec.08		Feb.09		Mar.09	Apr.09		May.09		June.09	July.09			Aug.09	Sept.09
Tide	High	High	Low	High	Low	Low	High	Low	High	Low	Low	High	High	Low	Low	Low
American Avocet							3	3	1							
American Coot	9	7	4	46	27		2									6
American Crow			1	3	4	3		1								
American Goldfinch																
American Kestrel																
American Wigeon																
Anna's Humingbird		2	1	1	1	3	1	1								
Barn Swallow								6	3	10	1	4	4	5	7	
Black Brant																
Black Phoebe	2	1				2					5	2		3		
Black Turnstone																
Black-bellied Plover												1				
Black-crowned Night-Heron																
Brandt's Cormorant																
Brewer's Black Bird																
Brownheaded Cowbird	13		26							1	13					
Bufflehead																
California Towhee								1	1		1					
Canada Goose		9		5	12	9	1	8	6		10	5	1	1	8	
Canvasback																
Caspian Tern																
Clapper Rail																
Clark's Grebe							1							1		
Common Goldeneye																
Common Snipe																
Cooper's Hawk																
Double-crested Cormorant							1					1				
Dowitcher spp.																
Dunlin																
Eared Grebe																
Elegant Tern																

SPECIES	Nov.08	Dec.08		Feb.09		Mar.09	Apr.09		May.09		June.09	July.09			Aug.09	Sept.09
Tide	High	High	Low	High	Low	Low	High	Low	High	Low	Low	High	High	Low	Low	Low
Eurasian Wigeon																
European Starling			1				1	5	2		7					
Forsters Tern																
Fox Sparrow																
Gadwall		14			6											
Golden-crowned sparrow			5	3	5	1				3						
Goldfinch spp.											1					
Great Blue Heron		1									1			1	1	1
Great Egret																3
Greater Scaup																
Greater Yellowlegs																
Grebe spp.									1					1		
Green-winged Teal		13	4													
Gull spp.	6	17	1	2		12	3	1	3	3	4	7	4	9		3
House finch		4	2				3	10	3	8	3		5	8		
Hummingbird sp.								1								
Killdeer			3	3		4	2	9	3	5	5		6	1	7	
Least Sandpiper																
Lesser Scaup																
Long-billed Curlew												1				3
Mallard		2	3	3			3	4	1	6				6	1	
Marbled Godwit												1				
Mourning Dove			1	10	4		1		2	3	2	1		3		
Norther Harrier																
Northern Mockingbird		1										1				
Northern Pintail																
Northern Shoveler																
Osprey																
Pied-billed Grebe																
Plover spp.															1	
Raven																

SPECIES	Nov.08	Dec.08		Feb.09		Mar.09	Apr.09		May.09		June.09	July.09			Aug.09	Sept.09
Tide	High	High	Low	High	Low	Low	High	Low	High	Low	Low	High	High	Low	Low	Low
Red Phalarope																
Red-breasted Merganser																
Red-tailed Hawk																
Red-winged Black Bird										2	1					
Ruddy Duck																
Ruddy Turnstone																
Sanderling																
Sandpiper spp.																
Semipalmated Plover												50				
Snowy Egret							3				1		2	2		
Song Sparrow				1	2	3		1	1	1	3		1			
Sparrow sp.						3										
Surf Scoter																
Swallow spp.						3				1	3		3			
Tern spp.										1						
Tree Swallow																
Turkey Vulture			1					1	1	1						
Unknown shorebird spp.*							10							3		
Unknown spp.*	1	32			2	1	1	2	1		11		2	5		2
Western Bluebird																
Western Grebe								1								
Western Meadowlark																
Western Sandpiper												50				
Whimbrel									3			1	4			
White Pelican																
White-crowned sparrow		10	13	2	29	1					2			1		
White-faced Ibis																
White-tailed Kite		1														
White-winged Scoter																
Willet				11			6		2			8	5			3
Wrentit																