Invasive Spartina Control Plans

for the

San Francisco Estuary

2008-2010 Control Seasons

June 2008

Coastal Conservancy

San Francisco Estuary Invasive Spartina Project

Preserving native wetlands

Invasive *Spartina* Control Plans

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Revised
June 5, 2008

This report was prepared for the California Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project with funding from the following contributors:

California Coastal Conservancy

California Wildlife Conservation Board (MOU #99-054-01 and subsequent)

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INTRODUCTION

This volume is a compilation of 24 site-specific *Spartina* control plans that were prepared by contractors of the San Francisco Estuary Invasive *Spartina* Project (ISP) for use by ISP Partners and permitting agencies. Twenty-three of the plans are updates of previous plans prepared for the 2005-2007 control seasons. One of the plans (Site 26: North San Pablo Bay Complex) is for a region of the Estuary where a new population of invasive *Spartina* was discovered in 2007.

Each plan briefly summarizes the treatment conducted at the site from 2005-2007, describes the current condition of the site and the non-native *Spartina* infestation there, provides information on the site owners, managers, and other partners, and explains what will be done over the next three years (2008-2010) to continue and potentially complete eradication of non-native *Spartina* at the site. Each plan also reviews the assessment of potential environmental effects of implementing the control program which was conducted under the 2005-2007 plans, as well as the status of compliance with environmental regulations (including CEQA, NEPA, ESA, and NPDES). Because it is the first plan prepared for the site, the plan for Site 26: North San Pablo Bay Complex includes a full evaluation of the potential environmental effects of implementing the control plan. All plans include updated and complete listings of potential treatment impacts and required mitigations.

Figure 1 shows the general location of the *Spartina* treatment sites, and **Table 1** provides a summary of the site and non-native *Spartina* acreages. In total, the plans address approximately 200 net acres of non-native *Spartina* within 23,000 acres of infested marsh at 24 sites.

Program Goals

The ISP's ultimate goal is to eradicate all forms of non-native *Spartina* from the San Francisco Estuary, and prevent it from spreading to additional outer coast and upstream areas. The goal for the 2008-2010 seasons is to continue aggressive treatment of all known non-native *Spartina* populations, and to achieve eradication wherever possible.

Shift in Control Program Impacts

In past seasons, the primary potential impact of the *Spartina* Control Program was determined to be the loss of vegetative cover caused by treatment of many hundreds of acres of *Spartina* within the Bay Area marshes (Conservancy 2003). A large portion (70-80 percent) of this treatment was accomplished by aerial or boat application of the aquatic herbicide, imazapyr. This was determined to cause very little physical impact to the marsh since it was not necessary to enter the marsh to implement treatment. The remainder (20-30 percent) of treatment was accomplished by ground application of herbicide (walking or driving a tracked vehicle through the marsh), or by digging or covering plants. Stringent mitigation measures were implemented to minimize the potential environmental impacts from these methods, but they were inherently potentially greater than aerial or boat applications because the workers must enter and disturb the marsh to effect treatment.

Beginning in 2008, there will be substantially less vegetative cover removed each season (e.g., 200 acres treated bay-wide rather than 1,600), so there will be significantly less potential impact caused by loss of vegetative cover. At the same time, most treatment will now be via ground application of herbicide or by digging, pulling, or covering plants, so that the most significant type of impact will now be that potentially caused by physically entering and moving through the marsh.

All such potential impacts were fully analyzed at the beginning of the project (see the CEQA and NEPA section below) and found to be short term and minimal with implementation of identified mitigations and conservation measures.

Sub-lethal Herbicide Application to Reduce Clapper Rail Impacts

In some areas with dense populations of California clapper rail (*Rallus longirostris obsoletus*), treatment may continue to be phased over multiple seasons to assure adequate time for rails to adapt to change in vegetation type

Figure 1. Location of San Francisco Estuary Invasive *Spartina* Project *Spartina* Treatment Sites, 2008-2010

and cover, or to relocate to other marshes with minimal disruption[1]. These areas include portions of the Colma Creek and San Bruno Marsh Complex (Site 18), and possibly Arrowhead Marsh (Sub-area 17c).

At these sites, phasing may include "chemical mowing" of areas where non-native *Spartina* vegetation is to be retained. Chemical mowing entails applying a sub-lethal concentration of imazapyr herbicide to stop seed production and dispersal, while maintaining the live plant, which continues to grow and provide refuge for the rails. This method was piloted in 2007 at sub-areas of the Colma Creek/San Bruno Marsh Complex (see Site 18, page 111). Monitoring in 2008 showed the technique to be successful, in that the chemically mowed areas did not produce seed in 2007 yet showed continued vigorous growth in 2008, and the fully treated areas showed high mortality. The decision to employ this method will be made based on analysis of clapper rail movement studies (where available from ongoing USGS study) and population survey data collected by ISP or East Bay Regional Parks District, in light of other factors explained below.

[1] Recent studies have shown that California clapper rails do continue to use standing dead *Spartina* and subsequent native vegetation expansion through nesting seasons after treatment (ISP 2006, 2007), and that rails may travel more than 20 miles between sites (USGS 2007).

Table 1. Summary Data for San Francisco Estuary Invasive *Spartina* Project *Spartina* Treatment Sites, 2008-2010

Site #	*Site Name*	*County*	*Approximate Site Area (Acres)*[1]	*Approximate Net Cover*[2] *Non-native Spartina (Acres)*	
				2005[3]	*2008*[4]
01	Alameda Flood Control Channel	Alameda	400	110	35
02	Bair/Greco Islands	San Mateo	4000	170	25
03	Blackie's Pasture	Marin	35	<1	<0.1
04	Corte Madera Creek Complex	Marin	300	5	2
05	Coyote Creek/Mowry Complex	Santa Clara & Alameda	3000	10	5
06	Emeryville Crescent	Alameda	150	<2	<1
07	Oro Loma Marsh	Alameda	300	40	3
08	Palo Alto Baylands	Santa Clara	250	<1	<0.1
09	Pickleweed Park	Marin	15	<0.1	<0.1
10	Point Pinole Marshes	Contra Costa	200	<1	<0.1
11	Southampton Marsh	Contra Costa	200	<1	<0.1
12	Southeast San Francisco	San Francisco	200	5	1
13	Whale's Tail Complex	Alameda	900	70	6
15	South Bay Marshes	Santa Clara	2000	10	10
16	Cooley Landing	San Mateo	200	10	2
17	Alameda/San Leandro Bay Complex	Alameda	500	80	30
18	Colma Creek/San Bruno Marsh Complex	San Mateo	150	50	25
19	West San Francisco Bay	San Mateo	600	60	10
20	San Leandro/Hayward Shoreline	Alameda	900	170	35
21	Ideal Marsh	Alameda	150	20	2
22	Two Points Complex	Alameda	1400	1	3
23	Marin Outliers	Marin	900	<2	1
24	Petaluma River	Sonoma	6500	0	0.1
26	North San Pablo Bay Complex	Napa & Solano		0	0.1
	TOTAL		23,250	820	200

Notes:

[1] Site area based on site boundaries established in 2008

[2] "Net Cover" refers to the actual amount of *Spartina*, and is calculated to represent the coverage as if all non-native *Spartina* plants were contiguous (i.e., compacted onto one discrete area).

[3] 2005 approximate net cover was calculated based on 2005 inventory monitoring data in GIS.

[4] 2008 approximate net cover was estimated by ISP staff based on preliminary 2007 data.

While the chemical mow approach has the advantage of providing continued habitat for clapper rails, it also has three significant drawbacks. First, failing to lethally treat invasive *Spartina* at any site effectively extends the required operating lifespan of the ISP, increasing costs to the Coastal Conservancy and other funders for continued project management, treatment, and monitoring. Second, intentionally applying sub-lethal dosages of herbicide to the plants entails releasing more herbicide and surfactants into the environment, and increasing the use of helicopters and other equipment with the subsequent increased burning of petroleum fuels. Finally, repeated sub-lethal applications of herbicide products has been shown to lead to increased resistance of the treated plants to the herbicide effect, which could inhibit the ability to use imazapyr to successfully control the population after chemical mowing – and there are no known effective alternatives for application on the estuarine environment at this time.

For these reasons, the option to employ chemical mowing for phasing must be weighed carefully for each site based on the best available information. In the weeks proceeding each treatment season, ISP management will review the available data with USFWS and East Bay Regional Parks District staffs to determine whether chemical

mowing or lethal treatment should be implemented. Any conservation measures proscribed by the USFWS will be implemented.

Earlier Entry into Clapper Rail Habitats

SPARTINA TREATMENT

For the last four years, the ISP and its partners have been conducting *Spartina* treatment activities within a very restricted time period each year. Treatment work depends on the alignment of a number of factors, including suitable tidal windows, weather, plant growth, and wind conditions. Additionally, many of the largest and most aggressive infestations of non-native *Spartina* support populations of the endangered California clapper rail. Ground-based treatment activities in these rail-inhabited sites has been prohibited during the months defined by USFWS as "clapper rail nesting season" – February 1st through September 1st. As a result, available treatment opportunities were further diminished, such that some of the largest non-native *Spartina* infestations in the Bay could only be effectively treated on a handful of days each year, *if at all*.

Proper application of aquatic herbicide to *Spartina* plants requires that the plants be actively growing, such that the tissues of the plant are translocating nutrients and fluids between the leaves and rhizomes and vice-versa. *Spartina alterniflora* hybrid plants typically begin to flower in early to mid August, and set seed in late September to early October. *Spartina densiflora* plants begin to flower in late June, and are in seed by August. In both cases, the active-growth phase of *Spartina* life history occurs in the months preceding flowering; late May through August for *S. alterniflora* hybrids, and February through July for *S. densiflora*. In short, optimal treatment windows for both plants occur during the breeding season of the clapper rail. Because the treatment work must occur in sub-optimal conditions, treatment efficacy is also sub-optimal.

For the last three years, treatment in rail-occupied areas has been permitted as early as July 15, but only where using aerial application techniques (helicopter). Aerial treatment is appropriate for large-scale infestations that are distant from sensitive receptors, such as residential developments, schools, or hospitals. The number of sites where aerial application is appropriate is limited, as most sites are located near sensitive receptors or the infestations are too small to justify aerial work. In most sites, this early-season treatment work over the last few years has resulted in high levels of efficacy. As a result, the number of sites that still contain populations of non-native *Spartina* large enough to justify aerial applications is shrinking. By 2009, there may be few, if any, areas where non-native *Spartina* remains in large enough stands to justify the cost of deployment of aerial applications.

As aerial applications become less appropriate, ground-based treatments must be substituted to target scattered, remnant stands. However, under the current constraints, these additional ground-based treatments within marshes inhabited by the clapper rail must also occur within the late-season, sub-optimal treatment window. Sub-optimal treatment timing results in levels of treatment survivorship that are difficult to overcome, making stand eradication unlikely. Under this scenario, the complete eradication of non-native *Spartina* within the San Francisco Bay Estuary will not be achievable in any foreseeable timeframe, as surviving plants will continue to produce and export propagules to new locations even when treatment is "successful".

In order to complete the eradication of non-native *Spartina* from the Estuary, the site-specific control plans for 2008-2010 include ground-based treatment in clapper rail-occupied habitat starting as early as May 1 for some sites. (See Attachment 1, "Summary of *Spartina* Treatment, Timing, and Clapper Rail Presence"). This early-season treatment schedule will overcome the sub-optimal timing of September treatments, and will enable applicators to schedule treatments within a larger treatment window, better tidal cycles, and more consistent weather conditions. Most importantly, early-season treatments will allow for greater *Spartina* treatment efficacy, resulting in a more efficient eradication schedule to coincide with Bay-wide tidal marsh restoration activities. Reducing the number of treatments required to reach the goal of eradication also translates into less herbicide being applied and less disturbance to the marsh and the wildlife that use it.

SPARTINA MONITORING & MAPPING

The ISP conducts annual monitoring of more than 35,000 acres of tidal marsh throughout the Estuary to prepare an accurate inventory of all invasive *Spartina* and to assess the effectiveness of treatments. Both aspects of monitoring are essential to support the *Spartina* Control Program, which needs to know where the plants are and whether treatments are effective, if it is to succeed in eradicating invasive *Spartina* from the Estuary.

In past years, *Spartina* inventory monitoring has used a combination of field and photograph interpretation methods. For field monitoring, biologists travel through or around the marshes on foot, bicycle, or boat, recording vegetation data using electronic data loggers. For photograph interpretation methods, experienced field staff analyze georectified, high-resolution infra-red aerial imagery and digitize invasive *Spartina* patches directly in a geographic information system (GIS). The photograph interpretation method, although not as accurate as field monitoring, has had the advantage of covering large and remote areas while requiring only limited human entry into the marsh for "ground-truthing." In 2007, field monitoring was used on approximately 29,000 acres (80 percent) of the total survey area, and photograph interpretation was used on approximately 7,000 acres (20 percent).

As a result of successful treatment over the past several years, the areas of invasive *Spartina* are becoming rapidly smaller and more fragmented, and increasingly difficult to discern from other vegetation and from dead *Spartina* in aerial photographs. At the same time, it is becoming more critical to the *Spartina* Control Program to have accurate information on the location and size of invasive *Spartina* patches so that they can be targeted for treatment. In response, the ISP has found it necessary to shift its inventory monitoring methods away from photograph interpretation to the more accurate field methods, and to initiate annual monitoring earlier in the season to provide more timely results for earlier initiation of *Spartina* treatment.

To minimize potential additional impacts to clapper rails and other wildlife that could result from additional ground based monitoring and/or earlier entry into marshes, the ISP is endeavoring to develop improved, lower impact, monitoring methods. One promising method to be tested in June 2008 is conducting vegetation surveys from low-flying helicopters equipped with GPS technology and data loggers. This method would allow accurate, timely assessment of marsh vegetation without requiring entry into the marsh, other than the hovering and slow movement of small helicopters over the marsh surface for a few minutes each season. Observations by ISP and USFWS staff in recent years have suggested that clapper rails are only minimally effected by the presence of low-flying helicopters, and that they show primarily curiosity and not alarm. Helicopter monitoring was developed and successfully implemented by the Catalina Island Conservancy on the Santa Catalina islands over the last several years. The ISP is working with one of the primary contractors for that effort (John Knapp, Native Range Inc., (805) 794-3194, jknapp@native-range.com) to test the method on a number of *Spartina*-infested marshes.

Response to Newfound Populations

The 2008-2010 Site-Specific *Spartina* Control Plans have included descriptions of all known infestations of non-native cordgrass around the Estuary. Annual ISP monitoring has most likely identified all substantial populations of non-native cordgrass through 4-5 years of Baywide surveys. However, the nature of this aquatic invader as well as the variety of morphologies and flowering phenologies in the hybrid swarm means that it is likely that scattered individual plants may be discovered in the future. *Spartina* propagules can disperse great distances on the tides, and a new pioneering clone may not be immediately identified considering the hundreds of miles of shoreline and thousands of acres of marsh habitat around the Estuary. In addition, cryptic hybrids lack the field characteristics of *Spartina alterniflora* and look more like the native *Spartina foliosa* parent; hence, they often require genetic testing to confirm their status and can be overlooked for some time before they are sampled

Fortunately, if new infestations are controlled while they are small, they only require minimal effort and have relatively few impacts associated with their treatment. The comprehensive field surveys and genetic testing program of the ISP provides assurance that any future discoveries of new pioneering infestations is expected to be relatively small.

For planning and environmental compliance purposes, treatment of any new population of invasive *Spartina* less than 2000 ft^2 (0.05 acre) will be considered to have minimal impacts, which should be sufficiently covered by the standard ISP mitigations. Newly discovered colonizers will be considered outliers of the ISP site to which they are adjacent, and the associated mitigation measures for that site will be applied to the new population. This will enable the ISP to undertake control measures in response to new early detections in the same season as their discovery, stopping seed dispersal and eliminating the threat before it reaches a size where the impacts from treatment may be greater. The area of the new infestation will most likely share most if not all of the habitat features of the adjacent sub-areas because of its proximity, and consequently the same special status species would be expected to use the new area. These species have already been evaluated and appropriate mitigations determined for the larger established infestations that were originally present before ISP control work began.

Environmental Compliance

CEQA AND NEPA

In addition to outlining the approach for controlling *Spartina* at each site, the site-specific control plans also provide documentation and analysis in compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), tiering off of the ISP's Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR; Conservancy 2003) and Addendum (Conservancy 2005).

The PEIS/EIR assessed the overall need for the *Spartina* control project and analyzed the potential effects of implementing treatment methods for the regional program and identified the mitigation measures that would be applied to each action to reduce or eliminate impacts at treatment locations. The 2005 Addendum evaluated a new herbicide, imazapyr, and determined that it posed no additional or increased threat to the environment above what had been assessed in the PEIS/EIR. The original site-specific control plans, prepared in 2004-2005, considered the need for the work at each site in light of the regional program and potential cumulative effects, and specified the treatment methods to be used and the required site-specific mitigations.

Most of the plans presented in this document in turn tier off of the original site-specific control plans, and incorporate all environmental compliance information and findings from those documents, unless otherwise specified. The plan for Site 26: North San Pablo Bay Complex, is a new plan and presents all information regarding environmental compliance for that site.

ENDANGERED SPECIES CONSULTATION

In 2003, the U.S. Fish and Wildlife Service (USFWS) completed a formal, intra-service endangered species consultation under Section 7 of the Federal Endangered Species Act, and issued a programmatic biological opinion for the ISP *Spartina* Control Program. USFWS subsequently completed formal intra-service consultations and issued biological opinions for implementation of site-specific control plans in 2004, for the 2004 control season, and in 2005, for the 2005-2007 control seasons.

ISP partners have complied with all conservation measures prescribed by USFWS in the biological opinions. Also, USFWS has reviewed data and reports prepared by the ISP on California clapper rail populations at *Spartina* treatment sites between 2005 and 2007 (Spautz 2005, Spautz and McBroom 2006, Avocet 2006, McBroom 2007a, McBroom 2007b, Spautz 2007, Avocet 2007), and determined that ISP is in compliance with California clapper rail "take" restrictions through 2007 (Ryan Olah, pers. comm. November 11, 2007).

Prior to implementation of the 2008-2010 plans contained herein, USFWS will once again conduct a formal intra-service consultation and prepare a biological opinion based on these plans and additional information provided. USFWS may choose to add additional or more restrictive mitigations ("conservation measures") to those included in the plans, if it should determine them necessary to further reduce or eliminate adverse impacts to species of concern. Any additional mitigations or other measures added by USFWS will be incorporated into these plans, and be implemented by the ISP and its partners.

NPDES WATER QUALITY PERMIT

According to the Ninth Circuit Court, the application of pesticides into waters of the United States, or onto aquatic plants growing in waters of the United States, results in discharges of pollutants and requires coverage under a National Pollutant Discharge Elimination System (NPDES) permit. To comply with this requirement, each ISP Partner (grant recipient) who will be applying herbicide as prescribed in these plans is required to submit a Notice of Intent (NOI) and application fee to the State Water Resources Control Board, indicating that they will comply with the terms of the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (General Permit No. CA G990005).

On behalf of the ISP partners, the ISP annually prepares and submits to the State an Aquatic Pesticide Application Plan (APAP), conducts water quality monitoring at the required number of treatment sites, and prepares and submits water quality monitoring reports.

Quality Control, Compliance Monitoring, and Reporting

In compliance with the ISP's Final PEIS/EIR Mitigation, Monitoring, and Reporting Plan, each sub-area of each site has been evaluated to determine potential site-specific impacts and necessary mitigation and conservation

measures[2]. These evaluations are attached as Site-Specific Project Impact Evaluation and Mitigation Checklists (Attachment 2).

ISP partners are required to incorporate the Impact Mitigation Checklists into their work plan, and to submit the signed checklist to the ISP upon completion of each treatment project. In this way, the responsible ISP partner documents compliance with CEQA and NEPA, and acknowledges the time, funding, and training of field staff that is required to properly conduct the *Spartina* control work at its site. Since the ISP partner must sign off on each mitigation and conservation measure as part of the development of their work plan and while implementing treatment activities, the ISP has the opportunity to assure that the mitigation requirements, and the reasoning behind them, are fully understood and that the partner is capable of implementing them on each site.

ISP Field Operations staff are on site or immediately available during each *Spartina* control event to provide technical assistance and oversight to the partner and contractors. The ISP Field Operations staff intervene if an ISP partner or contractor fails to properly implement a mitigation and conservation measure, and will halt activities until the problem can be resolved. Any failure to properly implement a mitigation or conservation measure is reported to the ISP and to the Conservancy, who initiate a consultation with the relevant regulatory agency (e.g., U.S. Fish and Wildlife Service or the Regional Water Quality Control Board) to determine an appropriate course of action. Actions in response to a failed mitigation or conservation measure may include implementation of additional mitigation measures by the implementing partner, and/or the issuance of a notice of violation to the implementing partner by one or more agencies. In addition, the Conservancy may choose to withhold payment of grant funding for work done in violation of a mitigation or conservation measure, whether or not the grantee was directly overseeing the work.

The ISP prepares and posts to its website annual field operations reports that document completion of treatment actions, implementation of mitigation and conservation measures, and any variances or violations that may have occurred during the season.

As noted above, the ISP also conducts water quality monitoring and prepares and submits water quality monitoring reports to the Regional Water Quality Control Board

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SITE 01: ALAMEDA FLOOD CONTROL CHANNEL, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Alameda Flood Control Channel, Alameda County, TSN: ISP-2004-01, 2005-2007 Control Seasons) dated May 2005. All six sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to one or more project partner. The grant recipient(s) for this site include:

County of Alameda Public Works Agency, 4825 Gleason Drive, Dublin, CA 94568*; Saul Ferdan, Weed and Pest Control Supervisor, (925) 803-7011, saul@acpwa.org*. The County of Alameda Public Works Agency, or the Alameda County Flood Control District (ACFCD) have been controlling non-native *Spartina* within the Alameda Creek Channel since shortly after the original introduction in the 70's. ACFCD worked with the ISP since the 2004 control season and has been a grantee and active partner with the ISP's efforts beginning in that year. The ACFCD aims to control non-native *Spartina* within the Channel in order to restore flood control capacity as well as enhance wildlife habitat in the area.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA: *Janet Cobb, Executive Officer, (510) 208-4436, jcobb@californiawildlifefoundation.org*. The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit corporation that has as one of its core purposes support of the programs and projects of the California Department of Fish and Game (DFG) and its resource partners. In this capacity, the CWF has agreed to contract *Spartina* control services for the sub-areas 01e and 01f, where necessary.

Other Partners:

East Bay Regional Parks District, 2950 Peralta Oaks Court, Oakland, California 94605: *Peter Alexander, Invasive Spartina Coordinator, (510) 635-0135, palexander@ebparks.org*. EBRPD manages the Alameda Creek Regional Trail along both banks of Alameda Creek in southern Alameda County from the mouth of Niles Canyon (in the Niles District of Fremont) westward to San Francisco Bay. The lower reaches of the Creek, downstream from Alvarado Blvd, represent the area infested with non-native *Spartina*, and are thus covered in this plan.

Site Description

Map Site 01: Alameda County Flood Control Channel includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

01a	Channel Mouth	***Map***	01d	Upper Channel - Union City Blvd to I-880	***Map***
01b	Lower Channel	***Map***	01e	Strip Marsh No. of Channel Mouth	***Map***
01c	Upper Channel	***Map***	01f	Pond 3	***Map***

The Alameda County Flood Control Channel (ACFCC) is a large, unlined, trapezoidal channel that runs from east to west through Hayward, Alameda County, draining a nearly 800 square mile watershed into the San Francisco Bay. The levees on both sides of the ACFCC are topped with multi-use public trails that are part of the San Francisco Bay Trail, Alameda Creek Regional Trail and Coyote Hills Regional Park. Downstream from Union City Blvd/Ardenwood Blvd., to the north of the northern levee, are inactive commercial salt ponds, with an East Bay Regional Parks District Alameda Creek Stables Staging Area trail access and parking lot. To the south are more inactive salt ponds, seasonal wetlands, and Coyote Hills Regional Park. Upstream from Ardenwood Blvd., there is residential development on either side of the levees, but there are currently no housing units, schools or other similar facilities downstream of Ardenwood Blvd.

Within the levees, which are set approximately 100-200 meters from the channel, are broad benches of accreted sediment, forming a marsh plain through which the stream channel meanders. These tidally influenced marsh plains were largely monocultures of invasive *Spartina* before treatment began in 2005. The marsh plain is now dominated by low marsh *Spartina foliosa* habitat nearer to the channel, and pickleweed (*Sarcocornia pacifica*) habitat farther away from the channel. There are short stretches of mudflats in the downstream areas near the

channel. The width of each of these zones is greatest toward the channel mouth (downstream of Coyote Hills), diminishing as the channel proceeds upstream and becomes narrower.

The combined infestation of the six sub-areas of the Alameda Flood Control Channel (particularly the large infestations at sub-areas 01b and 01c) historically comprised one of the largest *S. alterniflora* hybrid infestations in San Francisco Bay. The ISP's 2004 mapping effort estimated a total of roughly 200 contiguous acres of *S. alterniflora*/hybrids on this site spread over approximately 470 acres (32%) of salt marsh and tidal mudflats. Pond 3, part of the Lower Channel sub-area of this site, was the original introduction site of *Spartina alterniflora* in the mid-1970's as part of an Army Corps of Engineers experiment in bank stabilization. Most of the invasive *Spartina* in this site complex is downstream of Ardenwood Blvd. (4 miles from the mouth) where salinities are still high enough to exclude bulrush and tule that can out compete *Spartina* in fresher water.

The treatment method employed at this site has been aquatic herbicide, applied primarily by helicopter, with limited follow up from amphibious tracked vehicles and conventional spray truck on areas missed during the aerial application. The first imazapyr herbicide treatments in 2005 were conducted quite late in the season, at the end of September, resulting in limited efficacy aside from some sub-lethal impacts that reduced the density of the canopy and the height of the plants.

Treatment in 2006 and in 2007 was much more comprehensive and was able to utilize earlier treatment times (mid-July), which can offer optimal plant condition for increased treatment efficacy. The condition of the infestation throughout the Alameda Flood Control Channel site at the end of calendar year 2007 was one of high mortality of non-native *Spartina*, limited visible regrowth of plants, and significant exposure of mudflat areas that were previously dominated by non-native *Spartina* stands. Scattered populations of non-native *Spartina* remain within the site, and spring 2008 surveys of the area will determine the actual efficacy of treatment efforts in the 2007 season. However, the overall success of treatment efforts thus far within this site has resulted in a significantly decreased net acreage of non-native *Spartina*, nominal seed production or export from the site, and the restoration of significant expanses of mudflat within the site.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

SUB-AREAS 01A, 01B, 01C AND 01D: ALAMEDA FLOOD CONTROL CHANNEL MOUTH, LOWER CHANNEL, UPPER CHANNEL, AND UPPER CHANNEL (UNION CITY BLVD TO ALVARADO BLVD)

Sub-Area Partners

Owner(s): Alameda County Flood Control District
Manager(s): Alameda County Public Works Agency
Grantee(s): Alameda County Public Works Agency, California Wildlife Foundation

Sub-Area Description

This four sub-area section of this site encompasses the marsh areas contained within the main channel of the Alameda Flood Control Channel, from Alvarado Blvd to the mouth of the creek where it meets San Francisco Bay.

The 39-acre channel mouth sub-area (01a) encompasses the channel and Bay shoreline marshes westward of the ends of the levees on either side of the channel mouth. Some of the marshlands on the north and south sides of the channel outlet are also included in this sub-area (to a distance of around 200 feet). The area is much wider than the channel proper upstream, and consists of broad mudflats extending bayward. The Lower Channel sub-area (01b) is a 152-acre area of the channel from the mouth upstream to Coyote Hills, with a maximum 300-foot wide, accreted sediment bench in the downstream reach. This area of the Creek channel contains the greatest extent of open mudflat within the channel, especially on the inside curve of a wide meander as the channel swings from a general northwest direction to a southwest outlet into the Bay.

The Upper Channel sub-area (01c) is a 93-acre area of the channel from the Coyote Hills upstream to Union City Blvd/Ardenwood Boulevard. This area consists of benches of sediment colonized by a mixed upper tidal suite of plant species, including broad swaths of pickleweed, gumplant (*Grindelia stricta*), alkali heath (*Frankenia salina*) and other marsh plants. The upper edges of this zone, nearest the levees, can contain upland weedy species

like perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*), especially adjacent to and upstream of the stables staging area. The main channel of the Creek within this portion of the site is much smaller than downstream, at about 20-30 feet across. The uppermost sub-area, also called the ACFCC Upper Channel (sub-area 01d), is the reach of the Channel that lies upstream of Ardenwood Blvd and runs to Alvarado Blvd, just short of I-880 in the east. This sub-area is comprised of 33-acre area of 40-50 benches of sediment lining a central channel area roughly 20 -30 feet across. Vegetation in this area has been dominated by non-native *Spartina* within the lower section, but towards Alvarado Blvd the vegetation grades into tule (*Schoenoplectus californicus*), alkali bulrush (*Bolboschoenus maritimus*) and cattail (*Typha* spp.) which are able to out-compete even hybrid *Spartina* within the brackish upper reaches of the Creek.

These four sub-areas are linked in this updated site-specific plan as they are directly contiguous and form a single 'site' for treatment planning, access and environmental assessment purposes. The original delineation of the sub-areas was established before significant treatment efforts had been undertaken on the site, and before a consistent ISP project partnership with the relevant landowners and managers had been established.

Treatment at this site under the auspices of the ISP has been ongoing since 2004, when ground-based applications of glyphosate herbicide were done on a trial basis, and an aerial application of imazapyr herbicide was done under an Experimental Use Permit from the CA Department of Pesticide Regulation on 15 acres near the mouth of the Channel. In 2005 the entire area was treated with imazapyr herbicide via helicopter broadcast applications. The treatment in 2005 was done in late September, after the plants had both finished flowering and set seed, as well as begin to senesce for the winter. This late-season application was sub-optimal, and was the result of delays in receiving authorizations for the project, rather than any planned treatment approach. In both 2006 and 2007, treatment of the entire channel via broadcast aerial applications was repeated, both years occurring during the optimal timing window of mid-July, which is preferable due to the condition of the target plant material (actively growing, green, healthy shoots) and the availability of suitable tidal windows (low or receding low tides in the morning). Both later treatment seasons have resulted in observed efficacies that are much greater than those observed as a result of the 2005 treatment effort.

The infestation as of winter 2007 has diminished considerably from the initial estimated acreage in 2005. The infestation has been reduced to disparate resprouting plants throughout the area that was once dominated by uniform monocultural stands of non-native *Spartina*. Large areas of dead standing *Spartina* wrack remained at the end of 2007, and most of this material will likely be degraded before the bulk of treatment efforts begin in the summer of 2008. Areas of mudflat that were unvegetated as recently as 2003 have been re-exposed, with remnant, scattered non-native *Spartina* either reseeding sparsely, showing sub-lethal effects from previous treatments, or resprouting directly from plants that might have been missed from previous efforts. Overall, the infestation within the channel presents a markedly different aspect than when treatment efforts began at the site.

Treatment Strategy, Methods, and Timing

Methods:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial (primary method) Amphibious vehicles Truck-mounted spray equipment Backpacks Helicopter: spot treatment
Timing:	Annual treatment until eradicated Mid-July start time for both aerial and ground-based treatments

The basic strategy for treatment within the main Channel has been consistent for the last three control seasons (2005-2007): aerial applications of imazapyr herbicide applied by helicopter equipped with a retractable boom fixed with nozzles. Aerial applications have treated this area comprehensively during that time, with the exception of two areas that were left untreated as part of experimental protocols. This initial treatment effort was subsequently augmented where necessary by limited use of either amphibious vehicles (Hydrotraxx) or truck spot-treatment work on the ground.

Although the overall strategy for the 2008-2010 *Spartina* Treatment Seasons will remain the same, the infestation itself has decreased such that the use of broadcast aerial applications of imazapyr herbicide may become unnecessary after 2008. Once the efficacy of the 2008 *Spartina* Treatment Season has been assessed in the spring and

summer of 2009, it may be determined that strictly ground-based treatment work is all that is required for comprehensive treatment of the site. This ground-based effort may also be augmented by aerial spot-treatment via the 'spray-ball' or shortened boom, where gaining access to the target area will present challenges to ground-based applicators.

Though the results of the 2007 *Spartina* Treatment Season are pending, monitoring at this site indicates that the methods used during the 2005-2007 seasons has had a significant effect on reducing the infestation within these four sub-areas. As a result, it is anticipated that the continued utilization of these methods at the site will result in a further reduction of the remnant population here. Over the course of the next three control seasons, this reduction should, in turn, result in a significant reduction in the need for control work, especially aerial control work. As the infestation at this site moves toward eradication, ground-based spot treatment methods will become the primary treatment method at the site.

Monitoring Needs

Over the course of the 2008-2010 control seasons (and beyond) this site will increasingly require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. Previous mapping efforts (prior to 2008) have relied heavily on 'head's-up digitization' of the infestation within the marsh, which utilizes office-based GIS technology and ground-truthing to digitally delineate non-native *Spartina* infestations on an orthophoto of the site. Since the overall size and general contiguity of the infestation has decreased dramatically, this relatively coarse mapping strategy will eventually be unable to discern the location of scattered, small resprouts or newly establishing plants. The exact location of the individual plants within the overall site complex will be of paramount importance to control efforts, especially in terms of budgeting time and resources for control.

SUB-AREAS 01E AND 01F: SHORELINE NORTH OF AFCC MOUTH AND POND 3 (ECOLOGY MARSH)

Sub-Area Partners

Owner(s): California Department of Fish and Game
Manager(s): Alameda County Public Works Agency
Grantee(s): California Wildlife Foundation, Alameda County Public Works Agency

Sub-Area Description

This two sub-area section of the Alameda Flood Control Channel site lies just north of the main Channel mouth., Pond 3 or Ecology Marsh (Sub-area 1f) is the site of the first intentional planting (circa 1976) of *Spartina alterniflora* in the San Francisco Bay Estuary as part of a US Army Corps of Engineers restoration and bank stabilization effort. This 137-acre former salt pond is comprised of a crescent shaped block of marsh running along the north contour of the channel. The marsh is bordered on the north, south and east by levees, and the western boundary of the marsh is open to the Bay. Much of the elevation of the marsh is relatively high, and dominated by a mixed pickleweed plain. A small channel drains the northern portion of the marsh, and runs roughly parallel to the levee on that side (without much evident sinuosity), and a few smaller channels are located on the western end of the marsh near the Bay.

The 18-acre western portion of Pond 3 was designated as 'The Strip Marsh North of the Channel Mouth, (Sub-area 01e)' in the 2005-2007 ISP Site-Specific Plan (SSP) document for the site. It was originally delineated as a separate sub-area due to the more meadow-like aspect of the hybrid *Spartina* infestation there, and the fact that the vegetated edge of the marsh extends north of Pond 3 along a north/south levee in a tapering mid-marsh spur. As a result of treatments in the area, the meadow-like aspect of this area has been reduced, and the marsh edge is now almost exclusively open mudflat. As a result, the area, in terms of access, environmental impact and treatment strategy is now more appropriately linked to Pond 3.

Treatment at this site has closely followed the work done in the adjacent ACFCC. Aerial applications of imazapyr herbicide were applied to both the bayfront fringing marsh as well as the infested areas along the interior channels of Pond 3. Additionally, selected missed or resprouting areas within Pond 3 were subsequently targeted for ground-based control with amphibious vehicles. Treatment work in this area has been ongoing since the 2005 Treatment Season.

The current infestation in this area is a patchwork of resprouting or missed *Spartina* plants scattered mostly within in the upper marsh portion of Pond 3, especially along the channel edges within the marsh. The bayfront edge of

this marsh does have a few patches remaining, but they are small compared to the overall efficacy seen in the area. The infestation in these two sub-areas has been reduced by 95% from pre-treatment levels. The main concern in this marsh will be the targeting of the small, dispersed clumps that remain.

Treatment Strategy, Methods, and Timing

Methods:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial (primary method) Amphibious vehicles Truck-mounted spray equipment Backpacks Helicopter: spot treatment
Timing:	Annual treatment until eradicated Mid-July start time for both aerial and ground-based treatments

From the previous three treatment seasons, these two sub-areas have been targeted for treatment via aerial (helicopter) broadcast applications of imazapyr herbicide. This approach has resulted in a significant reduction in the non-native *Spartina* cover within the site. The remaining portion of the marsh that yet contains non-native *Spartina* is not contiguous, and presents difficulties in regards to access and approach.

During the 2008 Treatment Season, helicopter broadcast applications may again be warranted, pending early spring efficacy estimates of the 2007 Treatment Season. The use of aerial applications will be necessary if large, contiguous sections of the infestation re-appear, or if the net coverage of scattered resprouting clones within the marsh is large enough to make aerial applications more efficient than ground-based treatments. Since aerial work will be undertaken at adjacent sites, inclusion of sub-areas 01e and 01f into the effort will be readily available.

If the infestation presents a decidedly smaller aspect upon inspection in spring of 2008, ground-based treatment options (amphibious vehicles, trucks or backpacks) will be employed. Regardless of the treatment method used in 2008, it is anticipated that the treatments in 2009 and 2010 will rely exclusively on ground-based treatment methods to 'mop-up' the remaining stands of *Spartina* in the marsh. Similar to the adjacent ACFCC channel, as the infestation at this site moves toward eradication, ground-based spot treatment methods will become the primary treatment method at the site.

Monitoring Needs

Over the course of the 2008-2010 control seasons (and beyond) this site will increasingly require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. Previous mapping efforts (prior to 2008) have relied heavily on 'head's-up digitization' of the infestation within the marsh, which utilizes office-based GIS technology and ground-truthing to digitally delineate non-native *Spartina* infestations on an orthophoto of the site. Since the overall size and general contiguity of the infestation has decreased dramatically, this relatively coarse mapping strategy will eventually be unable to discern the location of scattered, small resprouts or newly establishing plants. The exact location of the individual plants within the overall site complex will be of paramount importance to control efforts, especially in terms of budgeting time and resources for control.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Alameda Flood Control Channel, Alameda County, TSN: ISP-2004-01, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

All six sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 02: BAIR & GRECO ISLANDS COMPLEX, SAN MATEO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Bair & Greco Islands Complex, San Mateo County, TSN: ISP-2004-02, 2005-2007 Control Seasons) dated May 2005. The original 10 sub-areas remain as defined in that plan, and three new sub-areas have been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to one or more project partner. The grant recipients for this site are:

The U.S. Fish and Wildlife Service, Don Edwards National Wildlife Refuge, 5 Marshland Road, Fremont, CA 94564; *Joy Albertson, (510) 792-0222 x 35.* Don Edwards National Wildlife Refuge (DENWR) owns and manages the Bair &Greco Island Complex, as well as many thousands of additional acres of marsh, both invaded and uninvaded by *Spartina*, throughout the South and Central Bay. DENWR also owns tens-of-thousands of acres of currently diked, former salt ponds, which are slated for restoration to tidal marsh in coming decades, and which would be vulnerable to *Spartina* infestation. The DENWR has implemented a control program on their properties over the last several years.

San Mateo County Mosquito Abatement District, 1351 Rollins Road, Burlingame, CA 94010; *James Counts, Field Operations Supervisor, (650) 344-8592.* The San Mateo County Mosquito Abatement District (SMCMAD) has been working in the area since 1953, and has extensive knowledge of, equipment for, and expertise relating to the specific requirements necessary for safe control work within this marsh environment. SMCMAD implemented the *Spartina* control work on this site last year, and several of the sub-areas outlined in this plan are areas where the SMCMAD regularly conducts mosquito control efforts. Control of the *Spartina* on these sites would allow for restoration of these areas to natural tidal influences and thus diminish the amount of mosquito breeding habitat available.

Site Description

Map Site 02: Bair and Greco Islands Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

02a	Belmont Slough/Island, North Point, Bird Island, Steinberger Slough/Redwood Shores Map	02g	West Point Slough Southwest and East Map
		02h	Greco Island South Map
02b	Steinberger Slough South, Corkscrew Slough, Redwood Cr North Map	02i	Ravenswood Slough & Mouth Map
		02j	Ravenswood Open Space Preserve Map
02c	Pond B2 North Quadrant Map	02k*	Redwood Creek & Deepwater Slough Restoration Map
02d	Pond B2 South Quadrant - Rookery Map	02l*	Inner Bair Island Restoration Map
02e	West Point Slough Northwest Map	02m*	Pond B3: Middle Bair Island Restoration Map
02f	Greco Island North Map		

* Sub-area added since the 2005-2007 *Spartina* control plan

The Bair & Greco Island complex encompassed by this plan is located in the southwest portion of the San Francisco Bay Estuary. The northern edge of the complex is at Belmont Slough on the border of Foster City and Redwood City, including the marshes of Brewer Island just south of the San Mateo Bridge. The southern border of the complex is the Union Pacific railroad line just south of the Dumbarton Bridge. The site is a 3,060-acre complex including marsh islands, active and inactive commercial salt ponds, six large sloughs with numerous smaller channels, and other bayfront marsh that is part of the San Francisco Don Edwards National Wildlife Refuge (DENWR).

The Bair & Greco Island complex contains many different marsh systems, all of which are impacted to varying degrees by *S. alterniflora* hybrids. Of the roughly 3,060 acres of baylands within the complex, there are approximately 116 acres infested with non-native *Spartina*. Below are brief descriptions of the non-native *Spartina* growth in each sub-area.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

SUB-AREAS 02A, 02B, 02C, AND 02D: BELMONT SLOUGH/ISLAND, NORTH POINT, BIRD ISLAND, STEINBERGER SLOUGH/ REDWOOD SHORES, STEINBERGER SLOUGH SOUTH, CORKSCREW SLOUGH, REDWOOD CREEK NORTH, POND B2 NORTH QUADRANT, AND POND B2 SOUTH QUADRANT-ROOKERY

Sub-Area Partners

Owner(s): CDFG, USFWS
Manager (s): CDFG, USFWS
Grantee(s): USFWS, SMCMAD

Sub-Area Description

Belmont Slough/Island, North Point, Bird Island, and the northern bank of Steinberger Slough along Redwood Shores represent a 448-acre portion of this sub-area. The sloughs are open tidal waters lined with strips of mixed native pickleweed/*Spartina foliosa* marsh. The shorelines and islands are comprised of thin to moderate-width open mudflats grading into native *Spartina* marsh, with some pickleweed/gumplant (*Grindelia stricta*) marsh at higher elevations. All sloughs and marshes are bordered by levees topped by access roads or the Bay Trail. Residential and recreational areas border both the Steinberger and Belmont Sloughs just inland of the levees.

The southern shore of Steinberger Slough to the mouth, both banks of Corkscrew Slough, and the marshes and shoreline on the northern shore of Redwood Creek is an 894-acre portion of this sub-area. This is part of the Bair Island Restoration and Enhancement Project managed by USFWS. The sloughs are open tidal waters lined with strips of native *Spartina foliosa* marsh. The shorelines and adjacent marshes are comprised of thin bands of open mudflats grading into native *Spartina* marsh, with some pickleweed/gumplant marsh at higher elevations. Portions of the sloughs are bordered by levees, some with access roads, but the adjacent areas are part of the habitat restoration project, and are typically not accessible to the public.

The B2 North Quadrant is a 541-acre, formerly diked area on the northern section of Outer Bair Island, adjacent to Steinberger Slough. This area is also part of the Bair Island Restoration and Enhancement Project. The levees surrounding the area were naturally breached, and tidal marsh has begun to restore. The site is predominantly pickleweed/gumplant habitat, with native *Spartina* marsh in lower areas and along sloughs. The levees surrounding the site area are deteriorated and there is no public access.

The B2 South Quadrant - Rookery, also part of the Bair Island Restoration and Enhancement Project, is a 61.7-acre diked area adjacent to the B2 North Quadrant. This site is being “restored” as seasonal wetland habitat, and is currently dominated by invasive *Spartina*. The levees surrounding the site are intact, but there is no public access.

Portions of this large group of sites have been targeted for treatment since 2004. In that year, the San Mateo County Mosquito Abatement District (SMCMAD) worked predominantly in the Pond B2 South area, targeting the *Spartina* there with glyphosate herbicide treatments. At the time this area was one of the largest single concentrations of non-native *Spartina* in the Bair and Greco Island Complex. Efficacy from the glyphosate treatments was low however. Partially as a result of the export of seed from B2, and partially a result of expansion of the smaller infestations already present, the adjacent infestations in Steinberger and Belmont Sloughs, as well as in Pond B2 North, dramatically expanded.

By 2005, the areas within both the North and South Quadrants of Pond B2, along with the shorelines of Belmont and Steinberger Sloughs had developed sizeable infestations. In the sloughs, the native tidal salt marsh vegetation that lines the banks was being displaced by widely scattered clonal patches of non-native hybrid *Spartina* throughout the lengths of their respective channels. In Belmont Slough, the infestation extended to the west even to HWY-101, in a small marsh called O’Neill Slough. In Steinberger Slough, the infestation was similar on the north side, with scattered clonal patches in amongst the native vegetation.

Within Bair Island however, the infestation had exploded, particularly within Pond B2 North, where ample open mudflat areas offered prime colonization habitat for the vigorous non-native hybrid *Spartina* propagules that found their way there. Pond B2 South maintained its near-monoculture, showing very little impact from the previous year’s treatment work.

Pond B2 was treated aerially via helicopter in 2005, utilizing imazapyr herbicide for the first time. Many of the other areas in this group of sites were treated as well, but only via ground or boat-based treatment methods. Pond B2 North was only partially treated. Typical of first-year treatment with imazapyr on established *Spartina* stands, the efficacy observed from these applications was less than anticipated. Nevertheless, in 2006, some diminishment of the infestation in B2 South, and some impact to the clonal patches along the slough edges were discernable.

In 2006, large-scale aerial applications of imazapyr herbicide were adopted for Pond B2 both north and south, as well as along the southern banks of Steinberger Slough and at selected spots within Corkscrew Slough. Additionally, the SMCMAD mounted the most comprehensive ground and water-based treatment efforts to date, targeting all of the non-native *Spartina* within these four sites that had not been treated aerially. By 2007, the aerial work showed marked results, with large swaths of the previously monocultural expanse of *Spartina* within B2 dead. Good efficacy was also observed along the banks of the sloughs, though some clonal patches remained.

In 2007, the aerial effort was repeated within B2 North and South, and along the banks of Corkscrew and Steinberger. Again the SMCMAD mounted a comprehensive effort along all other infested areas within these four sites. Efficacy assessments on these treatment efforts will occur in late spring or early summer 2008.

As of winter 2007, the infestations within this broad area are in various stages of control. In both of the B2 Ponds, north and nouth, the previous seasons' aerial treatments have resulted in significant reduction of the infestations in these marshes. What remains here are small patches both within the marsh plain and along channels, but very few of the remaining plants are wholly untouched by treatment. The patches here are scattered and unconnected, whereas previously they were solid, monocultural stands.

Along the northern channel banks of Steinberger Slough, the large clones that previously dotted the marsh plain have been almost completely removed. However, new small clones have sprouted here and represent the main portion of the infestation requiring treatment in 2008 and beyond. Additionally, scattered survivors remain from previous treatments within the footprint of the large clonal patches. These remnant individuals will also be a high priority for treatment going forward. This condition is similar to that of Corkscrew Slough, wherein scattered remnant patches, much diminished from pre-treatment condition, can be found along the channel. Few in number, they still represent a high priority for the ISP as part of the eradication effort in the area.

On the southern side of Steinberger, the best control has happened along the northern shoreline of Pond B2 North, where aerial treatments have almost completely removed the non-native *Spartina* from the area. Only a few remnant patches remain that will require treatment in 2008. However, south of B2 North, along the banks of Steinberger towards HWY-101, the infestation continues to thrive as a dense monocultural band along the southern shoreline of Pond B3 (Middle Bair). This particular area will require targeted control work in 2008 and beyond to remove the plants from the area, as restoration work at B3 aims to breach the levee through a thriving stand of non-native *Spartina*.

Belmont Slough remains a significant problem area. Areas of special concern are the northern banks of the slough, and the upper end of the slough near O'Neill Slough. At the mouth of the slough, south toward Bair Island, control has been spotty. All of these areas have numerous large clonal patches in need of treatment in 2008.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Amphibious Vehicles Truck-mounted spray equipment Backpacks Boats Helicopter
Timing:	June-July start time for ground-based and aerial treatments

Treatment efforts on these sites will basically follow the efforts done in previous seasons, especially in 2008, to the extent that the on the ground efficacy assessments of the 2007 treatment season dictate need. Aerial treatments will be done along the south side of Steinberger and within B2 North and South, and boats, trucks, backpacks and amphibious vehicles will be used where appropriate on all other areas. As the infestations diminish over subsequent seasons, it may become possible to do the work solely via ground and boat-based methods.

Monitoring Needs

The infestations within these sites require ground-based surveys using GPS equipment. In Pond B2 North and South, the infestations have typically been mapped using 'heads-up' digitization, wherein the extent of the infestation is mapped on GIS software in the office using orthophotos of the site and then ground-truthed. This method will no longer suffice to identify the clonal areas within B2 that remain from the previous treatment efforts at the site.

SUB-AREAS 02E, 02F, 02G AND 02H: WEST POINT SLOUGH NW, GRECO ISLAND NORTH, WEST POINT SLOUGH SW AND EAST, AND GRECO ISLAND SOUTH

Sub-Area Partners

Owner(s): USFWS
Manager (s): USFWS
Grantee(s): USFWS, SMCMAD

Sub-Area Description

This grouping of four sites within the Bair and Greco Island Complex essentially encompasses the marshland areas to the south of Redwood Creek to just north of the mouth of Ravenswood Slough. This area consists of Greco Island and West Point Slough, both of which were divided into two sub-areas previously. As these areas are all treated by SMCMAD during the course of the treatment season, and essentially are contiguous linked habitat, they have been combined for this Site-Specific Plan update.

West Point Slough NW is a 21-acre sub-area that includes both banks of the north end of West Point Slough, up to Redwood Creek, and a portion of the shoreward side of Greco Island. The slough consists of open tidal waters lined with strips of native *Spartina* marsh. The included portion of Greco Island is that portion of the island to the southwest of the PG&E power line maintenance boardwalk that bisects Greco Island. There are intact levees on the western edge of the slough, with an office park (primarily parking lot) and light industrial site inboard of the levees. Besides the light public usage of the accessible features, there is little public access to most of this area. Much of the developed shoreline on the northern portion of this sub-area is lined with rip-rap and fill.

Greco Island is reported to be the largest remaining prehistoric tidal marsh in the South Bay. The Greco Island North sub-area is 556 acres, with the eastern shore (bayfront) comprised of wide mudflats, many small sloughs lined with native *Spartina* marsh, and pickleweed/gumplant marsh at higher elevation. There is a power line right-of-way running the length of the island, but there is no public access to the site.

West Point Slough SW and East is an 87.2-acre sub-area that includes the southern end of West Point Slough around the end of Greco Island, and Flood Slough near Bayfront Park. West Point Slough becomes very narrow at the southern end, and densely vegetated with primarily invasive *Spartina*. A small wastewater treatment plant is located at the confluence of West Point and Flood Sloughs, adjacent to Bayfront Park. Bayfront Park is a moderately used public park located on hills and uplands overlooking the sloughs.

The 261-acre Greco Island South sub-area includes the southern lobe of Greco Island at the mouth of West Point Slough. The marsh in this area is similar the northern part of Greco Island (Sub-area 02f), except that it merges with portions of West Point Slough, and may have unique access issues due to the presence of a PG&E power line maintenance boardwalk across the marsh. There is no public access at this site.

SMCMAD has treated all four of these areas since 2005. The majority of the Greco Island South area has been treated with imazapyr via helicopter broadcast applications, whereas the areas along West Point Slough have been targeted with both boats and via trucks and backpacks. Each successive year has seen the infestations in these areas decrease, especially in 2007.

As of winter 2007, the mudflat areas to the south of Greco Island still support clonal patches of non-native *Spartina* that are detached from the main marsh adjacent. Although the bulk of the infestation at Greco Island has been significantly reduced, a sizeable population of non-native *Spartina* exists on the northeastern Bay-side portion of the marsh where the PG&E power lines run along the shore. Additionally, West Point Slough is an area of continued concern, as the population of hybrid *Spartina* here has maintained a presence despite repeated attempts at control. This particular area will require concentrated effort in the coming years to reduce and remove the remaining stands of non-native *Spartina* scattered along the shoreline.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: broadcast aerial
Truck-mounted spray equipment
Amphibious vehicles
Boats
Backpacks

Timing: Mid-July start time for both aerial and ground-based treatments

The infestations within this four-site area will be treated with a combination of aerial and ground and boat-based treatment methods similar to the approach over the past three control seasons. Greco Island and some parts of West Point Slough are appropriate targets for final aerial applications in 2008 as long as the infestations in those areas remain large enough to justify this method. Some of the areas around Greco also might warrant aerial applications by dint of the difficulty of access via any ground or water-based method. Otherwise, crews working along the shoreline in both trucks and boats or via amphibious vehicles will target all of the newly establishing and remnant plants in this area.

Monitoring Needs

As in other areas, the main areas of infestation in this area will require detailed GPS-based ground assessments of the locations of the non-native *Spartina*. This is especially the case as there are large populations of native *Spartina* within the sites. Additionally, comprehensive genetic surveys of Greco Island will need to be completed each year to determine the distribution and extent of the hybrid forms in this marsh.

SUB-AREAS 02I AND 02J: RAVENSWOOD SLOUGH AND MOUTH AND RAVENSWOOD OPEN SPACE PRESERVE

Sub-Area Partners

Owner(s): USFWS
Manager (s): USFWS
Grantee(s): USFWS, SMCMAD

Sub-Area Description

The Ravenswood Slough and Mouth site is a roughly 136-acre sub-area including both shores of Ravenswood Slough to its mouth, and the Bay shoreline to Ravenswood Point, with expansive mudflats along the Bay shoreline adjacent to the site. The slough is open tidal water lined with wide, accreted benches covered with native *Spartina* marsh. The slough is entirely bordered by levees, with commercial salt ponds inland of the dikes. There is no public access to this site.

For the purposes of this plan, the Ravenswood Open Space and Preserve consists of the 55-acre stretch of rip-rap and fringing strip marsh south of the Dumbarton Bridge (Hwy 84) outboard of the commercial salt pond known as "Pond SF2." The marsh is bordered by levees and is heavily used by the public for recreational purposes.

These two areas have been targeted for comprehensive *Spartina* treatment since 2005. SMCMAD has used boats, helicopters and amphibious vehicles to move through the fringing marsh edges of the slough and along the Bay shoreline at these two sites, and apply imazapyr herbicide to the target plants. The largest portion of the infestation in these areas is located within the channel of Ravenswood Slough, especially on the west side. This is an area of significant native marsh development, and the plants have been largely located on the lower edges of the marsh, straddling smaller channels next to the main channel. In this area, amphibious vehicles would deploy from the adjacent levee to treat the plants.

In 2007 both of these areas were targeted for aerial applications, whereas the Bay shoreline areas were again targeted using amphibious vehicles. 2007 saw the treatment of the entire infestation in this part of the Bair and Greco Island Complex.

As of winter 2007, the main contours of the infestation remained unchanged, wherein scattered remnant clonal patches persist within the Ravenswood Slough Channel, at its mouth, and southeast along the shoreline. However, some of these areas had not been previously treated via helicopter, and given the propensity for aerial applications to result in much higher and more consistent efficacy than any ground-based method, there is a high likelihood

that the infestation in these areas will have significantly diminished come late spring or early summer 2008 efficacy assessments in the area.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: Broadcast aerial
Truck-mounted spray equipment
Amphibious vehicles
Boats
Backpacks

Timing: Mid-July start time for aerial and ground-based treatments

Treatment in these two areas will follow the treatment work done previously on the sites. Where appropriate levels of non-native *Spartina* remain, broadcast aerial applications of imazapyr herbicide will be used. For the rest of the site, and into the coming control seasons, boats, trucks and amphibious vehicles will selectively target the individual remaining stands of non-native *Spartina* in the marsh.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring, especially as the infestation dwindles further and becomes more scattered. Genetic sampling of the plants within Ravenswood Slough should also be increased, as this area has a large population of native *Spartina* mixed within the non-native *Spartina* stands.

SUB-AREA 02K: REDWOOD CREEK AND DEEPWATER SLOUGH RESTORATION

Sub-Area Partners

Owner(s): USFWS, CDFG, Port of Redwood City
Manager (s): USFWS, Port of Redwood City
Grantee(s): USFWS, SMCMAD

Sub-Area Description

This site includes the areas along the shoreline of Redwood Creek in Redwood City. The area is defined by the southeastern shoreline of Bair Island and the Port of Redwood City and Greco Island. Included within this area is the Deepwater Slough Restoration area, a roughly 155-acre site on the southeastern side of Bair Island, to the south of Corkscrew Slough. This area also includes the Port of Redwood City facilities, especially the Redwood City Marina. This area has a wide variety of habitats, from rip-rap developed shoreline to restored tidal marsh, to industrial facilities to historic native tidal marsh systems. The *Spartina* infestation here is spread amongst several main locations, including the Marina, Deepwater Slough and the shorelines of both Bair and Greco Islands. Other smaller patches can be found upstream of the Marina, as well as throughout the site.

The Deepwater Slough Restoration area, as well as the shoreline of Bair Island along Redwood Creek, have both been treated with imazapyr since 2005 with a combination of aerial applications and boat-based applications. The aerial portion of treatment was done in combination with the treatment of adjacent stands of non-native *Spartina*, and did not encompass the entirety of the infestation in either area. Follow-up work was done via boat by SMCMAD to target those areas missed by aerial treatments. In 2007, these boat-based efforts were extended upstream to include the areas around the Marina as well as the areas toward Inner Bair Island. These areas were treated with imazapyr herbicide by a combination of truck and boat applications.

As of winter 2007, clonal patches of non-native *Spartina* remained at all locations within this site: in the Marina, along the eastern shoreline of Redwood Creek, along the shoreline of Bair Island, and within the Deepwater Slough Restoration. All of these areas will require re-treatment in 2008 and beyond. However, the areas within Deepwater Slough have been treated for at least two years, and do show signs of being controlled. Final efficacy assessments will be done in the late spring or early summer of 2008, and control work will proceed according to the results.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: Broadcast aerial
Truck-mounted spray equipment
Amphibious vehicles
Boats
Backpacks

Timing: Mid-July start time for aerial and ground-based treatments

Treatment in this area have been typically done with a combination of early season aerial applications on a select few sites in the Deepwater Slough area and out along the southeastern shoreline of Bair Island to the northeast of Corkscrew Slough, followed later in the year with ground and boat-based treatments along the rest of the shoreline. Treatments in 2008 and beyond will follow a similar strategy, with the need for aerial treatments diminishing as the size of the infestations shrinks. Areas where there will continue to be difficulty in regards to access may continue to warrant aerial applications in combination with aerial work done on adjacent sites. However the bulk of the work in future years will be done on the ground, especially around the marina area.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring, especially as the infestation dwindles and becomes more scattered. Additionally, the areas within the Deepwater Slough area will require genetic sampling and analysis to identify those non-native hybrid individuals that remain in this portion of the marsh.

SUB-AREA 02L: INNER BAIR ISLAND RESTORATION

Sub-Area Partners

Owner(s): USFWS
Manager (s): USFWS
Grantee(s): USFWS, SMCMAD

Sub-Area Description

The Inner Bair Island Restoration marsh is a roughly 327-acre diked marsh area along the shoreline of Redwood City, between the northeastern termini of Brittan and Whipple Avenues. The marsh is currently not open to tidal exchange, but the periphery of the main marsh area contains a thin band of tidal marsh vegetation. The site is slated to be opened to tidal exchange in the next few years.

The clonal patches on the southwestern corner of the site, in a small slough area that bounds the marsh proper to the south and west, are only a few in number. These clones were treated by SMCMAD in 2007 via imazapyr by boat. As of winter 2008, the clonal patches near the Whipple interchange remain standing. Efficacy assessments of the work done in 2007 will occur in late spring or early summer 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment
Amphibious vehicles
Boats
Backpacks

Timing: Mid-July start time

The infestation in the Inner Bair Island site is currently very small, and limited to a couple of areas along the southwestern portion of the marsh. Treatment of these areas is relatively straightforward, involving the use of boats to ferry equipment, applicators and materials to the plants for treatment.

However, once the main marsh area is opened to tidal exchange, the infestation may begin to colonize that area, and will require the use of other methods like amphibious vehicles and trucks to effectively treat the infestation.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring, especially as the infestation dwindles and becomes scattered. As at

the Pond B3 site on Bair Island, once the main marsh area is opened to tidal exchange, yearly genetic sampling of all newly establishing plants in the marsh will be required. This analysis will inform control efforts, as there is a large, healthy population of native *Spartina* in the area. Yearly sampling of the *Spartina* in this marsh will enable the ISP and its partners to specifically target the non-native *Spartina* while allowing the native colonizers to establish and flourish.

SUB-AREA 02M: POND B3- MIDDLE BAIR ISLAND RESTORATION

Sub-Area Partners

Owner(s): USFWS
Manager (s): USFWS
Grantee(s): USFWS, SMCMAD

Sub-Area Description

The Pond B3: Middle Bair Island Restoration is a roughly 400-acre diked salt pond in the northern portion of Bair Island. It is bordered to the southwest by Corkscrew Slough, to the northwest by Steinberger Slough, and in the northeast by Pond B2 North. Currently the marsh is not open to tidal exchange, and within the levees that surround the marsh is long-dead salt marsh vegetation and channels with stagnant water.

The areas of the levees that are targeted for breaching in 2008 or 2009 are located directly within existing stands of non-native *Spartina*. Natural colonization of this marsh may result in the importation of non-native *Spartina* propagules. However, the infestations that surround the marsh are included in a comprehensive treatment effort, and the density and location of the remaining non-native *Spartina* patches at breaching cannot be known at this time.

No non-native *Spartina* treatment has occurred at this site. Currently there is no non-native *Spartina* established at the site. Breaching of the levee system bordering the site will occur in 2008 or 2009, and the proposed locations of the breaches will cut through currently existing infestations of non-native *Spartina*. The potential for an infestation establishing in this site once it is subjected to normal tidal fluctuation will be great.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: Broadcast aerial
Truck-mounted spray equipment
Amphibious vehicles
Boats
Backpacks

Timing: Mid-July start time for aerial and ground-based treatments

The methods of control identified above are designed to encompass the possible infestation scenarios that might develop at the site once normal tidal exchange is restored. The use of any of these methods will be evaluated based on the size and location of the newly established infestation in the marsh. Aerial applications will be used should the infestation grow larger than ground based treatment methods can efficiently control, or should the infestation be located in areas that are inaccessible to any other control method.

Monitoring Needs

SMCMAD will work with the ISP to monitor the site post-breaching to quickly identify newly-establishing hybrid *Spartina* plants within the marsh. As native and non-native *Spartina* seedlings are virtually indistinguishable, this monitoring effort should, at least in the first couple of years following restoration, rely heavily on the use of genetic analysis. For the first two years, all newly establishing plants should be sampled and tested. All individual *Spartina* plants should also be mapped using GPS equipment to identify the native vs. non-native areas of the marsh.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Bair & Greco Islands Complex, San Mateo County, TSN: ISP-2004-02, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original 10 sub-areas remain as defined in that plan, and three new sub-areas have been added. The three new sub-areas are in the immediate vicinity of the existing sub-areas, and are extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 03: BLACKIE'S PASTURE, MARIN COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Blackie's Pasture, Marin County, TSN: ISP-2004-03, 2005-2007 Control Seasons) dated May 2005. All two sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the Conservancy directly to one or more project partner. The grant recipient(s) for this site include:

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.*The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement the *Spartina* Control Plan on Sub-area 05g (Cargill Pond – W Hotel) within this complex.

Other Partners:

City of Tiburon Public Works, 1175 Tiburon Boulevard, Tiburon, CA 94920; *Dave Davenport, Assistant Superintendent of Public Works, (415) 435-7399.* The City of Tiburon is the owner of the Blackie's Pasture site and is responsible for maintenance and upkeep on the site.

Tiburon Audubon Center and Sanctuary, 376 Greenwood Beach Rd., Tiburon, CA 94920; *Michele Pearson, Executive Director, (415) 388-2524 Ext. 109.* Tiburon Audubon leases the area of Blackie's Pasture situated downstream of the bridge over the main channel on the site. The ISP will coordinate control activities with Tiburon Audubon on this portion of the Blackie's Pasture site through the use of volunteer groups.

Site Description

Map Site 03: Blackie's Pasture includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

03a. Blackie's Creek (above bridge) Map
03b. Blackie's Creek Mouth and Outer Shoreline Map

Blackie's Pasture is a small City of Tiburon park co-managed by the City of Tiburon and Tiburon Audubon. The park is located along the shoreline of Richardson Bay, adjacent to Tiburon Boulevard. The park is heavily used by the public for passive recreation, and is comprised of a 0.7-acre pasture, a small creek channel ("Blackie's Creek") along the eastern edge of the pasture, and a shoreline area that includes the channel mouth, open mudflat (fed by sediment delivered by the creek), landscaped pathways and picnic areas, and rip-rap fill to the east along the Tiburon Peninsula. There is no riparian vegetation along the creek, and the main portion of the creek downstream of Tiburon Boulevard is deeply trapezoidal and constructed primarily for flood control purposes rather than wildlife habitat value.

The Blackie's Creek channel flows from Tiburon Boulevard out to a paved recreational and maintenance pathway bridge, and then flows roughly north-south for the final 100 meters to the Bay. The channel is 10-15 feet wide, steep-sided, and cuts its way through an area of the park composed of fill material. The banks above the mean high tide line are populated by several species of non-native upland weeds, with stands of coyote-bush (*Baccharis pilularis*). For the purposes of this plan, the area of the channel is estimated at one acre.

The second major area of the Blackie's Creek site is the Creek Mouth. This sub-area includes the small delta formed at the mouth of Blackie's Creek as it enters Richardson Bay, as well as the shoreline east along the Tiburon Peninsula. This area is dominated by *Spartina* stands, with a thin band of high marsh pickleweed habitat abutting the edges of the filled portions of the park. At the southern end of this area is a small beach that is mostly inundated at high tide, and on the northern end, the marsh is bordered by rip-rap and fill.

Treatment Approach

The treatment approach for all sub-areas is described below. The two sub-areas for this site share significant similarities and have been grouped together.

SUB-AREAS 03A AND 03B: BLACKIE'S CREEK, CREEK MOUTH, AND SHORELINE

Sub-Area Partners

Owner(s): Town of Tiburon, Tiburon Audubon
Manager (s): Town of Tiburon, Tiburon Audubon
Grantee(s): California Wildlife Foundation

Sub Area Description

Treatment of *Spartina alterniflora* hybrids and *Spartina densiflora* at Blackie's Pasture has been ongoing since 2003. The ISP, working with Tiburon Audubon and the Town of Tiburon, has targeted the site for manual, mechanical and chemical treatments at various points since that time. In 2003, all of the work at the site was done by Tiburon Audubon volunteers who selectively dug *Spartina densiflora* from the mouth of Blackie's Creek Channel. This effort was repeated in 2004, along with removal of large amounts of other invasive plant species from the site.

In 2005, the ISP coordinated chemical treatment of the marsh at the creek mouth, as well as upstream within the channel, and east along the coast of the Tiburon Peninsula. Imazapyr herbicide treatments using both backpacks and truck-mounted hose equipment selectively targeted the invasive *Spartina* plants in the marsh. In late 2005, the Town of Tiburon dredged a small portion of the Blackie's Creek Channel just downstream of Tiburon Boulevard. This work removed most of the rhizomatous *Spartina* material from the lowest portion of the channel, but left scattered stands of *Spartina* lining the edges of both channel banks.

In 2006, the Town of Tiburon dredged the remainder of the channel downstream of Tiburon Boulevard to the bridge over Blackie's Creek near the mouth. Again, the dredging work was mostly concerned with restoring flows that had been impeded by the colonization of the channel by the non-native *Spartina*, and only the bottom of the channel was cleared of the plants and their rhizomes. Scattered remnant patches were left in place along the channel banks. Through the California Wildlife Foundation (CWF), the ISP treated the remaining stands in the channel, all patches in the marsh at the creek mouth, and along the shoreline of the Tiburon Peninsula. Also treated in 2006 were the dredge spoil piles adjacent to the channel proper. The *Spartina* that was removed earlier in the season was still alive and green in the piles, and presented a concern that it might re-infest the adjacent channel.

In 2007, treatment of the site for *Spartina* exclusively involved the use of imazapyr herbicide via backpack sprayers. The current status of the *Spartina* infestation at Blackie's pasture can be described as significantly diminished from its pre-treatment extent, but small stands of *Spartina alterniflora* hybrids and a few individual plants of *Spartina densiflora* remain on the site.

The Channel Mouth contains remnant patches scattered throughout the native *Spartina* and pickleweed marsh. The *Spartina alterniflora* clones are severely impacted by the treatment efforts of previous seasons, showing small, singular sprigs of vegetative material where a tall clonal patch previously grew. The *Spartina densiflora* population here has been relegated to small seedlings mostly located on a thin sediment bench downstream of the bridge over the creek. Within the channel itself, very little invasive *Spartina* remains as of winter 2007 surveys. Both the herbicide treatments and the dredging have been extremely effective at controlling the infestation here. Along the shoreline to the east, the infestation is almost completely eradicated.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Backpack sprayers
Truck-mounted spray equipment
Digging

Timing: Annual treatment until eradicated
June-July start time for ground-based treatments

The *Spartina alterniflora* on the site will require herbicide treatments during 2008, but may be controlled to the extent that manual digging of resprouts or seedlings will be the only control method required after that season. Backpack sprayers should be all that is required here. For these treatments, early to mid-summer treatments result in the highest efficacy, therefore a treatment time of June or July is optimal.

In 2009, 2010 and beyond, manual digging of any remaining patches of non-native *Spartina* on the site should suffice to keep the infestation controlled here. *Spartina densiflora* is especially susceptible to manual digging, and since the plants here are almost entirely small seedlings that respond poorly to herbicide treatments, manual digging is the preferred option on these plants at this site. Manual digging can be done effectively any time of year, with early season work offering the additional benefit of removing the plants before they flower or set seed.

Monitoring Needs

The Blackie's Pasture site is a mixture of native and non-native hybrid *Spartina* populations. Therefore, continued use of ground-based GPS mapping coupled with comprehensive genetic sampling of plants on the site is imperative for the ISP Control Program. This is especially important as the plants that have been previously treated on the site show sub-lethal effects that can mimic the morphology of untreated native stands. Proper identification of the non-native hybrids in this marsh is an integral step in restoring the native tidal marsh plant community here and in Richardson Bay overall.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Blackie's Pasture, Marin County, TSN: ISP-2004-03, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

Both sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 04: CORTE MADERA CREEK COMPLEX, MARIN COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Corte Madera Creek Complex, Marin County, TSN: ISP-2004-04, 2005-2007 Control Seasons) dated May 2005. All 11 sub-areas defined in the 2005 plan are included in this update, and one new sub-area has been added. No new species or other significant environmental factors have been identified within the site. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the following project partner:

Friends of the Corte Madera Creek Watershed PO Box 415 Larkspur CA 94977 *Sandy Guldman, (415) 456-5052, sandra.guldman@gmail.com*. The Friends of the Corte Madera Creek Watershed (Friends) is the lead ISP partner in coordinating the *Spartina* control effort on all infested properties along Corte Madera Creek. Friends will work with the ISP on implementation of this Site-Specific *Spartina* Control Plan and will also continue to outreach to property owners with non-native *Spartina* about the importance of removal of invasive cordgrass to the overall health of the Corte Madera Creek watershed. Friends has an established network of community relationships already in place in the watershed that greatly facilitates the implementation of *Spartina* control work in the area.

Other Partners:

California Department of Fish and Game, Central Coast Region, PO Box 47 Yountville, CA 94599*; John Krause, Associate Wildlife Biologist, (415) 454-8050, jkrause@dfg.ca.gov*

Site Description

Map Site 04: Corte Madera Creek Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

04a	Corte Madera Ecological Reserve Map	04g	Creekside Park Map
04b	College of Marin Ecological Study Area Map	04h	Upper Corte Madera Creek (Above Bon Air) Map
04c	Piper Park East Map	04i	Lower Corte Madera Creek (Bon Air to 101) Map
04d	Piper Park West Map	04j	Corte Madera Creek Mouth (Below Hwy 101) Map
04e	Larkspur Ferry Landing Area Map	04k	Boardwalk No. 1 (Arkites) Map
04f	Riviera Circle (Larkspur Marina) Map	04l*	Murphy Creek Map

* Sub-area added since the 2005 *Spartina* control plan

The Corte Madera Creek watershed is located in Marin County and flows into northwestern San Francisco Bay along the southern side of the San Quentin peninsula. The site complex begins at the upper extent of tidal influence, approximately 5.2 kilometers from the mouth, where the 60 meter-wide channel flows from the large concrete culvert at the College of Marin in the City of Kentfield, through the City of Larkspur and along the northern border of the Town of Corte Madera to the Larkspur Ferry Terminal at the mouth. The surrounding landscape is highly developed along the length of this channel, including residential single-family houses, higher density condominiums and apartments, a small amount of commercial development, and several areas of houses along boardwalks perched on stilts above mudflat or marsh. At 900 meters upstream of the mouth, Corte Madera Creek flows under Hwy. 101 and continues out to the bay. There are 12 sub-areas in this site complex, with the addition of the tributary Murphy Creek off Kent Avenue west of the College of Marin and the mainstem of the creek.

Corte Madera Creek is ground zero for the entire *Spartina densiflora* infestation of the San Francisco Bay Estuary. This species was mistakenly introduced to Creekside Park during restoration efforts in the late 1970s, thought to be a form of the native *S. foliosa* by a well-meaning biologist. Since that time it had spread throughout the watershed, and to other locations along the Marin and even the Contra Costa shoreline. *Spartina anglica* was also introduced to this site during restoration work, but did not flourish (suspected to be at the southern edge of its range) and has still not been found outside the very small population in this watershed. In addition, several pockets of *S. alterniflora* can also be found here, ranging from individual clones in the upper reaches of the site by the

College of Marin Lot 13 to larger infestations downstream behind the Larkspur Ferry Terminal and under Hwy. 101. To round out the list, the first documented case of a *S. densiflora* X *S. foliosa* hybrid was also found here.

There were approximately 12 acres of non-native *Spartina* in the Corte Madera Creek watershed when control efforts were initiated in 2005 and 2006 using an Integrated Vegetation Management (IVM) strategy relying on extensive manual removal to complement treatment with imazapyr. The overall infestation of *S. densiflora* has been greatly reduced but still has a significant presence in all sub-areas. In 2007, *S. densiflora* had a great year for seedlings, which began to recolonize areas that had been controlled. *S. alterniflora* had expanded since 2005, because of late treatment at the largest infestation and the discovery of some new pockets, but should now be significantly reduced by the 2007 control work. The original *S. anglica* population has been controlled and is down to a very small area, but some new possible pockets have been discovered that need to be confirmed by genetic testing in 2008.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

SUB-AREA 04A: CORTE MADERA MARSH ECOLOGICAL RESERVE

Sub-Area Partners

Owner(s): California Department of Fish & Game
Manager(s): California Department of Fish & Game
Grantee(s): Friends of Corte Madera Creek Watershed

Sub-Area Description

The Corte Madera Marsh Ecological Reserve (formerly Heerdt Marsh) is a 120-acre undiked remnant of ancient marsh that was once part of an historic tidal marsh plain that extended over three miles along Corte Madera Creek to Ross Valley. It is located on the southern banks of the creek mouth in the Town of Corte Madera, just south of the Larkspur Ferry Terminal and east of Hwy. 101. The Greenbrae Boardwalk community, composed of a strip of houses on stilts above the marsh and mudflat banks of the creek, borders the site on the north side. To the south are two diked marshes, Muzzi and Martas (Sub-area 23e in the Marin Outliers complex), forming a continuous marsh plain stretching for 2.1 kilometers, broken only by channels and old levees. The marsh plain is dominated by pickleweed (*Sarcocornia pacifica*), with extensive stands of *S. foliosa*, particularly in the channels. There is a scarp along the eastern and northern bayfront that drops off sharply to the mudflats below.

Prior to the initiation of treatment in 2005, the infestation within the Corte Madera Marsh Ecological Reserve consisted of clusters of *S. densiflora* in the northwestern corner at the creek mouth and along the eastern bayfront. Several clones of hybrid *S. alterniflora* had colonized the main east-west channel that bisects the site, as well as encroaching on the marsh plain in the southern portion and along the bayfront in the northwest corner of the Reserve. Applicators wearing backpack sprayers applied imazapyr to the invasive cordgrass late in this first season, which resulted in poor efficacy since most plants (and especially the *S. densiflora*) had already begun to senesce. In 2006, the treatment crew accessed the site by boat, and again applied imazapyr to the target plants using backpack sprayers. This control work was much more effective than the first year, and reduced the clusters of *S. densiflora* to scattered individual plants, and the larger clones of *S. alterniflora* to areas of stubble with only patchy regrowth. A crew returned to the site in 2007, accessing the northern portion of the site by ground from the end of the Greenbrae Boardwalk, and the south side from the parking area for the Reserve. They walked the marsh plain with backpack sprayers to treat the remaining plants with imazapyr. As mentioned previously, 2007 was a banner year for seedlings of *S. densiflora*, and several of the historic infestation areas had carpets of them with very few if any remaining mature plants of this species.

An estimation of the current infestation at this site depends on the level of efficacy achieved on the applications to *S. densiflora* seedlings. The *S. alterniflora* in the main channel has been reduced to scattered low-density patches, while this species has been removed completely from the northwestern corner of the Reserve. Two clusters still persist along the bayfront in the southern half of the site. It is estimated that less than 500 ft^2 remains to be treated on this site in 2008.

Treatment Strategy, Methods, and Timing

Methods: Imazapyr treatment (primary)
Manual removal (follow-up and for any *S. densiflora* seedlings or first year plants)

Equipment: Backpack sprayer
Shovels or similar tools

Timing: Annual treatment until eradicated
Treatment should occur between May 1 and July 15

To complete the eradication on this site, it is essential that treatment occur early enough to stop seed production and dispersal, particularly from the *S. densiflora* that normally starts to flower in June. A treatment crew should access the site with backpack sprayers and apply imazapyr to any regrowth from either of the invasive *Spartina* species on the Reserve. Any new seedlings or very small first year plants should be pulled or dug and removed from the site. The ISP and Friends have repeatedly observed very low efficacy on plants with a low leaf surface area, justifying manual removal in appropriate substrates. If any portion of mature *Spartina* plants remain in 2009, this method could also be extended to them.

Monitoring Needs

The Corte Madera Marsh Ecological Reserve is a large site with numerous channels for the treatment crew to cross as they move across the marsh plain. Detailed maps of the current distribution of invasive *Spartina* must be provided to the applicators to eliminate laborious and time consuming reconnaissance in areas where the infestation may already have been eliminated. The onsite ISP Field Operations representative can then sweep over the rest of the area to ensure that no plants were missed during previous surveys.

The *S. foliosa* on this site is very robust, so there may be confusion in some cases trying to discern the stunted regrowth of *S. alterniflora* from the native. The monitoring crew will sample any suspicious plants that occur in the footprint of the original infestation and submit them for genetic analysis to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04B: COLLEGE OF MARIN ECOLOGY STUDY AREA

Sub-Area Partners

Owner(s): College of Marin, Marin County Flood Control District
State Lands Commission, and several private parties
Manager(s): Marin County Flood Control District
Grantee(s): Friends of Corte Madera Creek

Sub-Area Description

The College of Marin Ecology Study Area is located near the upper extent of tidal influence in Corte Madera Creek along the left bank west of Creekside Park directly across the creek from the confluence with Tamalpais Creek. This small patch of marsh sits alongside a remnant of the historic Corte Madera Creek channel running from McAllister Avenue down to a culvert that connects the area to tidal exchange under the paved mainstem trail. The site includes a narrow canal running behind the single-family homes on Berens Drive. Marshland in this area is dominated by saltgrass (*Distichlis spicata*) and pickleweed with a muted tidal prism due to aging culverts and diversions.

Spartina densiflora had heavily infested the left bank of the channel west of McAllister Ave. as well as the banks of the flood management canal behind Berens Dr. There was also a cluster of *S. densiflora* at the base of the larger channel just east of the paved recreation trail along Corte Madera Creek. Some digging occurred on this site in 2005, and the first imazapyr application was conducted in 2006 using backpack sprayers. The work along McAllister was very successful, reducing the infestation to just a handful of plants. During the winter of 2006-2007, the downstream portion of the Berens Drainage was controlled manually and the plants were taken offsite for disposal. In 2007, applicators with backpack sprayers walked the canal of the Berens Drainage and applied imazapyr to the dense linear hedge of invasive *Spartina* along the banks.

The historic creek channel along McAllister contains just a handful of remaining *S. densiflora* plants. The dense mature plants along the Berens Drainage have been treated twice and will require a follow-up application. It is estimated that less than 1000 ft^2 remains to be treated on this site in 2008.

Treatment Strategy, Methods, and Timing

Methods: Imazapyr treatment (primary)
Manual removal (follow-up and for any *S. densiflora* seedlings or first year plants)

Equipment: Backpack sprayer
Shovels or similar tools

Timing: Annual treatment until eradicated
Treatment should occur between May 1 and July 15

Applicators will treat the remaining *S. densiflora* plants on this site with imazapyr using backpack sprayers. Several of the original infestation pockets at this site consisted of linear stretches of mature plants at the edge of steep embankments, making manual removal prohibitive. However, any new seedlings or young plants could be pulled or dug where appropriate.

Monitoring Needs

Access is relatively difficult to the various areas of this site, especially with a backpack sprayer weighing the applicator down in soft mud. Detailed maps of the current distribution of non-native *Spartina* at this site must be provided to the treatment crew to determine the areas they need to include in their work. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREAS 04C AND 04D: PIPER PARK EAST & WEST

Sub-Area Partners

Owner(s): City of Larkspur
Manager(s): City of Larkspur
Grantee(s): Friends of Corte Madera Creek Watershed

Sub-Area Description

Piper Park is a 44-acre City of Larkspur Park on the southern bank of Corte Madera Creek north of Doherty Drive. There are two lobes of marsh, referred to as Piper Park East & West, which meet at a point on the creek creating an arrow shape pointing to the northeast. The Piper Park East site includes roughly 11 acres of pickleweed-dominated marsh west of Riviera Circle (Sub-area 04f) along the edge of the channelized lower reach of Larkspur Creek at its confluence with Corte Madera Creek. The Piper Park West site includes roughly 14 acres of pickleweed-dominated high marsh with a group of houses on stilts connected by a boardwalk along the northwestern border on the mainstem creek (refer to Sub-area 04k - Boardwalk Number 1 [Arkites]). Public park facilities including soccer fields, children's play areas, walking paths, ball fields and tennis courts border the upland side of both marshes in this area.

Prior to the initiation of treatment in 2005, *Spartina densiflora* had established a widespread presence at this site. In Piper Park East, the plants were mainly concentrated in the northern tip near the small dock on the creek, and in the southwestern lobe where Larkspur Creek enters from the west before passing through the marsh and out to the channel along Riviera Circle. In Piper Park West, the infestation was represented by scattered clusters distributed throughout the marsh, along the banks of many of the small channels, and up on the marsh plain. The total area of *S. densiflora* on both marsh sub-areas was approximately 0.25 acre.

No herbicide has been used in the treatment of *Spartina* on this site. Instead, each individual plant was dug or pulled depending on its size, and this control work was most conducted over the winter before clapper rail breeding season begins in February. Manual removal began with digging by volunteers from the Marin Rowing Association in 2003 and 2004. A more intensive effort began in 2005, with many large and medium-sized plants dug out and disposed offsite by Marin Conservation Corps crews. In both 2006 & 2007, follow-up digging occurred to eliminate seedlings or plants that had regrowth due to incomplete removal of the roots.

With the prolific growth of *S. densiflora* witnessed in 2007 from the apparently extensive seed bank deposited during the height of the infestation, there continue to be scattered plants found on the marsh plain in both marshes. As expected, they tend to be clustered around the areas that were most heavily infested before treatment began, while the majority of the marsh remains clear. In Piper Park East, the *S. densiflora* is found two locations: in the northern tip and downstream of Doherty Drive along the right bank of Larkspur Creek, while in Piper Park West the remaining plants are along the northwestern border with Boardwalk Number 1. Two patches of hybrid *S. al-*

terniflora have recently been discovered at this site, presumably dispersed from an infestation upstream. Each is located in the northern portion of the marsh close to the mainstem creek at the tip of the upland park, one in the East marsh and one in the West. The total infestation of hybrid *S. alterniflora* is less than 100 ft^2, and the remaining *S. densiflora* less than 50 ft^2.

Treatment Strategy, Methods, and Timing

Methods: Manual removal

Equipment: Shovels or similar tools

Timing: At least annual treatment until eradicated
Treatment should occur between May 1 and July 15

All non-native *Spartina* plants found at Piper Park will be removed manually before they set seed. For the *S. densiflora*, that necessitates entering the site between June 1 and July 15 to perform the control work. The two small patches of hybrid *S. alterniflora* are still newly established and can be removed in the same manner. The site will also be revisited over the winter months, and any invasive *Spartina* removed immediately.

Monitoring Needs

Monitoring will be essential to the completion of the eradication at this site, with the crews walking the entire marsh plain looking for isolated *S. densiflora* seedlings and removing them as they record them with GPS. The slightly larger patches of hybrid *S. alterniflora* will be dug out by a treatment crew, who will also scour the marsh looking for and removing the remaining seedlings or small plants missed previously. In addition, some genetic testing will continue to verify the hybrid status of any plants suspected of being hybrid *S. alterniflora*. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04E: LARKSPUR FERRY TERMINAL

Sub-Area Partners

Owner(s): Golden Gate Bridge, Highway, and Transportation District
State Lands Commission
City of Larkspur
Manager(s): Golden Gate Bridge, Highway, and Transportation District
Grantee(s): Friends of Corte Madera Creek

Sub-Area Description

The Larkspur Ferry Terminal is located on the north side of the mouth of Corte Madera Creek along Sir Francis Drake Boulevard in the City of Larkspur. A small channel cove was excavated north of the creek mouth in the 1970's to provide a space for ferries to and from San Francisco to dock. There is limited fringe marsh habitat in this area of rip-rap and fill along the steep sided embankments surrounding the ferry dock.

Prior to the initiation of treatment at this site, the infestation of *S. densiflora* had become well established in two distinct areas associated with the Ferry Terminal. The entire shoreline of the channel cove north of the docks was infested, scattered in some stretches but forming a dense hedge of mature plants over the majority. The second area of concentration was behind a seawall adjacent to the statue of Sir Francis Drake just west of Remillard Park. This area contained a dense linear infestation of both *S. densiflora* and hybrid *S. alterniflora* thriving behind the protection of the seawall. In addition, there were scattered infestations in the Wood Island drainage west of the Ferry Terminal as well as in an unnamed channel to the north of the lower mainstem that serves as a drainage from the Bon Air Shopping Center.

A portion of this site, the shoreline of the channel cove, was treated with imazapyr in 2005 by backpack sprayers, and this eliminated most of the mature *S. densiflora* plants in this area. Any regrowth in this area was retreated in 2006 using the same method, and the area behind the seawall received its first treatment. In 2007 it was first observed that although most of the mature *S. densiflora* plants appeared dead, upon closer inspection a small percentage of stems remained green, usually less than 5%. This has been interpreted to indicate that these plants were still marginally alive, so the plants around the cove were dug up and the area behind the seawall was targeted during the backpack sprayer application of imazapyr in summer 2007, concentrating treatment on the base of the plant since these unhealthy plants may not translocate the herbicide well. Manual removal was used in both the Wood Island drainage channel as well as the Bon Air Shopping Center drainage.

The *S. densiflora* infestation has been eliminated from the western side of the channel cove by the ferry docks, but numerous plants with a small percentage of regrowth are still present on the eastern half. A few hybrid *S. alterniflora* have recently colonized the site but are still very small. The area behind the seawall contains many plants that have a small percentage of green growth, and several hybrid *S. alterniflora* that have been greatly reduced by treatment. The *S. densiflora* has been eliminated from the Wood Island and Bon Air Shopping Center drainages by manual removal. The total infestation of hybrid *S. alterniflora* is less than 500 ft^2, and the remaining *S. densiflora* less than 50 ft^2 spread over the separate shoreline areas of this site.

Treatment Strategy, Methods, and Timing

Methods:	Imazapyr treatment (primary) Manual removal (follow-up and for any *S. densiflora* seedlings in appropriate substrate)
Equipment:	Backpack sprayer Shovels or similar tools
Timing:	Annual until eradicated Treatment should occur between May 1 and July 15

Due to the difficult rip-rap substrate that many of the invasive *Spartina* plants are rooted in on this site, an imazapyr application is still an appropriate method to continue moving this site towards eradication. Applicators will use backpack sprayers to treat the remaining plants on this site in 2008. Seedlings or small first year plants growing in softer substrate can be pulled or dug since they tend to respond less to herbicide, probably because they don't have sufficient leaf surface area to translocate enough chemical down to the roots to kill the plant. It is important to treat this site early in the season to ensure that no *S. densiflora* seed is produced and dispersed.

Monitoring Needs

With the addition of hybrid *S. alterniflora* to this site in recent years, there may be issues distinguishing the invasive from the native when it is growing in this low quality habitat and does not reach its normal stature. Any regrowth from less effective treatment can also stunt the plants, altering their appearance. Genetic testing will be required in either of these cases to inform the treatment crews. *Spartina* has been largely eliminated from some of the remote channels in this sub-area, such as the Wood Island drainage behind the Ferry Terminal and the channel that drains the Bon Air Shopping Center, but they were areas with prolific seedling recruitment that must continue to be checked to maintain the eradication. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04F: RIVIERA CIRCLE (LARKSPUR MARINA)

Sub-Area Partners

Owner(s):	State Lands Commission Numerous adjacent residential parcels owners
Manager(s):	Marin County Flood Control District, City of Larkspur
Grantee(s):	Friends of Corte Madera Creek

Sub-Area Description

Riviera Circle (now known as Larkspur Marina) is a housing development constructed on rip-rap and fill north of Doherty Drive along the south side of Corte Madera Creek in the City of Larkspur, west of Hwy 101 and the residences on Lucky Drive. This community is bordered by water on three sides: the north side sits on the mainstem of Corte Madera Creek while the west side sits on the channelized lower reaches of Larkspur Creek. The east side is along a Town of Corte Madera flood management channel connected to the High Canal. The banks of this area are generally steeply graded to raise the homes above the historic marsh elevation that they were built on. A thin perimeter band of mixed marsh vegetation consisting of pickleweed, alkali heath (*Frankenia salina*) and gumplant (*Grindelia stricta*) is bordered directly by the yards, docks, and gardens of these residential properties. There is an irregularly-shaped salt water lagoon in the center of the development, connected to Larkspur Creek and the main channel by culverts.

Almost every one of the more than 80 residential properties around Riviera Circle was infested with *S. densiflora* prior to the initiation of treatment in 2006. Many of the waterfronts contained a solid hedge of the non-native cordgrass across the entire frontage near the top of the rip-rap just below the mean high tide line, while others still

consisted of scattered plants. The total infestation on the site was approximately two acres representing the majority of the thin strip of marsh vegetation available.

While several property owners opted to have their plants manually removed, Riviera Circle was first treated with imazapyr in 2006, using an airboat to access the shoreline. The applicators hauled hose from the airboat up to the target vegetation, treated 2-3 adjoining lots from a central dock, and then moved systematically down the shoreline to the next application point. When surveyed the following year, this work was found to be very effective, but similar to other sub-areas of this plan, many *S. densiflora* plants showed a small percentage of green stems surrounded by dead plant material. In 2007, the treatment crew returned to the site with the airboat and retreated the crown of any *Spartina* plant with green growth observed on the shoreline, and Friends followed up in winter 2007-2008 with additional digging at several parcels and some replanting with native marsh vegetation. It should be noted that a number of parcels have still not been treated because Friends had not yet received their signed permission slips.

The infestation on this site has been reduced by 85-90% after two seasons of treatment combining manual removal with herbicide application. There is a small percentage of regrowth within the mature plants that used to thrive on this shoreline, as well as some seedling recruitment from the seed bank in the sediment. A handful of properties have not been treated, but Friends and the ISP are working with the State Lands Commission, City of Larkspur, and the adjacent private property owners to resolve these issues in 2008. Approximately 1000 ft^2 of *Spartina densiflora* remains on the site.

Treatment Strategy, Methods, and Timing

Methods:	Imazapyr treatment (primary) Manual removal (follow-up and for any *S. densiflora* seedlings in appropriate substrate)
Equipment:	Airboat (primary) Backpack sprayer (potentially for follow-up) Shovels or similar tools
Timing:	Annual treatment until eradicated Treatment should occur between May 1 and July 15

An Integrated Vegetation Management (IVM) strategy will continue to be used at Riviera Circle combining manual removal and spot treatment with imazapyr where appropriate. An airboat or shallow-bottom outboard will continue to be used to access the shoreline in 2008. Any healthy green regrowth can be treated with herbicide and allowed to translocate down into the roots to kill the plant. Seedlings and small, first-year plants will often be pulled since they tend to show low efficacy from the imazapyr treatment. The residential property owners contiguous to portions of the infestation that have not yet been addressed will have the choice between these two methods. If herbicide applications are required in future years when the infestation has been reduced to the final patches, applicators may arrange to access the shoreline by ground through the associated residential parcel.

Monitoring Needs

Monitoring data should be used to reduce the mobilization effort required of the treatment crew. If current *Spartina* distribution data is provided to them, they won't have to take the airboat into shore to check each frontage for the remaining live plants. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04G: CREEKSIDE PARK

Sub-Area Partners

Owner(s):	Marin County Parks
Manager(s):	Marin County Parks
Grantee(s):	Friends of Corte Madera Creek

Sub-Area Description

Creekside Park contains 21 acres of restored marshland habitat in Kentfield north of Corte Madera Creek west of Bon Air Road and Marin General Hospital near the upstream extent of tidal influence in this watershed. The site received dredge spoils from the creek in the late 1960's when the US Army Corps of Engineers constructed Units 1 and 2 of the Core Madera Creek Flood Control Project. In 1976 a new channel system was excavated, upland

areas were graded to intertidal elevations, central islands were constructed to provide upland refugia, and the site was planted with cordgrass and pickleweed. Creekside Park is a multi-use property, with playground and upland park areas to the east of the main marsh, and a paved trail along the southern border adjacent to the mainstem of the creek. A narrow lobe of marsh runs southeast from the central site, sandwiched between the creek and Bon Air Road down to the bridge.

The infestation at Creekside Park dates back more than 30 years to the early marsh restoration efforts of the 1970's. A first round of marsh plantings failed to germinate on the newly graded site, so in 1977 seeds of *S. densiflora* from heavily invaded Humboldt Bay, CA were introduced, as well as *S. anglica* from England. The infestation of *S. densiflora* was well established in Humboldt Bay having been introduced in the mid-19th century in ship ballast from South America. Hence it apparently was mistakenly identified as a form of the native *S. foliosa* because it was so prevalent. The other introduction, *S. anglica*, is often referred to as the most invasive species of cordgrass in the world, itself a hybrid between *S. alterniflora* and *S. maritima* that eventually gave rise to a new species. Creekside Park remains the only confirmed location of this species in the San Francisco Estuary, probably since it is at the southern extent of its range, while *S. densiflora* dispersed throughout the watershed and to other marshes in Marin and Contra Costa Counties. In 1979, Royston, Hanamoto, Beck and Abbey, the landscape architects responsible for the project, were given an Award of Excellence by the American Society of Landscape Architects for the restoration plan.

Over the years, *S. densiflora* had come to dominate the marsh at Creekside Park, lining the banks of the channels and forming continuous meadow stands across the marsh plain that totaled approximately 3.5 acres by 2005. On the other hand, the *S. anglica* had changed little in that time, remaining a small patch north of the footbridge by the paved trail. More recently, hybrid *S. alterniflora* from a nearby infestation on the mainstem has established some patches in the northern portion of the site and along the main channel in the south.

This site was first treated with imazapyr in 2006 with a crew of applicators walking the entire marsh with backpack sprayers. The results from this first application were difficult to interpret because although the vast majority of the *S. densiflora* appeared dead, upon closer inspection most had 5-10% green stems amongst the otherwise dead plant material. In 2007 the site was evaluated and a new strategy was developed to adaptively manage the infestation. The continuous meadow areas and channel banks were retreated with imazapyr, again using backpack sprayers to apply the herbicide to any green growth within the previously treated plants. Along the elevation transition areas on the eastern side of the marsh, crews dug out the scattered individuals focusing particularly on the small plants that may not respond as well to the herbicide. As mentioned previously in this site-specific plan, 2007 was a year of prolific seedling recruitment for this species; consequently these plants were either pulled in the eastern edge area where manual control was applied, or the applicators treated these young plants alongside the dying mature ones.

The infestation at Creekside Park has been reduced by at least 80% after two years of intensive treatment. The above-ground biomass of the *S. densiflora* is very persistent even when dead, and much of it is still visible across the site. Areas that were once small meadows of invasive cordgrass now have minimal green *S. densiflora* growth and did not flower or set seed in 2007. If the green stems that were retreated in 2007 were healthy enough to translocate the herbicide, then it is anticipated that only a small percentage of the site will need retreatment. However if the plants were not healthy enough to be affected by the treatment, then they should be in better shape this year to respond. Due to these uncertainties, the range of potential retreatment for 2008 is between 0.25-0.75 acre. The original infestation of *S. anglica* has been reduced significantly, but two small patches have cropped up in other areas of the site (one in the far southern end, and the second west of the playground in the north). Adjacent to this new northern patch of *S. anglica* are two clusters of hybrid *S. alterniflora* that are new to the site. The remaining area of these two additional species of invasive cordgrass represent less than 1000 ft^2 at Creekside Park.

Treatment Strategy, Methods, and Timing

Methods:	Imazapyr treatment (primary for established plants) Manual removal (primary and follow-up for any *S. densiflora* seedlings or small plants)
Equipment:	Backpack sprayer Shovels or similar tools
Timing:	Annual treatment until eradicated Treatment should occur between May 1 and August 1

The strategy adopted in 2007 for Creekside Park will continue to be implemented in 2008. A crew will survey the site and manually remove any live seedlings or small plants and dispose of them offsite. A second crew will follow-up by walking the areas of continuous *S. densiflora* infestation and along the major channels and apply imazapyr with backpack sprayers to any living non-native *Spartina* that was not previously removed. Both *S. anglica* and hybrid *S. alterniflora* will also receive a follow-up herbicide application in 2008, but may be manually removed thereafter once their coverage has been sufficiently reduced to lessen the impacts of digging.

Monitoring Needs

Monitoring will have several very important roles in completing the eradication at Creekside Park. A monitoring crew can take the time to look at the individual *S. densiflora* plants and determine if they are still alive (with a percentage of green above-ground growth) and therefore need treatment. This level of survey is beyond the scope of the treatment crews, which should focus their primary attention on completing the control work in the narrow window provided by the tides and afternoon winds. Detailed maps of the current distribution of non-native *Spartina* on the site will be provided to them to assist in this effort.

The second vital aspect of monitoring at this site is genetic testing, with three species of non-native cordgrass and also potential hybrids of *S. densiflora* and the native *S. foliosa*. Samples of suspect plants will be submitted for genetic analysis, and the data will be available for the treatment crews. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREAS 04H, 04I, 04J: CORTE MADERA CREEK (UPPER, LOWER, & MOUTH)

Sub-Area Partners

Owner(s):	State Lands Commission
	Marin County Parks & Open Space
	City of Larkspur
Manager(s):	Marin County Parks and Open Space
Grantee(s):	Friends of Corte Madera Creek

Sub-Area Description

This plan combines the three sub-areas 04h, 4i, and 04j that represent the three tidal reaches of Corte Madera Creek (upper, lower and mouth, respectively) and includes roughly 40 acres of marsh habitat. These three stretches of the creek have been combined in this site plan because they share most of the pertinent characteristics including habitat types, the distribution of the infestation, access and timing issues, and treatment strategy. Sub-area 04h represents the upper reach from the College of Marin downstream to the Bon Air Road bridge, and includes the short section of an unnamed tributary that drains marshes near Lot 13 (College of Marin parking). Sub-area 04i represents the lower reach from Bon Air Rd. downstream to the Hwy. 101 bridge over the creek, adjacent to the Marin Rowing Association dock. Finally, Sub-area 04j encompasses the mouth of Corte Madera Creek from Hwy. 101 downstream to San Francisco Bay. The shoreline adjacent to the creek is mostly in the City of Larkspur, but also includes the City of Kentfield on the north side upstream of Bon Air Rd.

The banks of the creek are armored in many places to contain high tides and storm flows, but many stretches have a narrow strip of marsh vegetation below the rip-rap, mostly pickleweed and *S. foliosa*, and a mudflat component. Much of the upper reach has an open space character, with Creekside Park (Sub-area 04g) and the College of Marin Ecology Study Area (Sub-area 04b) along the north bank, a small marsh to the south downstream of the confluence with the Lot 13 drainage, and the backyards of the houses on the south bank set back from the creek on the other side of the Marin County Flood Control District's gravel maintenance road above the rip-rap. The upper reach also includes the 300-meter channel of the Lot 13 drainage, the extent of its tidally influenced waters. A second shorter channel joins the first at the footbridge behind Lot 13 at the College of Marin, and there are associated marsh areas here as well as at the confluence with Corte Madera Creek.

The lower reach downstream of Bon Air Rd. contains the highest level of development contiguous to the creek, consisting mainly of single-family houses and condominiums, many with docks to provide recreational access to the water. There are also several small office parks along the shoreline for medical doctors and other professionals. Under the Hwy. 101 bridge and interchange ramps there is a small mid-elevation marsh section on the north bank and some mudflats on the south. The shoreline along the mouth reach downstream of Hwy. 101 contains a few commercial properties, the Greenbrae Boardwalk community of houses on stilts above the south bank border-

ing the Corte Madera Marsh Ecological Reserve (Sub-area 04a), and a 7.5-acre island of marsh behind the Larkspur Ferry Terminal (Sub-area 04e).

Since its introduction at Creekside Park in 1977, *Spartina densiflora* had come to dominate many of the strips of marsh along the Corte Madera Creek channel. Wider areas at the appropriate mid to high marsh elevation for this species contained clusters of this large bunchgrass, while if only a narrow strip of appropriate habitat was available (e.g. along residential frontages) the invasive cordgrass formed a thick hedge. When other suitable habitat was available beyond the mainstem creek banks, *S. densiflora* was most often in the process of colonization.

In the upper reaches, the small pickleweed marsh around Lot 13 had been invaded as had the point at the confluence with Corte Madera Creek and the marsh just downstream south of the mainstem and west of Harvard Drive. There were dense linear infestations of *S. densiflora* on both banks stretching from upstream of Creekside Park down to Bon Air Rd. Downstream of Bon Air Rd. on the south bank is a 40 meter-deep stretch of saltgrass (*Distichlis spicata*), mudflat and mixed marsh that extends 350 meters downstream. This area contained a 1-3 meter-thick linear infestation along the water's edge and scattered clusters of *S. densiflora* over the remainder. On the north bank of this lower reach, there was a relatively continuous infestation of *S. densiflora* plants along the shoreline of the offices, condominiums, and small parks on South Eliseo Drive. The infestation continued at a lower level in the wider marsh strip across from Riviera Circle (Sub-area 04f), around the point where Friends of Corte Madera Creek Watershed attempted to establish a native marsh plant demonstration garden, and up into the cove of Niven Park. Several large *S. densiflora* plants were discovered along the steep banks of the High Canal in 2007 and were removed manually. In the area of the Hwy. 101 bridge and interchange, the marsh on the north had become heavily infested, as had the previously unvegetated mudflats on the south bank. In the mouth reach of the creek, the island behind the Ferry Terminal was heavily infested, and there were some scattered plants under the houses of the Greenbrae Boardwalk on the south bank.

Hybrid *S. alterniflora* had only a small presence along the mainstem of Corte Madera Creek. The worst infestation was on the island at the mouth behind the ferry, and this expanded rapidly in the absence of treatment until 2007. Two other notable areas for hybrid *Spartina* include the far upstream extent of the site in the marsh adjacent to Lot 13 at the College of Marin, as well as several clones adjacent to Creekside Park.

Control work has followed an Integrated Vegetation Management (IVM) strategy from the beginning, incorporating spot applications of imazapyr with extensive manual removal (which also extended the treatment season because it could be conducted in winter). Treatment along Corte Madera Creek began in 2006, although a late season application was conducted on a small portion of the infestation at the mouth in 2005 with little efficacy due to senescent plants. Imazapyr was applied in the upper reaches from a truck-mounted sprayer stationed on the recreational trail and maintenance road alongside the creek, while backpack sprayers were used on the lower reaches and mouth, with a section of mudflat under Hwy. 101 accessed by boat. In 2007, imazapyr was applied by truck-mounted sprayer to retreat both banks upstream of Bon Air Rd. up to and including the tributary by Lot 13 (College of Marin), as well as the island behind the Larkspur Ferry Terminal at the mouth. Digging was employed on the remainder of the upper reach to the concrete culvert, on the heavily infested south bank downstream of Bon Air Rd. where many seedlings were removed, and on a few scattered plants on the banks along the Greenbrae Boardwalk.

The combination of digging and imazapyr has reduced the infestation significantly along the banks of Corte Madera Creek. As seen elsewhere in the watershed, areas that previously contained established stands of mature *S. densiflora* plants tended to have a small percentage of green stems amongst the dead plant material, which makes it difficult to conclusively determine efficacy. In the lower reaches below Bon Air Rd. the infestation in the wetland along the south bank has been almost eliminated through digging in 2007, while the north bank was not treated in 2007 and continues to have clusters of invasive cordgrass (although greatly diminished from the original infestation levels). At the Hwy. 101 interchange area there are small areas of both hybrid *S. alterniflora* and *S. densiflora* on the banks. The island behind the ferry terminal had seen a rapid expansion of both hybrid *S. alterniflora* and *S. densiflora*, and it is anticipated that there will be a good degree of follow-up required there in 2008. In addition, several suspected *S. anglica* plants were found outside of Creekside Park in 2007, so genetic testing will be used to inform treatment. There is an estimated 0.75-1.25 acres of invasive *Spartina* left on this site complex along the creek.

Treatment Strategy, Methods, and Timing

Methods: Imazapyr treatment (primary for established plants)
Manual removal (primary and follow-up for any *S. densiflora* seedlings or small plants)

Equipment: Truck-mounted sprayer
Backpack sprayer
Shovels or similar tools

Timing: Annual treatment until eradicated
Treatment should occur between May 1 and August 15

The current IVM strategy will continue along Corte Madera Creek, using extensive digging of seedlings and small plants, as well as larger individuals in appropriate substrates. Imazapyr will be used on regrowth in the previously large stands, such as the banks in the upper reaches and on the island behind the ferry terminal.

Monitoring Needs

With approximately six miles of creek banks within this site, and the deceptive appearance of some *S. densiflora* in response to the herbicide treatments, it will be essential for treatment crews to have accurate maps of the current distribution of *Spartina* to plan the work and to reduce their search time. There are also some questions regarding possible *S. anglica* found outside of Creekside Park for the first time. Genetic testing will be used to investigate these observations and inform treatment. *Spartina* has been eliminated from some of the remote channels along the creek, such as the Wood Island drainage behind the Ferry Terminal and the channel that drains the Bon Air shopping center. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04K: BOARDWALK NUMBER ONE (ARKITES)

Sub-Area Partners

Owner(s): State Lands Commission, and numerous adjacent residential parcels
Manager(s): Marin County Flood Control District, City of Larkspur
Grantee(s): Friends of Corte Madera Creek

Sub-Area Description

Boardwalk Number One (also known as Arkites) is a community of homes on stilts (former houseboats) directly over the mudflat and pickleweed marsh of the south banks of Corte Madera Creek in the City of Larkspur bordered to the east by Piper Park West (Sub-area 04d). The homes and connecting boardwalk line the east bank of a narrow channel stretching 400 meters north from Doherty Drive to the mainstem, and continue another 300 meters along the south bank of Corte Madera Creek.

The *S. densiflora* at this site is found at the transition zone between the pickleweed marsh and the creek banks, as well as between (and sometimes under) the houses on the mid-marsh plain. Prior to the initiation of treatment, the majority of the houses in the stretch along the mainstem were infested, while only about 30% of the houses on the side channel had *S. densiflora*. The site was first treated with imazapyr in 2006, with a crew of applicators with backpack sprayers walking around each house and along the boardwalk searching for and treating the invasive cordgrass. There were many mature plants, and a few clusters, but the site was still in the relatively early stages of invasion and there weren't solid linear hedges or small meadows. Boardwalk Number One was retreated with imazapyr in 2007, again using a crew with backpack sprayers.

A few homeowners requested digging of the sprayed, but not dead, plants. This was done in 2006 and 2007 while control work was being conducted in Piper Park West.

This site has been treated twice and should be down to just a handful of scattered plants. One property at the east end of the boardwalk has not yet been treated due to access permission issues. It is estimated that less than 500 ft^2 of *S. densiflora* remains along the Boardwalk Number One site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary for established plants)
Manual removal (primary and follow-up for any *S. densiflora* seedlings or small plants)

Equipment: Backpack sprayer
Shovels or similar tools

Timing: Annual until eradicated
Treatment should occur between May 1 and August 15

Since the *S. densiflora* plants at this site are right up against the houses, residents continue to have the choice of treatment method used by the contractor, either an application of imazapyr or digging and removing the invasive cordgrass. Manual removal will be the method of choice for all seedlings and small plants.

Monitoring Needs

Inventory monitoring of this site must be conducted by ground as opposed to conducting it from a boat along the shore. Many of the plants are hidden from view under the houses or behind stilts or boardwalk posts. A shoreline assessment greatly underestimates the size of this infestation. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 04L: MURPHY CREEK

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): Marin County Flood Control District
Grantee(s): Friends of Corte Madera Creek

Sub-Area Description

Murphy Creek is a small tributary of Corte Madera Creek in the City of Kentfield west of the College of Marin and upstream of the rest of the sub-areas of this site-specific plan. This plan refers to the 150-meter section of Murphy Creek that flows behind a small apartment building on Kent Avenue, west of the intersection with Stadium Way. The creek in this area contains mostly freshwater vegetation, and has a high percentage of canopy closure from the trees preserved on both banks. The surrounding landscape is fully developed, with homes, apartments, and the large Lot 15 (College of Marin parking) that increases the impervious surface and resultant runoff to the creek. This streambed is very silty and there is vegetation encroaching from the banks towards the center of the channel.

It was a surprise to discover *S. densiflora* in this small creek, well upstream of any prior infestations and where the vegetation is characterized by freshwater plants. Prior to treatment the invasive cordgrass had colonized both the banks as well the silty streambed itself. The *S. densiflora* was quite prevalent along this 150-meter stretch. Crews dug out all of the plants in 2006, but surveys in 2007 found that the site needed retreatment. This was probably due to incomplete removal of the root mass, in addition to the prolific recruitment of *S. densiflora* from the seed bank that was experienced around Marin County in 2007. The crew returned to the site in 2007 and removed all of the remaining plants.

S. densiflora has almost been eliminated from this site. If surveys do find any plants remaining, the estimated area is less than 100 ft^2.

Treatment Strategy, Methods, and Timing

Method: Manual removal (primary)

Equipment: Shovels or similar tools

Timing: Annual until eradicated
Treatment should occur between May 1 and August 15

Any remaining digging on this site should be conducted before flowering and/or seed set to ensure that no dispersal can occur to reinfest Corte Madera Creek downstream.

Monitoring Needs

Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached. It is possible that control of a handful of small plants could simply be conducted during a monitoring event.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Corte Madera Creek Complex, Marin County, TSN: ISP-2004-04, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original 11 sub-areas defined in the 2005 plan are included in this update, and one new sub-area has been added. The new sub-area is contiguous with the existing sub-areas, and is extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-area, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 05: COYOTE CREEK & MOWRY SLOUGH COMPLEX, ALAMEDA AND SANTA CLARA COUNTIES

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Coyote Creek & Mowry Slough Complex, Alameda and Santa Clara Counties, TSN: ISP-2004-05, 2005-2007 Control Seasons) dated May 2005. All six sub-areas defined in the 2005 plan are included in this update, and one new sub-area has been added. No new species or other significant environmental factors have been identified within the site. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The *Spartina* control work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partners. The grant recipients for this site are:

US Fish and Wildlife Service, Don Edwards National Wildlife Refuge, 1 Marshland Road, Fremont, CA, 94605*; Joy Albertson, (510) 790-0222 x 31, joy_albertson@fws.gov*. The Don Edwards San Francisco Bay National Wildlife Refuge (DENWR) owns and manages all but one of the sites encompassed by this Site-Specific Plan. In 2003 they acquired more than 15,000 acres of diked 'salt ponds' in the South Bay that are slated for restoration in the coming years. Several of these ponds (part of the Alviso group) are directly adjacent to the already invaded tidal marshes covered by this plan and therefore are at risk of future invasion themselves.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement the *Spartina* Control Plan on Sub-area 05g (Cargill Pond – W Hotel) within this complex.

Site Description

Map Site 05: Coyote Creek and Mowry Slough Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

05a	Mowry Marsh-Newark Slough to Calaveras Point Map	05d	LaRiviere Marsh Map
05b	Dumbarton/Audubon Map	05e	Mayhew's Landing Map
05c	Newark Slough Map	05f	Coyote Creek- Alameda County Map
		05g*	Cargill Pond (W Suites Hotel) Map

* Sub-area added since the 2005-2007 *Spartina* control plan

The Coyote Creek and Mowry Slough site complex includes approximately 3,700 acres of marshland in the southeast corner of the bay within the Don Edwards San Francisco Bay National Wildlife Refuge extending from the Dumbarton Bridge south to Coyote Creek adjacent to the cities of Newark and Fremont. The site is surrounded entirely by marsh and salt ponds, and there is no public access to the outer marshes. A portion of the Bay Trail runs along the upstream reach of Newark Slough (Sub-area 05c) and a trail provides recreational access through the western portion of LaRiviere Marsh (Sub-area 05d). This plan delineates seven sub-areas targeted for non-native *Spartina* control including recently restored tidal marshes, freshwater ponds and upland islands, as well as highly diverse historic marsh habitats that include large mid-marsh plains, extensive dendritic channel complexes, high marsh, pans, vast mudflats, thin strips of fringe marsh, larger creek and slough channels, and sandy beach areas.

The pioneering infestation of hybrid *Spartina alterniflora* in the Coyote Creek and Mowry Slough area was still in the early stages of colonization when a coordinated treatment effort began on this complex in 2005. Although the acreage was relatively small, just 25-30 total acres of invasive *Spartina,* it was scattered over the entire marshland complex, with clones distributed throughout the habitat types described above. Some of the channels in Dumbarton and Audubon Marshes contained dense linear infestations in short sections that were expanding to clog these interior waterways. Aerial spot treatment on the outer marshes has been very effective and has reduced the risk to those marshes significantly. Ground-based treatment on the inner marshes has been conducted late in the season

because of clapper rail breeding habitat restrictions, which has resulted in much lower efficacy. Finally, the Cargill Marsh – W Hotel (Sub-area 05g) has not been treated yet due to problems establishing ownership of the site. The total remaining infestation of hybrid *Spartina* on this site complex is approximately five acres, mostly concentrated in the inner marshes that have received ground-based treatment to date.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 05A: MOWRY & CALAVERAS MARSHES

Sub-Area Partners

Owner(s): USFWS
Manager(s): USFWS
Grantee(s): USFWS

Sub-Area Description

The Mowry & Calaveras Marshes site includes 1,080 acres of diverse marshland habitats along the bay shoreline and along the banks of creeks and sloughs. The area begins on the eastern banks of the mouth of Newark Slough, at its confluence with Plummer Creek, and extends two miles southeast along the 500 meter-wide Mowry Marsh to Green Point and the mouth of Mowry Slough. The site continues along 150 meter-wide marshes on both banks of Mowry Slough extending approximately four miles upstream, and also continues south along the thin fringe marsh bayward of salt ponds M1 & M2 that dominate most of this peninsula. At the extensive mudflats of Calaveras Point, the site continues east upstream along the northern shoreline of Coyote Creek for approximately 2.8 miles. The marshes in this area range from thin strips of *Spartina foliosa* and pickleweed (*Sarcocornia pacifica*) marshes between mudflats and salt pond levees, to wide, high-marsh pickleweed habitat along the banks of the larger sloughs.

Hybrid *Spartina* had just begun to colonize this area when treatment began in 2005. Most of this large marsh complex was very lightly infested, with scattered hybrid *S. alterniflora* clones dispersed amongst wide, mid-marsh pickleweed habitat on the shoreline, along the interior channel banks of Mowry Marsh and the north bank of Coyote Creek, and out onto the extensive mudflats of Calaveras Point. A portion of the site was treated with imazapyr in 2005 using ground-based methods such as truck-mounted and backpack sprayers. Since the Biological Opinion was received in September 2005, this work was conducted late in the season this first year and had lower-than-anticipated efficacy. The ground-based work was extremely difficult and time consuming, requiring weeks to access these small scattered infestations over vast areas of shoreline.

In 2006, the ISP and USFWS utilized an innovative new helicopter spot treatment method that had not previously been used in an ecological restoration context. Referred to as the “spray ball”, this application method suspended a PG&E power line ball beneath the helicopter that had been converted into a four-nozzle sprayer capable of spot-treating individual clones without the use of a broadcast boom. This method reduced the amount of herbicide entering the environment, as well as the potential collateral damage to non-target species such as gumplant (*Grindelia stricta*) that is susceptible to imazapyr. When the method was developed, it was not yet known that pickleweed would be largely unimpacted by imazapyr, a welcome surprise that has helped to reduce the impacts to marshes from *Spartina* treatment, and allow them to get on a positive trajectory more rapidly after cordgrass removal.

Imazapyr was applied by spray ball to the hybrid *Spartina* population in the Mowry & Calaveras Marshes in 2006, with the exception of some areas under the power lines that could not be reached due to clearance. Since these aerial treatments could be conducted much earlier than ground-based work, the efficacy was much higher than in 2005. In 2007, the spray ball was again used at this site, retreating approximately 40% of the previous infestation that had some regrowth as well as numerous new small hybrid seedlings that had established on the extensive mudflats at Calaveras Point over the previous year.

Aerial treatment normally produces very high efficacy because of its ability to achieve full coverage with an exact metered dose of imazapyr, and the earlier timing catches the *Spartina* while it is still actively growing and can fully translocate the herbicide. Therefore, it is anticipated that less than one acre will remain on the Mowry and Calaveras Marshes site complex in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Helicopter spot treatment (primary)
Truck-mounted sprayer or backpack sprayer (follow-up under power lines and primary in future years)

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

With the vast acreage of difficult marsh terrain encompassed by this site, an aerial spot application of imazapyr is still the most appropriate treatment method at the Mowry & Calaveras Marshes even with the small amount of *Spartina* remaining. There are two options for helicopter spot treatment, either utilizing the spray ball apparatus or shortening the standard boom used on broadcast applications, and limiting coverage by reducing flight speed and turning on the boom only over the target *Spartina*. Since the spray ball is suspended 100 ft below the helicopter, access is difficult to areas under the power lines that run through the area. For this reason, the spot treatment method of choice may have to be the shortened boom, or there will need to be follow-up treatment using truck-mounted or backpack sprayers to clean up the areas that could not be reached aerially. In future years it is possible that treatment in some accessible areas could be conducted by ground-based methods if the amount of *Spartina* remaining is too small to justify the expense of the helicopter mobilization.

Monitoring Needs

When the infestation was at its apex, individual clones could be easily seen from the helicopter during treatment and targeted. Now there are often just small patches or individual stems where these large clones stood, and they can be difficult to pick out from the air, especially if they are stunted from the previous year's application. Therefore, it will be important to produce detailed maps of the current distribution of invasive *Spartina* on Mowry & Calaveras Marshes to provide to the treatment contractor. In addition, the native *S. foliosa* in the far south bay is very robust with a high culm density, which can make identification of the hybrids difficult, especially from the air. There will need to be an extension of genetic testing in suspect areas to inform treatment, and since there are vast meadows of robust native *Spartina* in this area, the sampling may entail intensive transects to pick out cryptic hybrids in these stands. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05B: DUMBARTON/AUDUBON MARSH

Owner(s): USFWS
Manager(s): USFWS
Grantee(s): USFWS

Sub-Area Description

This site is located south of the Dumbarton Bridge and west of the City of Newark in the Don Edwards San Francisco Bay National Wildlife Refuge, and includes the areas known as Hetch-Hetchy Marsh, Railroad Marsh, Barge Canal and Plummer Creek. The larger Dumbarton and Audubon Marshes are bordered to the northeast by the lower reaches and mouth of Newark Slough. The 860 acres of marshland in this complex include open marsh plains, eroding marsh scarps, open mudflats, dendritic channels, and other habitats. An abandoned rail line bisects the larger portion of this sub-area, and the Hetch-Hetchy Aqueduct runs along the northern edge of these marshes, delivering water to San Francisco from the reservoir north of Yosemite Valley that is fed by the mighty Tuolumne River watershed.

As was the case throughout the Refuge, the Dumbarton/Audubon Marsh complex was only lightly infested when work began in 2005. However this sub-area contained the highest concentration of hybrid *S. alterniflora* in the entire Coyote Creek/Mowry Slough complex, representing more than 50% of the total infestation acreage. The infestation had spread up into the channels of the marsh, especially from the southern side of Audubon Marsh, forming very tall, dense linear infestations. It had also colonized the marsh plain in patches, as well as the native *S. foliosa* fringe on the bayfront. Imazapyr was applied to most of the known infestation in 2005 using truck-mounted and backpack sprayers. This reduced some accessible areas along the bayfront, such as the area where the Hetch-Hetchy Aqueduct dives under the waters of the bay, but efficacy was lower in other areas due to the late treatment and the resiliency of mature established stands.

Imazapyr was applied by spray ball to the entire hybrid *Spartina* population in the Dumbarton/Audubon Marshes in 2006. Since these aerial treatments could be conducted much earlier than ground-based work, the efficacy was much higher than in 2005. In 2007, the spray ball was again used at this site, retreating approximately 30% of the previous infestation as well as several new small hybrid patches that had established on the marsh plain over the previous year. Several areas in Dumbarton Marsh north of the HetchHetchy Aqueduct could not be reached with the spray ball because of power line clearance issues, and they are also filled with cryptic hybrids that need to be sorted out through genetic testing.

The majority of remaining hybrid *Spartina* on this site is located in the deep channels of Audubon Marsh that had such dense infestations of very large plants. The combination of the size of the plants and the low marsh elevation makes these *Spartina* plants more difficult to fully eliminate, and the depth of the channels may limit complete coverage in some cases. The stands of cryptic hybrid under the power lines in Dumbarton Marsh are also still present, and there are scattered linear stands of hybrid *Spartina* on the thin strips of marsh along Plummer Creek as far as 1.7 miles upstream, but fortunately none has been found in the Plummer Creek Mitigation Marsh. Since it is common for aerial treatment to produce very high efficacy, and most of this marsh complex has been treated twice by spray ball, it is anticipated that less than two acres will remain on this site in 2008.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr application
Equipment:	Helicopter spot treatment (primary) Truck-mounted sprayer or backpack sprayer (under the power lines and for follow-up in future years)
Timing:	Treatment should occur between July 15 and September 15 Annual beginning in 2008 until eradicated

With the vast distances to cover, and the scattered nature of the infestation in these difficult habitats, an imazapyr application is still the most appropriate method of treatment in this complex. The helicopter spot imazapyr treatment of hybrid *Spartina* at these marshes will be combined with the treatment of Mowry & Calaveras Marshes (Sub-area 05a) and can be conducted from the same staging area for cost efficiency. There are two options for helicopter spot treatment, either utilizing the spray ball apparatus or shortening the standard boom used on broadcast applications, and limiting coverage by reducing flight speed and turning on the boom only over the target *Spartina*. Since the spray ball is suspended 100 ft below the helicopter, access is difficult to areas under the power lines that run through the area. For this reason, the spot treatment method of choice may have to be the shortened boom, or there will need to be follow-up treatment using truck-mounted or backpack sprayers to clean up the areas that could not be reached aerially. Unlike most of the sites in this control plan, the power line area of Dumbarton Marsh is easily accessible by levee roads that could be used to stage a truck for ground-based work. In future years it is possible that treatment in some accessible areas could be conducted by ground-based methods if the amount of *Spartina* remaining is too small to justify the expense of the helicopter mobilization.

Monitoring Needs

When the infestation was at its apex, individual clones could be easily seen from the helicopter during treatment and targeted. Now there are often just small patches or individual stems where these large clones stood, and they can be difficult to pick out from the air, especially if they are stunted from the previous year's application. Therefore, it will be important to produce detailed maps of the current distribution of invasive *Spartina* on Dumbarton/Audubon Marshes to provide to the treatment contractor. In addition, the native *S. foliosa* in the far south bay is very robust with a high culm density, which can make identification of the hybrids difficult, especially from the air. There will need to be an extension of genetic testing in suspect areas to inform treatment, and since there are vast meadows of robust native *Spartina* in this area, the sampling may entail intensive transects to pick out cryptic hybrids in these stands. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05C: NEWARK SLOUGH

Sub-Area Partners

Owner(s):	USFWS
Manager(s):	USFWS

Grantee(s): USFWS

Sub-Area Description

The Newark Slough site encompasses roughly 400 acres of marsh and creek channel bank stretching from Thornton Avenue and Hickory Street in the City of Newark, downstream to the edge of the abandoned railroad line, 900 meters upstream of the confluence with Plummer Creek. In its upstream reach, the wide, levee-bound slough winds sinuously through the Don Edwards San Francisco Bay National Wildlife Refuge, skirting the southwest edge of the large hillside that the Refuge headquarters sits atop, along Marshlands Road just south of the Hwy. 84 approach to the Dumbarton Bridge, and past some decommissioned salt ponds. At the point where it crosses the Hetch-Hetchy Aqueduct, the levees stop and it traverses Dumbarton and Audubon Marshes as a more naturally meandering channel before flowing out to the bay. The fringing marsh upstream of the Refuge headquarters is very wide on the north side of the channel, and contains an extremely high density of gumplant (*Grindelia stricta*) that dominates large areas of the pickleweed marsh plain. Fringing channel bank marsh habitat borders the waters of the channel along the remainder of its length, often dropping off steeply at the channel's edge. A public trail provides recreational access to the upper portion of the slough from the Refuge headquarters, but the lower reaches are closed to the public.

Prior to the initiation of treatment in 2005, this site was moderately infested with hybrid *S. alterniflora* in clusters of clonal patches in discrete nodes along the banks and in some areas down onto the unvegetated mud below. The infestation had not yet colonized the marsh plain and was still confined largely to the channel corridor, but much of the length of the slough had been colonized. The site was treated with imazapyr in 2005 and 2006 using a truck-mounted sprayer in places where the infestation could be accessed from the levees along the slough, with the applicators hauling hose down to the marsh. However the treatment at this site was conducted late in the season in both years, and the result was lower efficacy, and the plants were allowed to produce seed and disperse the infestation. With the public trail closed for repairs in 2007, the remaining infestation was treated using the spray ball apparatus, greatly reducing the time needed for the application.

Treatment has reduced most of the clusters of hybrid *Spartina* to lower density linear patches, and eliminated many of the individual points. Since 2007 was the first year of treatment that was able to be conducted at the optimal timing when the plants were actively growing and had not set seed, there are still numerous scattered hybrid *Spartina* patches along the length of the slough, and there has been some expansion due to late treatment in previous years. Several small side channels west of the Refuge headquarters and south of Hwy. 84 were surveyed for the first time in 2007 and found to have patches of hybrids. There remains approximately two acres of hybrid *Spartina* along Newark Slough to be controlled.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr application
Equipment:	Helicopter boom and/or spot treatment (primary) Truck-mounted sprayer or backpack sprayer (follow-up)
Timing:	Treatment should occur between July 15 and September 15 Annual beginning in 2008 until eradicated

Imazapyr will be applied to the remaining infestation along Newark Slough utilizing a helicopter boom sprayer or spot treatment technology focused on the target hybrid *Spartina*. The efficiency of this method will allow the application to be conducted at the infestation points along the entire length of the slough within the narrow low tide window needed for high efficacy. USFWS will close the section of trail in this area to the public during the application. There are two options for helicopter spot treatment, either utilizing the spray ball apparatus or shortening the standard boom used on broadcast applications, and limiting coverage by reducing flight speed and turning on the boom only over the target *Spartina*. Ground-based methods should be used to follow-up the early season aerial application since there is decent access to this area along the levees. Any obvious misses from the aerial treatment can be treated in the same season rather than waiting an entire year to catch up with them after they have the opportunity to expand. In future years, treatment will be conducted by ground-based methods once the amount of *Spartina* remaining is too small to justify the expense of the helicopter mobilization.

Monitoring Needs

Now that the hybrid *Spartina* has been reduced to smaller patches or individual stems where the large clones once stood, they can be difficult to pick out from the air, especially if they are stunted from the previous year's application. Therefore, it will be important to produce detailed maps of the current distribution of invasive *Spartina* along Newark Slough to provide to the treatment contractor. In addition, the native *S. foliosa* in the far south bay is very robust with a high culm density, which can make identification of the hybrids difficult, especially from the air. There will need to be an extension of genetic testing in suspect areas to inform treatment, and since there are vast meadows of robust native *Spartina* in this area, the sampling may entail intensive transects to pick out cryptic hybrids in these stands. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05D: LARIVIERE MARSH

Sub-Area Partners

Owner(s): USFWS
Manager(s): USFWS
Grantee(s): USFWS

Sub-Area Description

LaRiviere Marsh is a 118-acre muted tidal marsh that was restored from a salt crystallization pond in the 1980's. It is located south of the toll plaza for the Dumbarton Bridge (Hwy. 84) between Thornton Avenue and Marshlands Road at the base of the hill where the headquarters of the Don Edwards San Francisco Bay National Wildlife Refuge is located. An unpaved levee with a recreational trail runs roughly north-south through the western portion of the marsh. There are still a number of other levees and various features that hearken back to the days of its use for salt production, including a narrow canal bordered by dikes that now has thin strips of marsh vegetation on either bank. Large areas of the marsh are dominated by alkali bulrush (*Bolboschoenus maritimus*), characteristic of the brackish conditions of this muted site. Other types of marsh habitat that have developed in this marsh include open mudflat and pans, pickleweed and *S. foliosa* marsh, and gumplant (*Grindelia stricta*) along well-drained channel edges that are punctuated with small upland islands leftover from before the restoration. The marsh is dedicated to Florence and Philip LaRiviere who headed the efforts of the Citizen's Committee to Complete the Refuge that succeeded in persuading Congress to expand DENWR to 43,000 acres in the 1980's making it the largest urban wildlife refuge in the country.

In 2005, LaRiviere Marsh contained approximately 3.5 acres of hybrid *Spartina alterniflora*. Although this still represented a moderate infestation, it was the highest proportion (3%) of any sub-area in the Coyote Creek and Mowry Slough complex. The infestation itself was evenly distributed over much of the marsh in clonal patches, with areas in the eastern portion that were beginning coalesce into uniform *Spartina* meadows. The hybrid *Spartina* was also scattered throughout dense stands of alkali bulrush, making ground-based control efforts very challenging.

Treatment began in 2004, with the application conducted by truck-mounted sprayers utilizing the herbicide glyphosate before imazapyr had been registered for aquatic use in California. Glyphosate was not very effective on hybrid *Spartina* in the marsh environment, binding quickly to the salts and sediment on the plants' leaves and keeping it from entering the plants to translocate. Unfortunately glyphosate was used again on this site in 2005, with much the same effect. In 2006, the switch to imazapyr was made, again applied by applicators hauling up to 900 feet of hose from the truck out into these imposing stands of vegetation. This treatment was conducted in September because of access restrictions on clapper rail breeding territory, and apparently many of the plants were approaching senescence and did not translocate the herbicide very well. Due to scheduling issues and a limited number of appropriate contractors to perform ground-based applications in the Bay Area salt marshes, only a small portion of the marsh near the western levee was treated in 2007.

Despite the hard work performed at this site over several seasons, the infestation has not been reduced significantly, probably a result of the mid to late September treatment in this area when the plants of the south bay have already started to senesce. The eastern portion of the site near Thornton Road contains some relatively large areas of hybrid *Spartina* meadow, and the marsh channels as well as the remnant canal have scattered linear infestations along their length. The current area of hybrid *Spartina* on the site could be as much as five acres, with invasive cordgrass of varying amounts distributed over much of the site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Helicopter spot treatment (primary)
Truck-mounted sprayer or backpack sprayer (follow-up)

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

The results of previous control efforts at this site warrant a change of strategy to adaptively manage the hybrid *Spartina* infestation that threatens to reinfest the downstream areas of the Refuge that have been successfully treated. The effectiveness of aerial spot treatment conducted at the height of the growing season in July or early August should improve the trajectory of the control efforts on LaRiviere. USFWS will close this area to the public during the application, which can be combined with treatments at the other sites in this complex to limit the inconvenience to citizens. The imazapyr application should be performed in 2008 by shortening the standard boom used on broadcast applications, and limiting coverage by reducing flight speed and turning on the boom only over the target *Spartina*. The meadows on the eastern side of the marsh are too extensive for the spray ball, but this technology could be used in the future if the size of the infestation still warrants aerial treatment. Ground-based methods should be used to follow-up the early season aerial application since there is decent access to this area from the levees, and may be used as the primary treatment method in areas of high gumplant (*Grindelia stricta*) cover that must be preserved and cannot be treated from the air. Any obvious misses from the aerial application should be treated later in the same season rather than waiting an entire year to catch up with them after they have the opportunity to expand. In future years, the final treatments will be conducted by ground-based methods again once the amount of *Spartina* remaining is too small to justify the use of the helicopter.

Monitoring Needs

LaRiviere Marsh is a relatively large site, and it is densely vegetated by a variety of monocots other than hybrid *Spartina*. It is essential that detailed maps of the current distribution of invasive *Spartina* at this site be provided to the treatment contractor to help them target only the non-native cordgrass. In addition, the native *S. foliosa* in the far south bay is very robust with a high culm density, which can make identification of the hybrids difficult, especially from the air. There will need to be an extension of genetic testing in suspect areas to inform treatment, and since there are vast meadows of robust native *Spartina* in this area, the sampling may entail intensive transects to pick out cryptic hybrids in these stands. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05E: MAYHEW'S LANDING

Sub-Area Partners

Owner(s): USFWS
Manager(s): USFWS
Grantee(s): USFWS

Sub-Area Description

Mayhew's Landing is a 70-acre restored, muted tidal marsh located south of Hwy. 84 and to the east of Thornton Avenue near the headquarters of the DENWR. The marsh is bordered to the east by residential land use and Bridgepoint Park in the City of Newark, and to the north and southeast by more recent developments of single-family houses. Mayhew's Landing marsh is connected to tidal action by a small channel running south under Thornton Ave. to Newark Slough. The area is brackish and much of it is dominated by cattails (*Typha* sp.), alkali bulrush (*Bolboschoenus maritimus*) and other marsh plants that are characteristic of moderate salinity. A narrow constructed flood control channel enters the site from the eastern neighborhoods and flows to a ponding area before continuing southwest to the channel to Newark Slough. There are additional open water areas in the southeast corner, and numerous upland habitat islands throughout the marsh.

This site contained approximately 1.5 acres of hybrid *Spartina alterniflora* when treatment began in 2005. The ability of non-native *Spartina* to colonize this marsh is hampered by the competition with brackish marsh plants that should have a higher fitness in this environment. However, since the *Spartina* within this marsh is part of a hybrid swarm, with a significant diversity of genetics, it is potentially capable of adapting to this less-than-ideal environment and producing much more brackish-tolerant progeny.

Imazapyr was first applied to the hybrid *Spartina* at Mayhew's Landing in 2005 using a truck-mounted sprayer. The applications were conducted late in the season and were only marginally effective due to senescent vegetation. The area was retreated with imazapyr in 2006, again using truck-mounted sprayers. Due to scheduling issues and a limited number of appropriate contractors to perform ground-based applications in the Bay Area salt marshes, Mayhew's Landing was not treated in 2007.

The remaining infestation is concentrated in the southern portion of the site in the area where the channel connects the site to Newark Slough and tidal exchange. There are also clusters to the east near the open water features in a narrow marsh area between two upland islands. There is less than 0.25 acre of hybrid *S. alterniflora* remaining at Mayhew's Landing.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Truck-mounted sprayer or backpack sprayer (primary)

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

A ground-based application of imazapyr will be used to treat any hybrid *Spartina* found on this site in 2008, utilizing a truck-mounted sprayer and possibly a backpack sprayer for some of the more remote clones in the northern portion of the site. Unlike other areas of this site plan complex, Mayhew's Landing is contiguous with residential land use and an aerial application cannot be conducted. The key to improved efficacy at this site is to conduct treatment earlier in the season when there is a much better chance of the invasive cordgrass being healthy enough to fully translocate the herbicide down into the roots.

Monitoring Needs

Detailed maps of the current distribution of hybrid *Spartina* will be provided to the treatment contractors to facilitate an efficient application. There are a very limited number of qualified applicators for this work, and very limited windows of opportunity to treat all of the infestations in the bay each year. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05F: COYOTE CREEK (ALAMEDA COUNTY)

Sub-Area Partners

Owner(s): USFWS
Manager(s): USFWS
Grantee(s): USFWS

Sub-Area Description

The Coyote Creek sub-area is a 1,100 acre site along the northern banks of Coyote Creek in Alameda County from the eastern edge of Calaveras Marsh (Sub-area 05a) extending upstream along Mud Slough to Arroyo Agua in the City of Fremont. This site includes the Island Ponds A19-A21 (Station Island) at the confluence of Mud Slough and Coyote Creek that have recently been breached and returned to tidal exchange as part of the South Bay Salt Ponds Restoration. This large area of marshland contains a diversity of habitats, including extensive mudflats, large stands of tule (*Schoenoplectus americanus*), channel banks, mixed pickleweed (*Sarcocornia pacifica*) marsh plains, and native *Spartina* meadows.

These upstream areas of the north side of Coyote Creek were in the pioneering stages of hybrid *Spartina* invasion and establishment in 2005 when treatment with imazapyr began. This is a result of the combination of low salinity water, competition from aggressive native brackish marsh species that have been expanding their range due to increased stormwater inputs, and the remote location in the far corner of the south bay. There were several patches on the strip marsh downstream of the confluence with Mud Slough, as well as some hybrid *Spartina* in the breach of Pond A21 (Island Ponds). The banks of Mud Slough contained only a few scattered plants in the lower reaches before the salinity drops off.

The site was partially treated with imazapyr by boat in 2005 by the Santa Clara Valley Water District (SCVWD) during their *Spartina* control activities on the south banks of Coyote Creek in the South Bay Marshes (Site 15). During control work at Calaveras Marsh in 2006, the spray ball was used to apply imazapyr to any regrowth and

some new pioneering patches that had cropped up. In 2007, the contractor returned to the site during spray ball operations, and treated what little hybrid *Spartina* was found along the Coyote Creek sub-area.

This site is expected to contain little if any non-native *Spartina* in 2008. The fertile habitat of these vast unvegetated mudflats may harbor some new pioneering plants.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Helicopter spot treatment (primary)
Airboat (follow-up or areas under power lines not accessible by helicopter)

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

Due to the remote location and extremely soft mudflats along the creek that make manual removal problematic, an imazapyr application would be the preferred treatment method if any hybrid *Spartina* is found on the site. The helicopter could spot treat the plants during operations at the adjacent marshes, or an airboat could be used to access the plants at low tide to allow for the maximum amount of dry time before they are inundated by the tides. The site should be treated relatively early in the season since plants in this area tend to senesce relatively early.

Monitoring Needs

This large area should be surveyed completely by the monitors so that the treatment crew knows whether they need to mobilize at all (there may be no invasive *Spartina* left) or to enable them to only go to the relevant locations. Detailed maps of the current distribution of hybrid *Spartina* will be provided to the treatment contractors to facilitate an efficient application. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 05G: CARGILL POND (W HOTEL)

Sub-Area Partners

Owner(s): unknown (formerly Cargill Salt)
Manager(s): unknown (formerly Cargill Salt)
Grantee(s): CWF

Sub-Area Description

This site is a restored, muted tidal marsh pond area bordered by Thornton Avenue on the west, Gateway Boulevard to the north, the W Hotel to the east, and Kiote Drive to the southeast in the City of Newark just east of LaRiviere Marsh (Sub-area 05d). A wide upland berm runs north-south through the site and divides it into two marsh sections. The site is connected to tidal exchange by a wide ditch that runs south from this berm 525 meters and under Thornton Ave. to Newark Slough. The ditch flows directly into the western half of the site, whereas the eastern half is connected by a breach in the upland berm. Much of the marsh is mudflat at low tide, with patches of pickleweed (*Sarcocornia pacifica*) and *S. foliosa* scattered throughout higher elevation spots in the center, and a band of pickleweed, native *Spartina* and gumplant (*Grindelia stricta*) around the perimeter.

There are expanding clusters of tall hybrid *Spartina* on the perimeter of both the east and west lobes of this marsh, and scattered plants mixed into the *S. foliosa* meadow areas. The channel that connects the marsh to Newark Slough has a dense linear infestation at its upstream extent where it branches at the breach, as well as scattered patches of robust hybrid *Spartina* on its banks downstream. This site has never been treated due to issues establishing ownership, which has apparently been recently transferred from its most recent owner, Cargill. The site currently has approximately 0.5-0.75 acre of hybrid *Spartina*.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Truck-mounted sprayer (or backpack sprayer)

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

This site will be treated with imazapyr using either a truck-mounted sprayer which can stage on the edges of the marsh and also on the wide berm that bisects the site. Backpack sprayers can be used in the future once the infestation is down to a more manageable size. Since this site has not been treated yet, and the clones are large and well established, it is anticipated that the infestation will take several years to eliminate. The site should be treated relatively early in the season since plants in this area tend to senesce relatively early.

Monitoring Needs

The native *S. foliosa* in the far south bay is very robust with a high culm density, which can make identification of the hybrids difficult. There are small meadows of robust native *Spartina* in this marsh that may require genetic testing in suspect areas to inform treatment. Detailed maps of the current distribution of invasive *Spartina* at this site should be provided to the treatment contractor to help them target only the non-native cordgrass. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Coyote Creek & Mowry Slough Complex, Alameda and Santa Clara Counties, TSN: ISP-2004-05, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original six sub-areas defined in the 2005 plan are included in this update, and one new sub-area has been added. Although the new sub-area is not contiguous with the other sub-areas, it is extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the areas treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 06: EMERYVILLE CRESCENT, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Emeryville Crescent, Alameda County, TSN: ISP-2004-06, 2005-2007 Control Seasons) dated May 2005. All two sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to one or more project partner. The grant recipients for this site are:

California Department of Parks and Recreation (CDPR), 363 Third Street West, Sonoma, CA 95476; *Marla Hastings, Senior State Park Resource Ecologist, (707) 938-9548 x. 22*. CDPR owns Emeryville Crescent East, and has taken over management responsibilities from CalTrans, who treated the site in 2004. CDPR will contract control work on this sub-area as part of their larger collaboration with the ISP.

East Bay Regional Parks District (EBRPD), 2950 Peralta Oaks Court, Oakland CA 94605-0381; *Peter Alexander, (510) 635-0135 x. 2342.* The EBRPD owns Emeryville Crescent West and has implemented a control program on their properties over the last several years, including *Spartina* treatment in Partnership with the ISP during the 2004 *Spartina* control season. The EBRPD will provide coordination and consultation to the Project, and will implement treatment on the site at Emeryville Crescent.

Site Description

Map Site 06: Emeryville Crescent includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

06a Emeryville Crescent East **Map**
06b Emeryville Crescent West **Map**

The Emeryville Crescent marsh is a 105-acre, fringing mixed pickleweed (*Sarcocornia pacifica*) marsh shoreline between Powell Street in Emeryville and the eastern landfall of the Oakland Bay Bridge. The marsh contains significant open mudflat areas along its Bayward edge, the delta of Strawberry Creek, small sinuous channels, freshwater willow thickets, sand/shell beaches, and a complex delta-like tidal exchange area in the western portion of the marsh. The site abuts an extremely heavily developed area on the east side of the Bay, with Interstate 80/580 directly adjacent to the east, and the approach to the San Francisco Bay Bridge adjacent to the south. Local anglers, dog-walkers, and other recreational groups frequently use the marshlands included in this site. Illegal activities such as dumping and littering, unauthorized camping, and public inebriation also occur along the edges of, and sometimes within, the marshlands of this site.

Two sub-areas, Emeryville Crescent East (6a) and Emeryville Crescent West (6b), have been delineated due to the historical ownership and maintenance of the site. The Emeryville Crescent East area, at 59 acres, includes all areas to the south of Powell Street in Emeryville, continuing south and west around the "crescent" formed by the interstate to roughly the last offramp of westbound I-80 before the toll plaza. The sub-area is comprised of a stretch of coarse sand/shell beach edged by up to a 100-foot wide, undulating band of native *S. foliosa*/ pickleweed fringe marsh.

Emeryville Crescent West, at 45 acres, includes those areas to the west of the last off ramp of I-80 westbound before the toll plaza to the Oakland Bay Bridge. This sub-area is also comprised of a stretch of coarse sand/shell beach, but the bordering band of native *S. foliosa*/pickleweed fringe marsh is narrower (approximately 40-50 feet wide).

Treatment Approach

The treatment approach for the two sub-areas has been grouped together and is described below.

SUB-AREAS 06A AND 06B: EMERYVILLE CRESCENT EAST & WEST

Sub-Area Partners

Owner(s): EBRPD, CADPR
Manager (s): EBRPD, CADPR
Grantee(s): EBRPD, CADPR

Sub-Area Description

Treatment in Emeryville Crescent East has been ongoing since 2003. In that year, Caltrans maintained the eastern section of the marsh, and covered selected areas of the infestation with heavy geotextile fabric coverings. Not all of the infestation was treated in this way however, and several sizeable clones were left untreated on the eastern-most portion of the marsh near I-80.

In 2004, both the eastern and western portions of the marsh were treated using glyphosate herbicide. Caltrans targeted most of the clonal patches on the eastern portion of the marsh, and East Bay Regional Parks District (EBRPD) used amphibious vehicles and trucks to treat the clonal patches on the western side of the marsh. All areas of the marsh were treated in this season, but efficacy from these treatments was extremely low.

In 2005, the California Department of Parks and Recreation took over management of the eastern portion of the marsh as part of the Eastshore State Park system along the shoreline. CADPR contracted the spray work on the site, which was overseen by the ISP. The western portion of the site was again treated by EBRPD. Both treatments used imazapyr herbicide.

In 2006, both areas were again comprehensively treated with imazapyr herbicide. Efficacy from the treatments in 2005 had reduced the infestation, but significant amounts of resprouts or missed plants remained in the marsh. Treatments targeted all remaining stands.

In 2007, much less non-native *Spartina* remained at the site, though much of the area where it had grown previously still contained scattered resprouts such that areas where a healthy patch was present in previous seasons. All previously infested areas were treated in 2007, along with any areas where the hybridity of the individuals might be in question.

As of winter 2007, the infestation at the Emeryville Crescent has been reduced to only small, scattered remnant re-sprouts of the original infestation that was on the site. However, these re-sprouts are located throughout the previously infested area of the marsh. Both the area around the radio towers in the west and the shoreline of the crescent down to the outlet of Strawberry Creek in the east, still support small plants.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Amphibious vehicles
Truck-mounted spray equipment
Backpacks

Timing: June-July start time for ground-based treatments

Treatment of the remaining plants at Emeryville will utilize most of the same equipment as in previous years. In order to successfully eradicate the *Spartina* from the Emeryville Crescent however, treatment activities will need to occur as early as mid-June to early July in order to take advantage of the actively growing vegetative stage of the plants at that time of year. Treatments up through 2007 have had to wait until after September 1st, and at this late stage of the season, the plants are beginning to senesce for the year and are much less susceptible to herbicide uptake. Moving treatment to earlier in the year will help to avoid this problem.

Monitoring Needs

The Emeryville Crescent infestation has diminished significantly from its pre-treatment levels. Also, the treated plants have exhibited some sub-lethal effects which result in morphologies similar to native *Spartina foliosa*. Ground-based GPS surveys will be required at this marsh combined with genetic sampling throughout the *Spartina* stands.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Emeryville Crescent, Alameda County, TSN: ISP-2004-06, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

Both sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the areas treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 07: ORO LOMA MARSH, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Oro Loma Marsh, Alameda County, TSN: ISP-2004-07, 2005-2007 Control Seasons) dated May 2005. All two sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly the project partner. The grant recipient for this site is:

East Bay Regional Parks District, 2950 Peralta Oaks Court, Oakland, California 94605: Peter Alexander, Invasive *Spartina* Coordinator, *(510) 635-0135, palexander@ebparks.org*. EBRPD manages the Hayward Regional Shoreline south from the border of the City of San Leandro to the Hayward San Mateo Bridge. The two marshes that make up Oro Loma Marsh are within the Hayward Regional shoreline, representing one of the largest single marsh complexes in the area. EBRPD has been managing the *Spartina* on this site since 200 or earlier.

Site Description

Map Site 07: Oro Loma Marsh includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

07a Oro Loma Marsh-east **Map**
07b Oro Loma Marsh-west **Map**

Oro Loma Marsh is a large, 324-acre, recently restored salt pond located on the eastern shore of the San Francisco Bay Estuary adjacent to the town of San Lorenzo, about 1.5 miles south of the Metropolitan Oakland International Airport. The marsh is surrounded by levees, with Bockmann Channel and Sulfer Creek bordering the marsh to the north and south respectively. The San Francisco Bay Trail, a multi-use public recreational pathway, utilizes the levee to the west of Oro Loma, and the Southern Pacific Railroad borders the marsh to the east. The surrounding area includes various industrial and commercial developments to the north and south including a sewage treatment plant, electrical substation, and capped landfill. Beyond the railroad to the east are residential developments, the Skywest Golf Course, and Hayward Municipal Airport, with I-880 approximately 0.5 mile from the marsh edge. The marsh is comprised of young *Spartina* and pickleweed habitat in newly deposited and extremely soft bay mud. For the purposes of this plan, the levee that partially bisects Oro Loma Marsh from north to south is used to divide the site into eastern (7a) and western (7b) sub-areas. The western half of the marsh along the bay is less vegetated than the eastern half, and both contain networks of channels as well as some man-made sloughs.

For the purposes of this plan, the Oro Loma Marsh East sub-area includes the 194-acre marsh east of the central bisecting levee. The marsh is composed of mixed pickleweed plains interspersed with wide mudflats and channels. In the easternmost portion of the marsh, the pickleweed-dominated higher marsh forms wide meadows. The constructed channels throughout this sub-area drain into Sulfer Creek to the south, as well as between the breached levee system that separates the two portions of Oro Loma. The substrate in this area is soft bay mud except in the channel bottoms which are more armored with debris.

For the purposes of this plan, the Oro Loma Marsh West sub-area includes the 129-acre marsh west of the central bisecting levee. Much of this area consists of open mudflat that is being colonized by pickleweed stands and *Spartina*. The marsh drains to the bay through a wide opening in the Bay Trail levee system that runs along the western side of the marsh and separates the marsh from the open waters of the Bay. This portion of the marsh contains wide channels both constructed before breaching as well as naturally developed since the area was restored to full tidal action.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREAS 07A AND 07B: ORO LOMA MARSH EAST AND WEST

Sub-Area Partners

Owner(s): EBRPD
Manager (s): EBRPD
Grantee(s): EBRPD

Treatment within the two marshes at Oro Loma has been ongoing since 2004. Initially, treatment involved the heavy use of ground-based glyphosate herbicide applications only in Oro Loma East. Amphibious vehicles, trucks, and backpacks were deployed throughout the marsh, utilizing high berms to access the central portions of the marsh. This work was extremely labor intensive, and though most of the plants were treated, very little efficacy resulted from the work.

In 2005, a portion of Oro Loma West and the main infestation within Oro Loma East was targeted for broadcast aerial imazapyr applications in September. This treatment resulted in significantly greater efficacy than was obtained from the previous year's efforts. However, large portions of the marsh remained untreated due to EBRPD's desire to observe the effects of the herbicide treatments on the large stands of pickleweed that represent the bulk of the vegetation in both sections of Oro Loma.

In 2006, aerial applications were again used in both sections of Oro Loma, but in this year, all of the non-native *Spartina* accessible to broadcast aerial applications was targeted for treatment in July rather than September. Areas under the power lines that divide the two marshes were treated via truck and hose. In 2007, when efficacy assessments were made on the 2006 treatments, most of the non-native *Spartina* in the marsh was dead. The 2006 treatments proved the most effective to date, leaving very little non-native *Spartina* remaining in the marsh.

In 2007, treatment was accomplished by boat, truck and helicopter. Scattered clonal resprouts remained in the central portion of Oro Loma West as well as East, and the levee system in the west still supported a long, continuous stand of *Spartina*. Much of this infestation was treated, with ground-based work beginning in July, followed by targeted aerial treatments, and later by boat.

As of winter 2007, the infestation within Oro Loma West appears to be reduced to 3-4 dozen clones scattered throughout the wide marsh plain. These plants are likely resprouts from the historic infestation within the marsh, rather than newly establishing seedlings (given the size of the plants). However, there could be scattered seedling establishment out on the open mudflats.

The infestation in Oro Loma East is similar in that scattered plants remain throughout the marsh, but in small clonal patches. Very few, if any, of the patches in this marsh area remain as large, contiguous stands. The infestation in both marshes is severely reduced from its pre-treatment extent. The plants that remain exhibit sub-lethal herbicide effects and stunted growth.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Aerial (helicopter broadcast)
Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers
Boat

Timing: June-July start time for both aerial and ground-based treatments

The main portion of treatment at Oro Loma Marsh over the last three years has been done via aerial applications. For the past two years, this work has occurred in July, when the plants are actively growing and most able to absorb the applied herbicide. Ground-based treatment in Oro Loma West has been able to proceed in July as well, but Oro Loma East has had to wait until post-September first. Relative to the historical infestation in these marshes, there is very little non-native *Spartina* remaining in these marshes, and natural succession with pickleweed and *Grindelia* is occurring throughout the marshes, with its greatest development in Oro Loma East. Effective treatment of all of the remaining *Spartina* in these marshes will require marsh entry as early as June, in order to treat target plants at the optimal life history stage for herbicide uptake and translocation.

Monitoring Needs

Much of the infestation within Oro Loma has been mapped using 'heads up' digitization on GIS software utilizing orthophotography and checked with ground-truthiness. When the infestations in these marshes were readily discernable via this mapping method, the resulting map products were sufficient for planning and treatment activities. However, most of the non-native *Spartina* in these marshes has been removed, and the remaining stands present are limited and scattered throughout the marshes. Although it will be difficult to access and labor-intensive, GPS mapping of the plants on the ground will be a necessity in the 2008 control season and beyond. The specificity of locations provided by this methodology will enable more efficient treatment by the Control Program of the ISP.

Additionally, *Spartina* plants within this marsh will require yearly genetic sampling to identify if any clones establishing in the marsh need treatment, and to identify clones that are native which will be allowed to flourish. This work will enable the ISP to track the full restoration of Oro Loma, post-non-native *Spartina* removal, as well as enable the complete eradication of the invader in this marsh.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Oro Loma Marsh, Alameda County, TSN: ISP-2004-07, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

Both original sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 08: PALO ALTO BAYLANDS, SANTA CLARA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Palo Alto Baylands, Santa Clara County, TSN: ISP-2004-08, 2005-2007 Control Seasons) dated May 2005. The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

City of Palo Alto, City of Palo Alto Baylands Nature Preserve, Open Space Division, 1305 Middlefield Road, Palo Alto, CA 94301; *Greg Betts, Open Space Division Manager, (650) 463-4900. Daren Anderson, Baylands Senior Ranger, (650) 617-3156, daren.anderson@cityofpaloalto.org.* The City of Palo Alto had contracted for some control work on this site prior to its partnership with the Coastal Conservancy's ISP, and had been involved with the monitoring and mapping for several years. Since 2005, the have contracted treatment work with private aquatic vegetation management firms with the Conservancy grant funding.

Other Partners:

Palo Alto High School, 50 Embarcadero Road, Palo Alto, CA 94301; *Lynn Hori, Biology Teacher, (650) 329-3710 x 7352.* For the past 7 years, students from Palo Alto High School, working in conjunction with the Naturalist for the Baylands, have monitored and mapped the spread of *Spartina* in the marsh and conducted other studies on this invasion, including covering as a treatment option, as well as aspects of the native marsh ecology.

Site Description

Map 1 Map 2

Site 08: Palo Alto Baylands is part of a 1,940 acre nature preserve and park complex, one of the largest tracts of undisturbed marshland remaining in San Francisco Bay, owned by the City of Palo Alto and located on the western bayfront approximately 2.5 miles south of the Dumbarton Bridge (see Attachment 3, "*Spartina* Control Site Maps"). The site is located east of Hwy. 101 at the end of Embarcadero Road, and includes those areas south of Faber-Laumeister Marsh and north of Charleston Slough. Within the site, Harriet Mundy Marsh is a peninsula vegetated with pickleweed (*Sarcocornia pacifica*), *S. foliosa,* and gumplant (*Grindelia stricta*) that extends out to Sand Point from the main parking area. There is a restored marsh cove to the southwest of the parking area that was once home to a yacht club before it was allowed to silt in and return to marshland. Hooks Island just offshore from Mayfield Slough is a pickleweed marsh with large areas of *S. foliosa* that have been colonized in recent years by large clones of alkali bulrush (*Bolboschoenus maritimus*). The park has high visitation on the 15 miles of established trails through the marsh, houses the Lucy Evans Baylands Nature Interpretive Center, and is a favorite spot for birdwatchers, naturalists, local schools, wind surfers, kayakers, anglers, bikers and runners.

Prior to the initiation of ISP treatment, this site was lightly infested with hybrid *S. alterniflora*, although a number of cryptic hybrids initially went undetected in certain areas due to access issues for collecting samples. The infestation was concentrated on inner Hooks Island and continuing south along the shoreline between Mayfield and Charleston Sloughs. There were also several patches in Harriet Mundy Marsh near the interpretive center. The site was treated by backpack sprayer in 2005, but although imazapyr was available to the contractor, they used the much less effective glyphosate, resulting in almost no efficacy. The City of Palo Alto switched to a new contractor in 2006, and they subsequently treated the hybrid *Spartina* with imazapyr using truck-mounted sprayers and long hoses hauled over the mud using large pieces of lumber. They treated the clones in the restored marsh south of the main parking area by backpack, and a single patch on the west tip of Hooks Island with a boat and backpack. The same contractor returned in 2007 and retreated with imazapyr where necessary using the same methods. Despite the relatively small infestation, the challenges of access and the widely scattered nature of the hybrid *Spartina* on this site necessitated two days to complete treatment.

The majority of the remaining *Spartina* is on inner Hooks Island and on the adjacent mainland shoreline across the Mayfield Slough channel, and many clones that were field identified as hybrid here turned out to be cryptic natives. A handful of scattered patches of hybrid area still present in the southern portion of the restored marsh,

and a new clone was discovered in a channel at the confluence of Matadero Creek and Mayfield Slough near the new levee road bridge. Approximately 2500 ft^2 of hybrid *Spartina* remains on the Palo Alto Baylands site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer, backpack sprayer, lumber for crossing channel mudflat

Timing: Treatment should occur between July 15 and September 1
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

This south bay site has always been treated in mid to late September, and the hybrid *Spartina* in this area tends to have started senescing by that time. The key to completing the eradication at this site is earlier timing, getting in by late July or early August, and conducting the work along Hooks Island on a receding tide to maximize dry time and efficacy. The work will be conducted using the same methods from 2006 & 2007, with a truck-mounted sprayer working in areas close enough to a truck staging area, and backpack sprayers for the scattered clones in the restored marsh.

Monitoring Needs

The appearance of the *Spartina* on Hooks Island is confusing, and warrants a more complete sampling and analysis of the genetics at the site. The monitoring crew may sample some side by side transects and provide the results to the contractor to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Palo Alto Baylands, Santa Clara County, TSN: ISP-2004-08, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 09: PICKLEWEED PARK, MARIN COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Pickleweed Park, Marin County, TSN: ISP-2004-09, 2005-2007 Control Seasons) dated May 2005. The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* control within this plan.

Other Partners:

City of San Rafael, 1400 Fifth Avenue, P.O. Box 151560, San Rafael, CA 94901*; John Tune, Superintendent of Parks Division, (415) 485-3377,* john.tune@ci.san-rafael.ca.us

Site Description

Map 1 Site 09: Pickleweed Park is an 18-acre City of San Rafael Park located on the edge of San Rafael Bay in the **Map 2** northwestern San Francisco Bay Estuary (see Attachment 3, "*Spartina* Control Site Maps"). It is bounded to the north by San Rafael Creek and to the south by East Canal Street. The park itself is heavily used by the public, with ball fields, a community center, playground, a multi-use recreational trail on the southern boundary, and a footpath around the perimeter of the park along the Bay edge.

Bordering the park on the east side is the 10-acre Tiscornia Marsh, a thin band of high marsh pickleweed/gumplant habitat, which grades abruptly via a 2-3 foot escarpment to an extensive mudflat extending bayward. This band of marshland tapers as it extends southward along the park boundary, and becomes very thin as it curves eastward along the riprap of a levee surrounding an area filled for development. There is an east/west wooden service walkway through the marsh that provides access to the Pacific Gas and Electric (PG&E) power line tower adjacent to the site.

Treatment work at Pickleweed Park began in 2004 with extensive digging of the infestation of *Spartina* densiflora that had colonized the northeastern portion of the marsh. At this time, the *Spartina* densiflora plants had grown to considerable size and the removal of each large clump entailed significant effort by work crews. The largest plants were hauled out of the marsh this year and disposed of in an upland area to desiccate and die.

In 2005, the infestation consisted of much smaller individual *S.* densiflora plants, and initially crews were contracted to dig out the plants identified in the marsh. The characteristics of the infestation in 2005 were significantly different than those presented in 2004. Since all of the larger plants had been removed, what remained were small, relatively immature individual plants and large concentrations of new seedlings eagerly colonizing the areas where the mature plants had been removed. The result was an infestation that was entirely intermixed with the native tidal marsh plant assemblage, and digging of the plants resulted in the complete removal of all vegetation in the target area. Recognizing that manual efforts would unduly damage the marsh, the treatment strategy switched to the application of imazapyr herbicide. Treatment was done via backpack with the applicators walking the marsh targeting remnant patches.

In both 2006 and 2007 the infestation was treated similarly, with the applicator using backpack sprayers to treat the plants in the marsh. As a result of the four years of treatment at this site, there is very little non-native *Spartina* remaining at Pickleweed Park. However, each year, new seedlings of *Spartina* densiflora have been found scattered throughout the areas where the larger infestation previously grew. Small individual plants are

located in the southern portion of the marsh, and two small clones of *Spartina alterniflora* were also found in this area.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application
Digging

Equipment: Shovels or similar tools
Backpack sprayers

Timing: June-July start time for ground-based treatments

The remaining infestation at Pickleweed Park should only require selected digging of the small plants left in the marsh. Once the plants are dug from the site, they should be removed to an upland location or landfill where they will desiccate and die.

Herbicide treatments at this marsh are probably not necessary any longer, but may be used if the infestation unexpectedly expands or new substantial stands of hybird *Spartina* are discovered on the site. As for treatment in 2008, however, herbicide applications will be the secondary method for Pickleweed Park.

Monitoring Needs

The infestation at Pickleweed Park has been well-mapped, and mapping in 2008 and beyond will require detailed surveys of the areas previously infested for new seedlings and resprouts. Eradication of the plants in this marsh will require meticulous scrutiny of the low vegetation here to identify the small, camouflaged *Spartina densiflora* seedlings that will be the Control Program's primary focus for the following seasons.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Pickleweed Park, Marin County, TSN: ISP-2004-09, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 10: POINT PINOLE MARSHES, CONTRA COSTA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Point Pinole Marshes, Contra Costa County, TSN: ISP-2004-10, 2005-2007 Control Seasons) dated May 2005. All two sub-areas defined in the 2005 plan are included in this update, and one new sub-area has been added. No new species or other significant environmental factors have been identified within the site. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

East Bay Regional Parks District (EBRPD), 2950 Peralta Oaks Court, Oakland, CA 94605-0381; *Peter Alexander, Fisheries Specialist, (510) 635-0135 x 2342*. palexander@ebparks.org. The EBRPD owns Point Pinole Regional Shoreline began implementing a *Spartina* control program here in partnership with the ISP in 2004. The EBRPD will provide coordination and consultation to the Project, and will continue to implement treatment on the site at Point Pinole.

Site Description

Map Site 10: Point Pinole Marshes includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

10a	Whittel Marsh	**Map**	10c*	Giant Marsh	**Map**
10b	Southern Marsh	**Map**			

* Sub-area added since the 2005-2007 *Spartina* control plan

Point Pinole Regional Shoreline is a 2,315-acre multi-use park owned by the East Bay Regional Parks District (EBRPD). It is located at the northwestern corner of the City of Richmond, in Contra Costa County, bordered to the south and east by the Union Pacific Railroad. Point Pinole opened to the public in 1973 after the property was acquired from Bethlehem Steel. Bethlehem had acquired the land in the early 1960s from Atlas Powder Co., one of several firms that had manufactured gunpowder and dynamite there for almost 100 years.

The park occupies a roughly triangular peninsula on eastern San Pablo Bay that contains a large upland core with open, grassy parklands interspersed with predominantly eucalyptus woodlands. Along the northern shoreline of the park east of the point is the relatively intact Whittell Marsh (Sub-area 10a) composed mainly of high marsh pickleweed (*Sarcocornia pacifica*). Along the western shoreline there is a narrow band of tidal marsh on the south side of a bend in the shoreline. This is referred to as Southern Marsh (Sub-area 10b), which grades quickly over a 10-20 meter span from high marsh pickleweed to sandy mudflat. Giant Marsh (Sub-area 10c) has been added as a third sub-area to this plan. It is a larger remnant pickleweed marsh located at the southwestern corner of Point Pinole Regional Shoreline.

The non-native *Spartina* infestations at Point Pinole were in the early stages of establishment when EBRPD partnered with ISP in 2004, covering a total area less than one acre. The small infestation at Whittell Marsh was composed mainly of *Spartina densiflora* scattered over the marsh plain with a single patch of hybrid *Spartina alterniflora* along the shoreline. At the time, this was the northernmost infestation of both *S. densiflora* and hybrid *S. alterniflora* in the entire Estuary. The small Southern Marsh had scattered *S. densiflora* plants along the shoreline, and the infestation at Giant Marsh consisted of scattered hybrid *S. alterniflora* that had colonized the mudflats and shoreline but had not yet infiltrated the interior marsh channels or pickleweed plain. The likely source of seeds or propagules for these *S. densiflora* infestations was Marin County where this species was originally introduced at Creekside Park in the 1970's.

The site was treated with glyphosate prior to the partnership with ISP as well as in 2004 & 2005. EBRPD switched to imazapyr in 2006 & 2007 because of the higher efficacy seen with this herbicide at sites around the bay. The infestation of *S. densiflora* has been eradicated from Southern Marsh and largely eliminated from Whittell Marsh. Both of these sites now have some newly confirmed cryptic hybrid *S. alterniflora*, and Giant Marsh still has some small patches of hybrid *Spartina* along its shoreline and some areas of cryptic plants. EBRPD will

be using an Integrated Vegetation Management (IVM) strategy to complete the eradication at Point Pinole, relying on manual removal to complement treatment with imazapyr where appropriate. The total infestation of both species of non-native *Spartina* at Point Pinole requiring is under 2500 ft^2.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 10A: WHITTELL MARSH

Sub-Area Partners

Owner(s): EBRPD
Manager(s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

Whittell Marsh is a 40-acre marsh located on the northern shore of Point Pinole Regional Shoreline 600 meters east of the point. It is comprised of a wide section of pickleweed (*Sarcocornia pacifica*) and gumplant (*Grindelia stricta*) high marsh extending out to the bayfront from a mainly eucalyptus-dominated upland. The bayward edge of the marsh has been undercut by wave action, forming a shallow bench, below which a sloping sandy beach is interspersed with gravel and mudflat habitat. There is one large channel in the western half of this marsh as well as a network of smaller channels providing foraging habitat to many animal species. This site also includes a series of smaller marshes within Point Pinole Regional Shoreline that begin 500 meters to the east along the San Pablo Bay shoreline.

When this site was treated in 2004 as part of the ISP pilot projects, the infestation of non-native *Spartina* covered approximately 0.25 acre. Patches of *S. densiflora* were scattered along the shoreline of the eastern half of Whittell but had only colonized the interior of the marsh along the large channel in the western half. There were also several small clones of hybrid *S. alterniflora* colonizing the mudflats and eroding benches at the northeastern corner of the marsh. EBRPD had treated the *S. densiflora* several times before partnering with the ISP, but began annual treatment at this site in 2004 using backpack sprayers. In 2006 they switched to imazapyr and have seen better efficacy.

This site has received treatment very late in the season each year, allowing *S. densiflora* to set seed and establish a few new plants along the shoreline. However both species of invasive cordgrass at Whittell Marsh have almost been eliminated. There are still a handful of plants along the shoreline in the eastern portion, and a single plant on the large channel. One new clone of hybrid *S. alterniflora* was confirmed in 2007. It is located along the shoreline of a small marsh patch approximately 500 meters east of Whittell. Less than 50 ft^2 of the two species of invasive *Spartina* remain on this site.

Treatment Strategy, Methods, and Timing

Method: Manual removal (for all *Spartina densiflora*)
Imazapyr treatment (for the new hybrid *Spartina alterniflora* clone)

Equipment: Shovels or similar tools
Backpack sprayer

Timing: Treatment should occur between May 1 and July 15
Annual beginning in 2008 until eradicated

The key to completing the eradication at this site is to treat the *S. densiflora* earlier to eliminate seed production and dispersal. Any remaining plants of this species will be extremely small and will be removed manually to reduce herbicide use and since plants with such a low surface area don't translocate the imazapyr very well resulting in poor efficacy. The newly discovered hybrid *Spartina* clone will be treated with imazapyr by backpack sprayer because it is too large to remove manually.

Monitoring Needs

Monitoring will be essential to the completion of the eradication at this large marsh, with the crews walking the entire marsh plain looking for isolated *S. densiflora* seedlings or small plants and removing them as they record

them with GPS. Detailed maps of the infestation will be provided to the applicators when they treat the new hybrid clone, and they can recheck the areas for *S. densiflora* to make sure that none was missed.

There have been many cryptic hybrids confirmed in this area of San Pablo Bay because the *S. foliosa* tends to be very robust, and there may be confusion in some cases trying to discern any stunted regrowth of hybrid *S. alterniflora* from the native. The monitoring crew will sample any suspicious plants that occur in the area and submit them for genetic analysis to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 10B: SOUTHERN MARSH

Sub-Area Partners

Owner(s): EBRPD
Manager(s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

The Southern Marsh site at Point Pinole Regional Shoreline contains an estimated 10 acres of mixed tidal fringe marsh and mudflat along the southern portion of the peninsula. The small remnant marsh patch is very narrow, grading from pickleweed-dominated high marsh to gravelly mudflat over a short distance. Interspersed within the marsh are sizeable areas of cobble, devoid of vegetation. This site is bordered to the south by Giant Marsh (Subarea 10c).

Prior to the initiation of treatment in 2005, small infestations of both *S. densiflora* and hybrid *S. alterniflora* were found in Southern Marsh and along the adjacent shoreline, covering a combined total area of 0.5 acre. The hybrid *S. alterniflora* infestation consisted of clones establishing on the mudflats and on unvegetated areas of the cobble beach. There were only scattered patches of *S. densiflora* clustered along the bayward edge of the pickleweed high marsh at this site. The site was treated with glyphosate in 2004 & 2005 using backpack sprayers. EBRPD made the transition to imazapyr at this site in 2006, which finally eliminated the last individuals of both species of *Spartina densiflora* and reduced the hybrid *S. alterniflora*.

ISP monitoring surveys found no *S. densiflora* at Southern Marsh in 2007. Approximately 1500 ft^2 of hybrid *Spartina alterniflora* still remain along this shoreline.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (for the remaining hybrid *Spartina alterniflora* clones)
Manual removal (for all *Spartina densiflora*)

Equipment: Backpack sprayers; Shovels or hand pulling

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

The remaining hybrid *S. alterniflora* will be treated with imazapyr in 2008 using backpack sprayers. This work should be conducted much earlier than previous years because it appears that the late season control work at this site has had lower efficacy than anticipated. Populations of hybrid *S. alterniflora* in San Pablo Bay often senesce earlier than other areas of the San Francisco Estuary. If any plants of *Spartina densiflora* are found on this site, they will be manually removed and disposed off site.

Monitoring Needs

There have been many cryptic hybrids confirmed in this area of San Pablo Bay because the *S. foliosa* tends to be very robust, so there may be additional genetic testing required to distinguish hybrid *S. alterniflora* from the native if there are new patches found. The monitoring crew will sample any suspicious plants that occur in the area and submit them for genetic analysis to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 10C: GIANT MARSH

Sub-Area Partners

Owner(s): EBRPD
Manager(s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

Giant Marsh is a 30-acre pickleweed marsh in the far southwestern corner of Point Pinole Regional Shoreline on San Pablo Bay. The Union Pacific Railroad borders the marsh to the east, with the parking lot for Point Pinole just beyond. Along the shoreline to the south are the fringe marshes at the mouth of Rheem Creek (Sub-area 22c in the Two Points Complex), and Southern Marsh (Sub-area 10b) is to the north. Giant Marsh has the scars of a system that was manipulated by humans for commercial purposes. There are several large channels that appear to have been straightened and there are old eroding levees that crisscross the marsh plain in the northern portion.

This is a newly added sub-area that has not yet been treated. The infestation at Giant Marsh is composed of scattered clones of hybrid *Spartina alterniflora* along the bayfront edge of the marsh and out onto the mudflats. This infestation is in the very early stages of establishment, with less than 500 ft^2 of hybrid *Spartina* that has been identified. The invasive cordgrass has not yet colonized the interior of the marsh or established along the channels.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

Treatment should occur fairly early in the season at this site because hybrid *S. alterniflora* tends to senesce very early in this part of San Pablo Bay, which has effected treatment at other sites in the past several years. Imazapyr will be applied to the infestation by backpack sprayer.

Monitoring Needs

This site has normally been surveyed by boat, so in 2008 the entire marsh plain needs to be surveyed on foot to check the interior of the marsh and down into the channels to ensure that no pioneering infestations have been missed. There have been many cryptic hybrids confirmed in this area of San Pablo Bay because the *S. foliosa* tends to be very robust, so there may be additional genetic testing required to distinguish hybrid *S. alterniflora* from the native if there are new patches found. The monitoring crew will sample any suspicious plants that occur in the area and submit them for genetic analysis to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Point Pinole Marshes, Contra Costa County, TSN: ISP-2004-10, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

Both original sub-areas remain as defined in that plan, and one new sub-area has been added. The new sub-area is contiguous with the existing sub-areas, and is extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-area, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 11: SOUTHAMPTON MARSH, SOLANO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Southampton Marsh, Solano County, TSN: ISP-2004-11, 2005-2007 Control Seasons) dated May 2005. The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

California Department of Parks and Recreation, Diablo Vista District, 845 Casa Grande Road, Petaluma, CA 94954; *Christina Freeman, Environmental Scientist, (707) 769.5652 ext 209,* cfreeman@parks.ca.gov . The California State Department of Parks and Recreation (CDPR) owns and manages the Benicia State Recreation Area, and within that, Southampton Marsh. CDPR continues to participate actively with the ISP in the *Spartina* eradication effort on this site as well as several other sites around the Estuary. CDPR manages the Southampton Marsh site to promote and preserve native habitat, and the control and removal of non-native *Spartina* within this area works toward this goal.

Site Description

Map 1 **Map 2** Site 11: Southampton Marsh is the largest extant marsh within the Carquinez Strait (see Attachment 3, "*Spartina* Control Site Maps"). Its roughly 175 acres are located within the 720-acre Benicia State Recreation Area, Solano County. Highway 780 borders the park on the north and east, Southampton Bay on Carquinez Strait to the south, and residential development of the City of Vallejo sits atop the hill to the west of the park. Cyclists, runners, walkers and roller skaters use the park's 2 ½ miles of road and bike paths, which circle the perimeter of the Park. Picnicking, bird watching and fishing are also attractions.

The marsh lies in the central and southern portions of the park up to the Southampton Bay shoreline, and consists mostly of high marsh pickleweed (*Sarcocornia pacifica*) and gumplant (*Grindelia stricta*) habitat, with dense edges of brackish marsh species at the base of the western hill and along the bay, including tule (*Schoenoplectus californicus*), cattails (*Typha* sp.) and alkali bulrush (*Bolboschoenus maritimus*). A deep main channel flows north-south through the center of the marsh, with several smaller channels branching from it that are lined with the highly invasive perennial pepperweed (*Lepidium latifolium*) that has displaced the native gumplant that would normally be found on these well-drained banks.

Southampton Marsh is one of the few remaining sites of the endangered plant species *Cordylanthus mollis* ssp. *mollis* (soft bird's-beak). The *Cordylanthus* can be found along some of the smaller channels in the southern portion of the site, and in some of the high marsh areas in the north. Access to the marsh is restricted to park personnel and researchers to protect the endangered plant population from potential damage from trampling.

Southampton Marsh contains the only known population of *Spartina patens* in the San Francisco Estuary, and the presence of another unusual eastern North America native, black grass (*Juncus gerardi*), suggests that they were probably planted here anonymously. Prior to the initiation of treatment in 2005, the .5 acre infestation of *S. patens* consisted of several large circular clones on the marsh plain south of the bend in the main channel, with multiple smaller clones peppered up into the northern and eastern edges, through the center of the marsh, and down into the tule along the southern bayfront.

The most problematic area was a dense linear infestation of *S. patens* interspersed with the endangered *Cordylanthus* that it is displacing along a smaller channel near the large clones. These highly sensitive areas required a unique treatment strategy to eliminate the invasive *Spartina* while simultaneously preserving the annual *Cordylanthus*. Digging or covering was out of the question because of the damage it would do to the marsh substrate, and potential removal of the accumulated seed bank of the endangered plant. Since imazapyr can have residual effects in terrestrial settings, potentially stopping the germination and growth of seedlings months after an application, this herbicide was only used on the large *S. patens* clones remote from the *Cordylanthus*. This was a very conservative approach because imazapyr is not known to be persistent in the aquatic environment, degrading rapidly in water by photolysis. Glyphosate, which binds readily to sediment and does not have residual action, was

substituted in the areas contiguous to the endangered plant. The entire application was timed for after the *Cordylanthus* had set seed, when the herbicide would have no impact on the dying annual vegetation or its seed bank for future years. This meant that treatment occurred in October or even early November depending on the dynamics of the given year.

In 2005, backpack sprayers were used to apply either glyphosate or imazapyr in the appropriate areas. The treatment of the large clones was very effective, eliminating them almost completely after just one imazapyr application, but the late timing and lower salt marsh efficacy of glyphosate did not reduce the linear channel infestation significantly. The contractor returned to the site in 2006, again using backpack sprayers to spot treat with imazapyr the small patches, regrowth, and several new discoveries scattered over the large marsh plain. Glyphosate was used to continue to whittle away at the *S. patens* interspersed with *Cordylanthus*. The same general strategy was repeated in 2007.

The large clones have been eliminated at Southampton Marsh, and the remaining infestation on the marsh plain consists of tiny plants scattered widely over the previous hot spots. The linear infestation growing with the *Cordylanthus* has been reduced, but the conservative treatment strategy has resulted in a longer timeline to complete the eradication. The *Cordylanthus* is thriving in this area of the infestation where glyphosate has been applied after the endangered annual has set seed, an indication of the success of the protective treatment strategy. Less than 500 ft^2 of *Spartina patens* remains to be treated in Southampton Marsh.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr and glyphosate treatment (primary) Manual removal (possible follow-up, HAND PULLING ONLY in areas with *Cordylanthus*)
Equipment:	Backpack sprayers; Shovels or similar tools
Timing:	Imazapyr treatment (areas with no *Cordylanthus*) between August 1 and September 1. Glyphosate treatment should occur after *Cordylanthus* has set seed (usually after October 1) Annual beginning in 2008 until eradicated

In previous years, the treatment contractor would plan for a single event for both the imazapyr and glyphosate applications to this marsh. To complete the eradication, and stop all *S. patens* seed production, it is recommended that future treatment be split into two separate events. In August, imazapyr will be applied to all remaining outlier *S. patens* scattered around the site that is not associated with *Cordylanthus*. The contractor will return in early autumn (after *Cordylanthus* has set seed) to apply glyphosate to the invasive *Spartina* growing with the endangered plant.

In future years, manual removal could be used on the last areas of the infestation. In areas with *Cordylanthus*, the manual control work would be restricted to hand pulling of seedlings or very small plants, being careful not to disturb the endangered plant or threaten its seed production. Elsewhere in Southampton Marsh, shovels could be used on the last *S. patens* plants, especially if they are the result of regrowth that may not be healthy enough to translocate the herbicide.

Monitoring Needs

A small *Spartina patens* plant is very difficult to find within the large marsh plain and densely vegetated edges of Southampton Marsh. Monitoring efforts will need to be very comprehensive to complete the eradication here, including the use of flagging to mark the remaining plants for the treatment crew. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Southampton Marsh, Solano County, TSN: ISP-2004-11, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less

than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 12: SOUTHEAST SAN FRANCISCO SHORELINE COMPLEX, SAN FRANCISCO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Southeast San Francisco Shoreline Complex, San Francisco County, TSN: ISP-2004-12, 2005-2007 Control Seasons) dated May 2005. The original six sub-areas remain as defined in that plan, and three new sub-areas have been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partners. The grant recipients for this site are:

California Department of Parks and Recreation (CDPR), 363 Third Street West, Sonoma, CA 95476; *Marla Hastings, Senior State Park Resource Ecologist, (707) 938-9548 x 22*. CADPR owns Yosemite Channel and they have been working closely with the ISP to develop control methods for this site, as well as establishing a network of contacts throughout the Southeast San Francisco area to facilitate control efforts in other sub-areas not addressed in this plan.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* Control Plans on a number of sub-areas within this plan.

Other Partners:

Port of San Francisco, Pier 1, San Francisco, CA 94111; *Carol Bach, Environmental Health & Safety Manager (415) 274-0568), Carol_Bach@sfport.com.* The Port of San Francisco has jurisdiction over Baylands within the borders of the City and County of San Francisco and may require entrance permits or notification for proposed work activities. The ISP has worked with the Port in the past to implement *Spartina* control efforts at Pier 94.

Golden Gate Audubon, 2530 San Pablo Ave, Suite G, Berkeley, CA 94702-2047, *Arthur Feinstein, Executive Director (510) 843-6551, afeinstein@goldengateaudubon.org* Golden Gate Audubon (GGAS) has been an active participant in restoration and monitoring of the bay for many years, and is eager to control the spread of non-native *Spartina* in the marshes of this area. They have recently conducted control work on *S. alterniflora* hybrids at Pier 94 with an aim toward restoring the site for shorebird habitat. The GGAS will continue to be an active participant in control efforts at the Pier 94 site, as well as others throughout the Southeast San Francisco Complex as needed, through the use of volunteers, contact sharing, and coordination.

Literacy for Environmental Justice (LEJ) 800 Innes Avenue, Unit 11, San Francisco CA. 94124, (415)282-6840. The goal of the LEJ is "to foster an understanding of the principles of urban sustainability and environmental justice in our young people in order to promote the long-term health of our communities." To that end, the LEJ will participate in eradication efforts, as well as monitoring, on the Heron's Head Park sub-area.

City of San Francisco Recreation & Parks (SFRP), McLaren Lodge, 501 Stanyan Street, San Francisco, CA 94117-1898; *Lisa Wayne, Natural Areas Director, (415) 753-7266.*. San Francisco Recreation & Parks owns the sub-area of India Basin Shoreline Park and will be partnering with the ISP to control the *Spartina* on the park site. SFRP has some staff and equipment available to use in the *Spartina* control efforts on the site in coordination with the ISP.

United States Navy, *Ryan Ahlersmeyer, (619) 532-0960.* The Navy will be working with the ISP to implement control activities on a portion of their Hunter's Point property. The *Spartina* growing at this sub-area will be controlled using the resources both of the ISP and the Navy.

Site Description

Map Site 12: Southeast San Francisco Shoreline Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

12a	Pier 94 Map	12f	Candlestick Cove Map
12b	Pier 98/Heron's Head Map	12g*	Crissy Field
12c	India Basin Map	12h*	Yerba Buena Island Map
12d	Hunters Point Naval Reserve Map	12i*	Mission Creek Map
12e	Yosemite Channel Map		

* Sub-area added since the 2005-2007 *Spartina* control plan

The Southeast San Francisco Complex includes a scattered group of remnant marshlands within a heavily industrialized landscape on the western shores of the San Francisco Bay Estuary. The complex is bounded by the Treasure Island and Yerba Buena Island in the north, and the San Francisco County and City boundaries to the south. The Southeast San Francisco complex is adjacent to an inactive naval shipyard, shipping container facilities, and Monster Park stadium (formerly Candlestick Park), as well as the Bayview residential neighborhood of San Francisco.

The eight sub-areas of the Southeast San Francisco complex contain many scattered, small, individual clonal populations of *Spartina alterniflora* hybrids according to the ISP's 2007 *Spartina* Inventory Map. The largest area within this complex is the Yosemite Slough area, which has a large proportion of native *Spartina* plants as a result of the targeted treatment of non-native *Spartina* at the site since 2004. The individual patches of non-native *Spartina* within this area represent localized 'stepping stones' in the available marsh habitat of the area to the open waters of the north bay, and the outer coast. This infestation in Southeast San Francisco is not large on its own but nevertheless represents a significant threat to marshlands in other parts of the San Francisco Bay.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

SUB-AREA 12A: PIER 94

Sub-Area Partners

Owner(s): Port of San Francisco
Manager (s): Golden Gate Audubon
Grantee(s): CWF

Sub-Area Description

Pier 94 is an approximately 5-acre site located just south of the mouth of the Islais Creek Channel, and is bordered by a gravel and aggregate storage/production facility, shipping container terminal and transfer facility, a rendering plant, and other heavy industry. The Golden Gate Audubon Society is restoring the marsh at Pier 94 that consists of tidal pans and high marsh pickleweed (*Sarcocornia pacifica*)/gumplant (*Grindelia stricta*) habitat. Although the site is open to the public, the presence of this remnant marsh patch is not advertised by posted signs, and there is no trail system. Therefore, recreational use of the site is very low. Significant restoration work on the site has been accomplished since 2005, including the removal of large amounts of concrete rip-rap, garbage clean-up, re-grading, and native plant plantings including the endangered California sea blite (*Sueda californica*).

Initial treatment at the site involved both covering and digging of clones in 2003 with both Golden Gate Audubon and Hanson Aggregates. The largest portion of the infestation was controlled at Pier 94 as a result of this treatment. Golden Gate Audubon has conducted follow-up volunteer digging at the site since, and combined with the rip-rap removal and re-grading work, has resulted in the removal of many of the small remaining patches, particularly in the northern portion of the site.

Treatment Strategy, Methods, and Timing

Method: Digging
Covering
Imazapyr herbicide application

Equipment: Geotextile fabric & wooden stakes for covering
Shovels or similar tools
Backpack sprayers for herbicide application
Truck-mounted spray equipment

Timing: June start time for ground-based herbicide treatments
All year for covering or digging work

The small size of the infestation at Pier 94 enables the use of several treatment options to remove the remaining non-native *Spartina* on the site. Golden Gate Audubon has an established volunteer base for this and other sites and could easily handle the manual labor required for either digging or covering at the site. Herbicide application at the site would become necessary if any of the clones are deeply embedded in rip-rap or other sediments that preclude the full removal of all rhizome fragments associated with the clones.

Digging at the site would simply involve the use of garden shovels, with the resulting plant material subsequently disposed at a non-tidal upland site or landfill to desiccate and die. Covering of the plants would involve the use of Mirafi 700 geotextile fabric or a similar material, which is secured over the plant with 4-foot wooden stakes driven through the material and into the marsh. Typical placement of tarp material allows for a meter of extra material around the periphery of the target *Spartina* clone to preclude the *Spartina* plants from extending runners beyond the tarped area. All tarping work requires constant monitoring to assure that storm events, high tides, or vandalism do not displace the material once it is placed over the plants. Tarping material will need to remain over the hybrid *Spartina* for a full calendar year to kill the plants.

Herbicide application at the site would involve the use of a backpack sprayer, with the applicator walking the marsh and treating the target plants as they are identified.

Monitoring Needs

Yearly ISP inventory monitoring at this site, utilizing GPS mapping, will be required to identify the locations of clones in this marsh. Once the existing infestation is removed, subsequent patches of *Spartina* found in this marsh should be genetically analyzed to determine if native *Spartina* is establishing at the site.

SUB-AREA 12B: HERON'S HEAD/PIER 98

Sub-Area Partners

Owner(s): Port of San Francisco
Manager (s): Literacy for Environmental Justice
Grantee(s): CWF

Sub-Area Description

Heron's Head Park (formerly known as Pier 98) is a 25-acre restored wetland at the base of the Hunters Point Power Plant, south of Lash Lighter Basin. Heron's Head is a long, thin peninsula extending east into San Francisco Bay that it is built on landfill and was slated for development as a Port of San Francisco facility, but has now been transformed into a thriving marsh maintained primarily by volunteers of Literacy for Environmental Justice (LEJ). More than 1000 student volunteers serve as primary caretakers of the park each year. They help to plant native plant species, remove non-natives such as invasive *Spartina*, and clean and maintain the wild areas of the park. Herons Head Park supports over 78 species of birds annually, and acts as a rest stop for migratory birds along the Pacific Flyway. The area consists mostly of rip-rap fill with some high marsh habitat, and there is a Pacific Gas and Electric (PG&E) pond on the western side. Adjacent land uses include Port of San Francisco facilities used as police driver training areas, and the now mothballed Hunter's Point PG&E power production facility. There is a public recreational trail through the center of the peninsula that is frequently used by joggers, dog walkers and the occasional fisherperson.

Treatment work at Heron's Head has been exclusively done by volunteers working with LEJ. This work has been ongoing since 2003, though no control work was done in 2007. Work here has consisted primarily of digging, with some covering work. Despite the treatment work done at this site, the infestation here has expanded in the last two years. There are now large clonal patches newly or re-establishing throughout the marsh, especially in the central portion of the marsh. There are also large clones established within the PG&E power plant pond on the southwestern end of the peninsula.

Treatment Strategy, Methods, and Timing

Method:	Covering Digging, or Imazapyr herbicide application
Equipment:	Geotextile fabric, wooden stakes for covering Shovels or similar tools Backpack sprayers
Timing:	Year-round treatment for covering or digging June start-time for herbicide application

Due to the expansion of the infestation in this marsh, treatments here will be imperative during the 2008 Treatment Season. The most efficient treatment method given the substantial increase in infested area is the targeted use of imazapyr herbicide via backpack sprayers, with applicators walking the marsh to access the individual clones scattered throughout the marsh plain. Treatment via herbicide is especially appropriate for the infested banks of the PG&E Pond on the southwestern end of Heron's Head Park.

If herbicide treatments are not used at Heron's Head, mobilization of large groups of volunteers through the LEJ will be necessary to address the problem here. Digging at the site would simply involve the use of garden shovels, with the removed plant material disposed at a non-tidal upland site or landfill to desiccate and die. Covering of the plants would involve the use of Mirafi 700 geotextile fabric or a similar material, which is secured over the plant with 4-foot wooden stakes driven through the material and into the marsh. Typical placement of tarp material allows for a meter of extra material around the periphery of the target *Spartina* clone to preclude the *Spartina* plants from extending runners beyond the tarped area. All tarping work requires constant monitoring to assure that storm events, high tides or vandalism do not displace the material once it is placed over the plants. Tarping material will need to remain over the plants for a full calendar year to kill the plants.

Monitoring Needs

As has been done in the past, yearly ISP inventory monitoring at this site utilizing GPS mapping will be required to identify the locations of clones in this marsh. There is a possibility that native *Spartina* will establish, or has already established in this marsh. Random genetic sampling of clonal patches at Heron's Head should be undertaken each year to identify hybrid and cryptic hybrid *Spartina* here.

SUB-AREA 12C: INDIA BASIN SHORELINE PARK

Sub-Area Partners

Owner(s):	City of San Francisco
Manager (s):	City of San Francisco Recreation and Parks
Grantee(s):	CWF

Sub-Area Description

The India Basin area includes a 2-acre marsh/mudflat in a small cove several hundred feet to the north of India Basin Shoreline Park, a small City of San Francisco park, as well as the adjacent shoreline to the south to the end of Donahue Street. The site is located south of Heron's Head Park (Sub-area 12b) in the small bay referred to as India Basin on the eastern edge of the Bayview neighborhood of San Francisco. The park receives heavy public use, and the adjacent land uses including a now closed and partially demolished PG&E power plant as well as residential housing.

Treatment at this site has been somewhat inconsistent. The first year of treatment was in 2005, with glyphosate herbicide. This treatment was done in early October, when the plants had mostly senesced for the winter. Very little efficacy occurred as a result of this treatment, either from the use of the less effective glyphosate or from the late growth stage of the plants. In 2006, no treatment occurred on the site due to timing and contractor issues. In 2007, the first treatment of the site using imazapyr was conducted in September, before the plants set seed or had gone dormant for the winter. Efficacy estimates of this treatment are pending.

The infestation at India Basin currently exists in three clonal patches. The main and largest patch is in fact a half-dozen or more coalesced clones in the mudflat area directly north of the India Basin Shoreline Park parking lot. A much smaller patch is just south of the parking lot, in a small, fenced brackish pond. The third clone is north

along the shoreline near the PG&E power plant, and is an individual clone growing in the sand and mud shoreline edge. The condition of these patches for the 2008 Treatment Season is pending summer 2008 efficacy surveys.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment
Backpack sprayers

Timing: June-August start time

Treatment of all the patches at India Basin will involve the use of truck-mounted spray equipment or backpack sprayers, using the park's parking lot as the staging area. This work will be repeated each year until the plants are eradicated at the site.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring.

SUB-AREA 12D: HUNTER'S POINT NAVAL RESERVE

Sub-Area Partners

Owner(s): United States Navy, City of San Francisco
Manager (s): United States Navy, City of San Francisco
Grantee(s): CWF

Sub-Area Description

The Hunter's Point area is a peninsula bordered to the north by India Basin and to the south by South Basin and Yosemite Slough. This area contains a decommissioned Naval Base undergoing restoration and conversion to a mixed-use facility. The San Francisco Naval Shipyard and Hunters Point Shipyard were located on this peninsula, and much of that infrastructure is still present. There are approximately 8.8 acres of marshland associated with this site, with the majority represented by a thin band of mostly sandy shoreline bordered by rip-rap. There is a sandy bay in the South Basin near Yosemite Slough with more developed marsh structure, and this is the main area of *Spartina* within the Reserve. This area is considered a US EPA Superfund Site, with high levels of heavy metals and radioactivity in sediments. Access to the shoreline needs to be coordinated through the US Navy.

The first year of treatment at this site was 2007, using imazapyr herbicide via both backpack sprayers and trucks. Applicators worked in teams to treat all of the *Spartina* found in the small bay on the South Basin.

As 2007 was the initial year of treatment, assessments of the efficacy of the 2007 effort will be conducted in summer of 2008. The infestation is split between a mostly contiguous band of tall *Spartina* located behind a sandy stretch of beach, and a group of coalesced clones stretching along the marsh edge toward Yosemite Slough. There are also several small clones stretched out along the beach to the east.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment
Backpack sprayers

Timing: June-August start time

Treatment in this marsh will be done with backpacks and truck-mounted spray equipment as was done in 2007. Access to the site will be authorized by the US Navy. All areas infested with non-native *Spartina* within the Hunter's Point area will be targeted.

Monitoring Needs

Regular yearly inventory monitoring using GPS equipment should be sufficient to identify the infestation in this area in 2008. In 2009, genetic sampling should be done on any newly establishing clones, as the Hunter's Point area is directly adjacent to Yosemite Slough, which maintains a population of native *Spartina* which may begin to colonize Hunter's Point.

SUB-AREAS 12E AND 12F: YOSEMITE SLOUGH & CANDLESTICK COVE STATE RECREATION AREA

Sub-Area Partners

Owner(s): California State Parks (CADPR)
Manager (s): California State Parks (CADPR)
Grantee(s): California State Parks (CADPR)

Sub-Area Description

Yosemite Channel is a 12-acre mudflat-dominated marsh located within a heavily industrialized area just southwest of the Hunter's Point Naval Reservation, and north and west of Candlestick Point. The site is comprised of a relatively large mudflat with some adjacent higher fringe salt marsh habitat. This sub-area also includes a small area to the east of Yosemite Channel and the Double Rocks feature on the southern shoreline of the South Basin (this area is referred to as the "boat launch" area by California Department of Parks and Recreation staff). Yosemite Slough is slated for restoration by California Department of Parks and Recreation beginning in approximately 2009. There is currently no public use of the site (except perhaps as an illegal dumping area), as the area is primarily fenced off.

The Candlestick Cove State Recreation Area encompasses the shoreline and upland areas of Candlestick Point, to the east of Monster Park football stadium. The tidal marsh development along this shoreline is relatively limited, mostly consisting of steep rip-rap with an occasional small cove. *Spartina* in this area is relegated to small scattered clones.

Treatment on these two sites has been ongoing since 2004. Treatments initially involved the use of glyphosate herbicide applied via both backpack and truck. In 2005, treatments switched to the use of imazapyr herbicide via the same methods. Treatments have targeted all areas of the marsh each year.

The infestation within Yosemite Slough has been significantly reduced. The remaining *Spartina* plants in this marsh are predominantly native, though scattered remnant clones exist throughout the site. In some cases the sublethal effects of the herbicide results in re-sprouting plants that mimic the morphology of the native *Spartina* in this marsh. As a result, the current infestation in this marsh is a mix of native and hybrid plants that will require yearly genetic analysis to determine which parts of the marsh require treatment.

Along the shoreline of Candlestick Cove, only remnant patches of previously treated non-native *Spartina* remain.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment
Backpack sprayers

Timing: June-August start time for ground-based treatments

Treatments in these two areas will conform to treatment methods used in the past. Where trucks can access the shoreline areas, they will be used to treat the remaining clones in the marsh. Where it is more efficient to use backpacks, applicators will walk the marsh targeting remaining plants.

Monitoring Needs

Yosemite Slough will require yearly genetic sampling to determine the makeup of the remaining plants in these areas. There is considerable variability in the morphology of the plants here, and genetic results will directly inform treatment approaches to these areas.

SUB-AREA 12H: YERBA BUENA AND TREASURE ISLAND

Sub-Area Partners

Owner(s): City of San Francisco
Manager (s): City of San Francisco
Grantee(s): CWF

Sub-Area Description

This site includes all of the shoreline of both Yerba Buena and Treasure Islands in San Francisco. For the most part, the shoreline of Treasure Island consists of steep rip-rap shoreline with very little tidal marsh habitat whatsoever. In contrast, the shoreline of Yerba Buena Island consists of rocky cliffs, sandy beaches and developed shoreline in the form of a marina and Coast Guard dock areas. There is very little tidal marsh vegetation along the shoreline of either island.

No previous treatment has occurred on this site.

The infestation on Yerba Buena Island consists of a single, genetically identified non-native *Spartina* clone on the northeastern shoreline, at the base of a rocky outcrop near the landfall of the Oakland-San Francisco Bay Bridge. Access to the site is through the Coast Guard facility on the island.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Boat
Backpack sprayer

Timing: June-August start time for ground-based treatments

Access to this site will be reliant on the status of the new San Francisco-Oakland Bay Bridge relative to any road re-alignments done around and below the bridge's landfall on Yerba Buena Island. If the area is accessible through the Coast Guard facilities there, either ground or boat-based backpack work will be used to treat the target area.

Monitoring Needs

As has been done in the past, yearly GPS monitoring of the shorelines of both islands will be required to inform treatment work at the site.

SUB-AREA 12I: MISSION CREEK (CHINA BASIN)

Sub-Area Partners

Owner(s): City of San Francisco
Manager (s): City of San Francisco
Partner(s): CWF

Sub-Area Description

For the purposes of this plan, Mission Creek (China Basin) is defined as the channel extending roughly 1000 meters southwest from the 3rd Street Bridge on the south side of PacBell Park in San Francisco. The shoreline of the basin is highly developed, including houseboats, public parks, light industrial development, parking lots, walkways and other uses. There is very little tidal marsh development, with the largest portion in the upper part of the channel near I-280, which was constructed as part of the condominium development in the north side of the channel.

Previous treatment at the Mission Creek site consists only of the pruning and removal of flowers on the clonal patches found there in 2007 so that the plants were unable to spread seed from the site. No other control work has been undertaken here.

There are two main infestations in the Basin, as identified by 2007 genetic sampling and analysis of the *Spartina* in the area. Both are upstream of the positively 4th Street bridge on the north side of the channel in a newly developed marsh area adjacent to a wide promenade fronting a large-scale condominium development. The larger of the clones is to the west by a sewage overflow and public access dock.

Treatment Strategy, Methods, and Timing

Method: Digging
Imazapyr herbicide application

Equipment: Shovels or similar tools
Backpack sprayer

Timing: June-August start time for herbicide treatment
All-year for digging

Treatment in this area can easily be accomplished simply by digging the plants up and removing them from the site. The infestation is very small and has not yet spread throughout the marsh area available. If herbicide treatment is preferred, the site can be quickly treated with a backpack sprayer.

Monitoring Needs

As there is both native and non-native *Spartina* at this site, yearly genetic sampling here will be necessary to inform the Control Program.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Southeast San Francisco Shoreline Complex, San Francisco County, TSN: ISP-2004-12, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original six sub-areas remain as defined in that plan, and three new sub-areas have been added. The three new sub-areas are in the vicinity of the existing sub-areas, and are extremely similar in physical and ecological character to one or more of the original areas. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 13: WHALE'S TAIL COMPLEX, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Whale's Tail Complex, Alameda County, TSN: ISP-2004-13, 2005-2007 Control Seasons) dated May 2005. The original seven sub-areas remain as defined in that plan, and three new sub-areas have been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partners. The grant recipients for this site are:

County of Alameda Public Works Agency, 4825 Gleason Drive, Dublin, CA 94568*; Saul Ferdan, Weed and Pest Control Supervisor, (925) 803-7011, saul@acpwa.org* The County of Alameda Public Works Agency, or the Alameda County Flood Control District (ACFCD), had an ongoing maintenance program to manage the invasive *Spartina* on their lands, but were unable to effectively control it due to the rapid rate of expansion of established populations, invasion pressure from nearby sites, limited funding and staff, and endangered species issues. ACFCD has worked with the ISP since the 2004 control season and has been a grantee and active partner with the ISP's efforts for the 2005-2007 seasons. The ACFCD aims to control non-native *Spartina* within the areas under its jurisdiction in order to restore flood control capacity, as well as to enhance wildlife habitat in the area.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* Control Plans on a number of sub-areas within this plan.

Other Partners:

California Department of Fish and Game Central Coast Region, PO Box 47 Yountville, CA 94599*; John Krause, Associate Wildlife Biologist, (415) 454-8050, jkrause@dfg.ca.gov* The CDFG owns the Whale's Tail marshes, manages the Cargill Mitigation Marsh, and is actively working in the surrounding area to restore large tracts of diked salt ponds to tidal influence. The Eden Landing Ecological Reserve restoration project (Baumberg tract) encompasses some 775 acres of potential salt marsh habitat directly adjacent to infested stands of non-native *Spartina*. The CDFG were concerned with the potential effects of the adjacent infestations of non-native *Spartina*, and the capacity of these invasives to undermine the habitat diversity envisioned in the Eden Landing restoration plan. Coordination of CDFG efforts with those of the ACFCD will greatly enhance the effectiveness of the control work in this area.

Site Description

Map Site 13: Whale's Tail Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

13a	Old Alameda Creek North Bank	Map	13f	Cargill Mitigation Marsh	Map
13b	Old Alameda Creek Island	Map	13g	Upstream of 20 Tide Gates	Map
13c	Old Alameda Creek South Bank	Map	13h*	Eden Landing-North Creek	Map
13d	Whale's Tail North Fluke	Map	13i*	Eden Landing-Pond 10	Map
13e	Whale's Tail South Fluke	Map	13j*	Eden Landing-Mt Eden Creek	Map

* Sub-area added since the 2005-2007 *Spartina* control plan

The Whale's Tail and Old Alameda Creek Complex is an over 800-acre site situated within Eden Landing on the eastern shores of the San Francisco Bay Estuary, immediately south of the San Mateo Bridge and bordered to the east by Union City and to the south by the Alameda Flood Control Channel. Eden Landing consists largely of old salt evaporator ponds that Cargill Salt suspended the use of in 2003 when they were purchased through a Federal and State-sponsored partnership known as the South Bay Salt Ponds Restoration Project. Initial work to restore

tidal influence to some of these ponds since 2003 has created some additional *Spartina* habitat that was not previously at risk of invasion. The two parallel channels of Old Alameda Creek bisect Eden Landing, with the two "flukes" of Whale's Tail consisting of older restoration project marshes found on either side of the mouth at the Bay front. There are a variety of habitats in this diverse area, including mature restoration marsh with a range of channel orders and morphologies, highly-channelized flood control conduits, young restoration sites with little vegetation or structure, mudflats, eroding scarp, and sand/shell beach.

Three of the 10 site sub-areas have been added since the 2005-2007 Site-Specific Plan for the area; they all represent newly created habitat that was rapidly invaded after the opening of North Creek in 2005 and the work around Mt. Eden Creek and Pond 10. The areas included within this complex are entirely restricted from public access and are either managed by CDFG as wildlife habitat (sub-areas 13d, 13e, 13f, 13h, 13i, 13j), or by ACFCD for flood control purposes (sub-areas 13a, 13b, 13c, 13g).

The invasive *Spartina* at the Whale's Tail and Old Alameda Creek Complex is one of the oldest infestations of non-native cordgrass in the San Francisco Estuary. Prior to the start of *Spartina* control work under the ISP in 2004, this site complex contained 82 net acres of *Spartina alterniflora* hybrids representing about 15% of the area. In some places the infestation had become a dense monoculture, and the hybrid *Spartina* had established in a wide variety of marsh habitats and elevations including high marsh pickleweed (*Sarcocornia pacifica*)/saltgrass (*Distichlis spicata*), lower marsh *Spartina foliosa*/mudflat areas, channel banks, edges of salt pans, and bayfront scarps and mudflats.

A portion of Old Alameda Creek was selected for experimental-use applications of imazapyr by helicopter in 2004. In 2005, the first large-scale broadcast applications of imazapyr were conducted at this site complex, followed by comprehensive aerial treatment in both 2006 and 2007 of all identified hybrid *Spartina* within the complex. ACFCD completed the treatment along the upstream extent of Old Alameda Creek (above 20 Tide Gates) utilizing an amphibious tracked vehicle and truck-mounted sprayer where aerial applications cannot be performed because of proximity to residential land use. In addition, ACFCD also conducted some ground-based spot applications each year in September from amphibious tracked vehicle and/or truck-mounted sprayer to treat any areas missed during the aerial work from that summer, including the areas under low-hanging power lines. This site complex now contains approximately eight acres of hybrid *Spartina*.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

SUB-AREAS 13A, 13B, 13C: OLD ALAMEDA CREEK (NORTH & SOUTH BANKS & CENTRAL ISLAND)

Sub-Area Partners

Owner(s): County of Alameda
Manager(s): ACFCD
Grantee(s): CWF (aerial treatment) and ACFCD (ground treatment)

Sub-Area Description

The three sub-areas of Old Alameda Creek (sites 13a-13c) have been combined in this Site-Specific Plan due to their contiguity as part of the same watercourse, and their similarities in ownership and management. Old Alameda Creek consists of two parallel manmade channels that begin at the "20-Tide Gates" structure near Union City and run approximately four miles west to the mouth where Old Alameda Creek empties into the Bay. The channels were ditched out of remnant tidal marshland, leaving a 50 m wide central island and 5-15 m wide north and south marsh benches up to the levees. All three sub-areas share the same marsh elevations, hydrologic gradient, and associated plant assemblages. The open mud along the channel banks grades sharply to a thin band of *Spartina foliosa*, with predominantly pickleweed (*Sarcocornia pacifica*) on the benches and gumplant (*Grindelia stricta*) at the toe of the levee and in well-drained areas on the island. The three sub-areas contain approximately 160 acres of marshland.

Aerial applications from 2004-2007 have been very successful on these sites, and over the past two years they have been conducted at the optimal time for treating *Spartina*: late July/early August. Prior to treatment, dense stands of invasive *Spartina* lined both banks of both channels, and was rapidly coalescing together toward the center of the island to form continuous meadows. Following the 50-acre Experimental-Use imazapyr application

in 2004, the 2005 aerial treatment covered the majority of the central island and south bank, but only the north bank mouth due to timing issues. Efficacy was moderate from the 2005 control work because the application occurred in late September, and the majority of the infestation was composed of very tall and very dense hybrid *Spartina* that can often take a year of weakening before lethal impacts are realized from retreatment. Aerial treatment in 2006 was comprehensive and targeted all known hybrid *Spartina* in these sub-areas, which reduced long stretches of *Spartina* to stubble along the channel banks and killed large patches on the island. Aerial treatment in 2007 targeted some missed stretches along the channels (particularly in the upstream reaches) as well as any regrowth from areas of less than 100% efficacy.

The current infestation consists of scattered patches of regrowth from established clones, predominantly at low elevation along the channel banks, as well as some recruitment from seedlings. As one moves upstream, the hybrid *Spartina* is much less prevalent, probably a result of greater freshwater and more competition from alkali-bulrush (*Bolboschoenus maritimus*). Hybrid *Spartina* cover on these three sub-areas has been reduced by 90%+, leaving approximately three acres scattered over the footprint of the previous infestation.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr application
Equipment:	Helicopter broadcast (primary), Amphibious tracked vehicle or truck-mounted sprayer (follow-up), Helicopter spot treatment (possible primary method in future years)
Timing:	Treatment should occur between July 15 and September 15 Annual beginning in 2008 until eradicated

Aerial applications continue to be appropriate for these sub-areas in 2008, particularly with the large marsh acreage surrounding the infestation and the absence of public access to the area. In addition, access to the central island is impossible without a boat; conversely, when there is enough water to utilize a boat, the *Spartina* on the edges of the channels is inundated and cannot be treated effectively. The invasive *Spartina* at low elevation has proved more challenging to kill than other infestations. Therefore it is essential that dry time and plant exposure is maximized to achieve the necessary efficacy, and aerial applications optimize these narrow treatment windows. Standard procedure for aerial treatment is to set the schedule based on the tides, choosing a day with a receding tide close to the low at sunrise, to avoid the late morning/early afternoon winds and achieve at least four hours of dry time for the majority of the plants' height.

ACFCD will conduct follow-up, ground-based spot applications of imazapyr to complement the aerial treatment in 2008. These will occur in areas where the helicopter cannot reach, such as under power lines and around water control structures, and these applications can be concurrent with the aerial treatment. Later in the season, after the effects of the aerial applications are visible, ACFCD will also treat any areas missed by the helicopter. Ground-based applications on sub-areas 13a-c will utilize an amphibious tracked vehicle to access remote *Spartina* on the marsh plain and along the channels, and truck-mounted sprayer for infestations close to the levee road. A boat and backpack sprayer may be used to access and spot-treat remaining plants on the central island.

Helicopter spot-treatment may become an appropriate primary method in 2009 or 2010 if the infestation remains large enough to justify the expense; with widely-scattered patches, it is far more efficient than ground-based methods. This is especially true if a portion of the infestation on the central island persists, which is difficult to access at the proper tide for effective treatment by any other means. Otherwise, the primary method in 2009 and beyond will involve ACFCD ground-based applications similar to those described above for 2008 follow-up work.

Monitoring Needs

Due to the large scale of this site, as well as access issues to the central island, ISP inventory monitoring of these sub-areas has been conducted using color-IR aerial photography and heads-up digitizing of the invasive *Spartina* present on the site. As the ISP Control Program and its partners plan treatment of the much smaller, scattered infestations in the future, current year *Spartina* location and area data will be required to efficiently treat the entire infestation each year. Agency staff and vegetation management contractors will require detailed maps to allocate the appropriate resources and to ensure complete treatment within the narrow windows of opportunity available each year.

It is also essential to monitor the completeness of the aerial applications ***within*** each season, and return to the site in September to conduct ground-based clean-up treatment on areas that were missed. Mature *Spartina* that is not treated will normally flower and set seed, potentially infesting adjacent areas that have already been controlled, or even dispersing to a new area of the Bay. Experienced applicators can recognize the subtle signs of imazapyr impacts to treated plants within several weeks, such as yellowing, reddening, or dark blotches on the leaves. Plants that are obviously green and healthy, and are not exhibiting any of these features, should be individually spot-treated as soon as is feasible, no later than September 15 in a given year. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREAS 13D-13E: WHALE'S TAIL NORTH & SOUTH

Sub-Area Partners

Owner(s): CDFG
Manager(s): CDFG
Grantee(s): CWF

Sub-Area Description

The two halves of Whale's Tail have been combined in this Site-Specific Plan due to their proximity and their similarities in ownership and management. The Whale's Tail marshes, located on the eastern shores of the San Francisco Bay Estuary immediately south of the San Mateo Bridge, are a pair of old Cargill salt production ponds that self-restored in 1930. From an aerial view, these two marshes resemble the two flukes of a whale's tail bordering the mouth of Old Alameda Creek to the north and south. The Whale's Tail North Fluke sub-area is a 167-acre marsh bordered to the north by the levees of Mt. Eden Creek and to the east by former salt ponds that will be restored as part of the Eden Landing Ecological Reserve and the South Bay Salt Pond Restoration project. The Whale's Tail South Fluke sub-area is a 156-acre marsh that tapers to a point in the south along shoreline rip-rap, and is bordered to the east by the Cargill Mitigation Marsh.

These two marshes are quite similar with large mid-marsh plains of pickleweed (*Sarcocornia pacifica*) and scattered pans, with gumplant (*Grindelia stricta*) lining the second and third order channels, and saltgrass (*Distichlis spicata*) at higher elevations. The bayward edge of the marsh consists of a complex, undulating sand/shell beach with an eroding scarp composed of clay and cobble, grading into wide mudflats extending westward into the Bay. Two channels flow through Whale's Tail South Fluke marsh to provide the tidal connection for the adjacent Cargill Mitigation Marsh. The first, in the northern portion of the marsh is the smaller of the two, roughly four to six meters across at its mouth. This channel drains from the northern portion of the Cargill site to the east through a small levee breach. A larger channel parallels the eastern levee, with its origin in a 10m-wide breach in the levee separating at the southwest corner of the Cargill site. The channel runs to a small delta into the bay at the southern end of Whale's Tail South Fluke.

Prior to the initiation of full-scale ISP treatment in 2005, the two marshes of Whale's Tail contained approximately 35 acres of invasive *Spartina* representing 10% of the available habitat. The primary non-native cordgrass infestation was along the bayward edge of the marshes, composed of expanses of coalesced clones that had capitalized on (and accelerated) the marsh scarp erosional process, while simultaneously prograding *Spartina*-suitable marsh habitat onto the mudflats bayward. Within the central portion of the marshes, the *Spartina* infestation was established along the edges of channels, at the periphery of the many shallow pans, and in disjunct locations within the wide open stands of pickleweed high marsh throughout the area. The presence of the two large, heavily-infested channels in the South Fluke marsh allowed the *Spartina* to establish farther into the interior of this marsh, utilizing the channels as distribution pathways for propagules.

There were several attempts at *Spartina* control on Whale's Tail North prior to 2005, with limited success. After some mowing at the mouth of Mt. Eden Creek in 2003, a small area of *Spartina* along the bayfront in North Whale's Tail was removed using the Aquamog amphibious excavator as a pilot project in 2004, along with limited applications of glyphosate from truck and backpack in that year. Imazapyr was first utilized on these sub-areas in 2005, with an aerial application to all the bayfront clones which was moderately effective. In addition, there were late-season, ground-based applications to the interior and channels of both marshes utilizing the MarshMog amphibious tracked vehicle, but this did not reduce the infestation substantially because of the October timing. In 2006, aerial applications were conducted on both marshes, including work on the heavily-infested sinuous channels in the South Fluke and follow-up on the bayfront infestation. A crescent along the bayfront at the northern edge of the site was not treated because of concerns about the proximity to the toll plaza for the San

Mateo Bridge. Aerial applications were again conducted in 2007 on all visible *Spartina* hybrids, and the crescent by the toll plaza was treated in September from a truck.

The 2006 work was highly effective, especially along the bayfront where all treated areas have been almost completely eliminated, and since whatever remaining *Spartina* hybrids that were present in 2007 were retreated aerially, there should only need to be limited work on these areas. The interior marsh efficacy was substantial for the first time after 2006, with a marked decrease in the *Spartina* in the larger, heavily-infested channel that connects the Cargill Mitigation Marsh to the tides. There are scattered small patches and individual plants in the interior of both marshes, and some apparent misses from the aerial retreatment in 2007. Most notable of these is the bow-shaped channel just southwest of Cargill Mitigation Marsh where the two channels that feed that marsh join. In addition, the crescent adjacent to the toll plaza is the only area that has received imazapyr treatment in just one year, so this area will definitely require follow-up in 2008. Overall the infestation on these two sub-areas has been reduced by 90%+, leaving approximately three acres scattered across the marshes, channels and mudflats.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr application
Equipment:	Helicopter broadcast (primary), truck-mounted sprayer (toll plaza) Amphibious tracked vehicle or truck-mounted sprayer (primary and/or follow-up), Helicopter spot treatment (possible primary method in future years)
Timing:	Treatment should occur between July 15 and September 15 Annual beginning in 2008 until eradicated

Aerial applications will probably continue to be appropriate for these sub-areas in 2008, particularly with the large marsh acreage surrounding the infestation and the absence of public access to the area. The invasive *Spartina* at low elevation in the channels has proved more challenging to kill than other infestations. Therefore it is essential that dry time and plant exposure is maximized to achieve the necessary efficacy, and aerial applications optimize these narrow treatment windows. Standard procedure for aerial treatment is to set the schedule based on the tides, choosing a day with a receding tide close to the low at sunrise, to avoid the late morning/early afternoon winds and achieve at least four hours of dry time for the majority of the plants' height.

Ground-based imazapyr treatment will be required at the toll plaza crescent in 2008, utilizing a truck-mounted sprayer or amphibious tracked vehicle to deliver the herbicide. This equipment may also be employed as a primary method within the marshes depending on the efficacy from 2007 aerial treatments; if the infestation was reduced significantly to very small patches scattered throughout the system, then a spot-treatment method will be more appropriate than broadcast for 2008. This may best be completed using amphibious tracked vehicle due to the difficult terrain and large size of the site, or it may utilize a helicopter spot-treatment technology such as the spray ball or a shortened boom. If the remaining infestation is located in a discrete portion of the marsh, a crew with backpack sprayers may be the most cost effective method depending on the contractor chosen for the work.

Monitoring Needs

Due to the large scale of this site, as well as access issues, ISP inventory monitoring of these sub-areas has been conducted using color-IR aerial photography and heads-up digitizing of the invasive *Spartina* present on the site. As the ISP Control Program and its partners plan treatment of the much smaller, scattered infestations in the future, current year *Spartina* location and area data will be required to efficiently treat the entire infestation each year. Agency staff and vegetation management contractors will require detailed maps to allocate the appropriate resources and to ensure complete treatment within the narrow windows of opportunity available each year.

If any early season control work is completed, it will also be essential to monitor the completeness of these applications ***within*** each season, and return to the site in September to conduct ground-based clean-up treatment on areas that were missed. Mature *Spartina* that is not treated will normally flower and set seed, potentially infesting adjacent areas that have already been controlled, or even dispersing to a new area of the Bay. Experienced applicators can recognize the subtle signs of imazapyr impacts to treated plants within several weeks, such as yellowing, reddening, or dark blotches on the leaves. Plants that are obviously green and healthy, and are not exhibiting any of these features, should be individually spot-treated as soon as is feasible, no later than September 15 in a given year.

An expansion in the genetic testing of *Spartina* remaining in these sub-areas is required, because there are remaining stands of *Spartina foliosa* that should be preserved. This would serve to provide a seed source within the marsh to begin to restore this important component of the native marsh plant assemblage. If significant stands of native *Spartina* are found, they should be marked in such a manner that the method used for treatment can clearly identify and avoid those areas. If aerial treatment is employed, these markers should be visible from the helicopter and brought to the attention of the pilot during the reconnaissance flight. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 13F: CARGILL MITIGATION MARSH

Sub-Area Partners

Owner(s): CDFG
Manager(s): CDFG
Grantee(s): CWF

Sub-Area Description

The Cargill Mitigation Marsh sub-area is a 49-acre former solar salt production evaporator pond that was restored by opening the site to muted tidal action in 1995, and full tidal action in 1998. It is bounded on the north by the levees of the Old Alameda Creek channel, on the west by the South Whale's Tail marsh, and to the east and south by recently decommissioned salt production ponds that are part of the Eden Landing Ecological Reserve and the South Bay Salt Ponds Restoration Project. The entirety of the site is surrounded by levees, with two breach points on the western levee that drain the site into the Whale's Tail South Fluke. A line of upland habitat islands run north-south down the center of the southern half of the site, staggered at even distances, and two similar but larger islands were created in the southern corners of the marsh.

Since the Cargill Mitigation Marsh was a recently-restored salt evaporator pond, it was largely unvegetated with native salt marsh species when tidal action was restored in 1995 and 1998. Without any biotic resistance to invasion, the marsh had become heavily-infested with large, coalescing clones of invasive *Spartina* at every place where the elevation was appropriate. The majority of the western portion of the site had coalesced into meadows, with the heaviest infestation centered at the southern breach. Several large polygons of open mud still exist that were still too low in elevation to be colonized.

Prior to the first ISP treatments in 2005, Cargill Mitigation Marsh sub-area contained approximately 19 acres of *S. alterniflora* hybrids, representing approximately 40% of this restoration site. Aerial application of imazapyr began in 2005 at this sub-area, and the entirety of the site was treated. However, with the large acreage treated in the surrounding sites over that two-day period, a number of swaths were missed. By the summer of 2006, these stood out in sharp contrast to the surrounding dead *Spartina* from the first imazapyr application. Cargill Mitigation Marsh was retreated in 2006 with an aerial imazapyr application, which hit those missed swaths and all other hybrid *Spartina* on the site. In 2007, a number of clones that appeared dead after 2005 treatment showed some regrowth of less than 5%; these clones were retreated with imazapyr applied by helicopter, along with any other *Spartina* identified on the site.

Treatment has been very effective over most of the site, especially from the 2006 and 2007 imazapyr applications. The *Spartina* just inside the breach in the southwest corner represents the majority of the remaining infestation on this sub-area, with some other low elevation clones along the large channel that have also not been eliminated. The hybrid *Spartina* infestation has been reduced by 90%+, with approximately two acres remaining over this sub-area.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Helicopter broadcast (primary),
Amphibious tracked vehicle (primary and/or follow-up),
Helicopter spot treatment (possible primary method in future years)

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

Aerial application will probably continue to be appropriate for this sub-area in 2008, particularly with the difficult terrain of this site, absence of public access to the area, and use of broadcast aerial in adjacent sites that creates an economy of scale that makes the method cost effective even at smaller acreage. This marsh is such a recent restoration from a salt production pond that a high percentage of the site is still unconsolidated mud that makes ground-based work extremely challenging. In addition, as with other sites around the Estuary, the invasive *Spartina* at low elevation in the channels has proved more challenging to kill than other infestations. Therefore it is essential that dry time and plant exposure is maximized to achieve the necessary efficacy, and aerial applications optimize these narrow treatment windows. Standard procedure for aerial treatment is to set the schedule based on the tides, choosing a day with a receding tide close to the low at sunrise, to avoid the late morning/early afternoon winds and achieve at least four hours of dry time for the majority of the plants' height.

Amphibious tracked vehicles may be employed for late-season follow-up to the aerial application in 2008. The very low ground pressure of these vehicles is probably the only way that ground-based applications could be conducted on this type of site, where an applicator on his own would sink in the mud. By 2009, the amount of invasive *Spartina* in this marsh should be reduced to small individual plants and regrowth over a small percentage of previous clones. At this point, spot treatment would be preferred to broadcast, and amphibious tracked vehicles will most likely become the primary method. A helicopter spot-treatment technology may also be an appropriate primary method by 2009, such as the spray ball or the use of a shortened boom.

Monitoring Needs

Due to the large infestation on this site, as well as access issues, ISP inventory monitoring of this sub-area has been conducted using color-IR aerial photography and heads-up digitizing of the invasive *Spartina* present on the site. As the ISP Control Program and its partners plan treatment of the much smaller, scattered infestations in the future, current year *Spartina* location and area data will be required to efficiently treat the entire infestation each year. Agency staff and vegetation management contractors will require detailed maps to allocate the appropriate resources and to ensure complete treatment within the narrow windows of opportunity available each year.

If any early season control work is completed, it will also be essential to monitor the completeness of these applications *within* each season, and return to the site in September to conduct ground-based clean-up treatment on areas that were missed. Mature *Spartina* that is not treated will normally flower and set seed, potentially infesting adjacent areas that have already been controlled, or even dispersing to a new area of the Bay. Experienced applicators can recognize the subtle signs of imazapyr impacts to treated plants within several weeks, such as yellowing, reddening, or dark blotches on the leaves. Plants that are obviously green and healthy, and are not exhibiting any of these features, should be individually spot-treated as soon as is feasible, no later than September 15 in a given year.

This sub-area did not have any native *Spartina foliosa* due the age of the restoration and the competitive ability of the hybrid *Spartina*. Expanded genetic testing should not be required here unless questionable plants are found during inventory monitoring. The goal will be the elimination of all *Spartina* on the site. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 13G: UPSTREAM OF 20 TIDE GATES

Sub-Area Partners

Owner(s): County of Alameda
Manager(s): ACFCD
Grantee(s): ACFCD

Sub-Area Description

The "20 Tide Gates" is a water control structure on Old Alameda Creek that spans the entire watercourse and is located at the upstream extent of sub-areas 13a, 13b, and 13c. sub-area 13g is a 30-acre area of the Old Alameda Creek channel that continues upstream for approximately one-half mile north to a railroad grade at the edge of Union City. This morphology of this sub-area is similar to the other Old Alameda Creek sites, with two parallel channels and a central island. However, the salinity is much lower than the downstream areas, and a brackish vegetation assemblage dominates. The mid elevation areas are densely covered with alkali bulrush (*Bolboschoenus maritimus*) and some tule (*Schoenoplectus acutus*) and cattail (*Typha* sp.), with a pickleweed (*Sarcocornia pacifica*) understory on the margins and where this species is able to get enough sunlight to thrive.

In 2005, this sub-area contained approximately three acres of invasive *Spartina* representing 10% of the site. ACFCD began applying imazapyr to the infestation in that year, utilizing an amphibious tracked vehicle to transport the herbicide and personnel around to the patches. The majority of the infestation on this sub-area was concentrated in the first 200 m upstream of the 20 Tide Gates, with some large clones that had coalesced on the island, and a linear stand along the south channel banks. Retreatment was conducted much earlier in the season in 2006 and 2007 using the same method and delivery system.

Initial, late-season control work was not very effective, but retreatment in 2006 and 2007 has reduced the infestation to small, scattered patches. This site is not used by California clapper rail for breeding, so ACFCD was able to begin their ground-based applications at the optimal time for *Spartina* treatment in late June/early July. This subsequently reduced the hybrid *Spartina* on the site by 99% to a few hundred square feet. With the tall, dense cover of brackish marsh species on this sub-area, finding the invasive cordgrass on the ground is very challenging.

Treatment Strategy, Methods, and Timing

Method: Imazapyr application

Equipment: Amphibious tracked vehicle (primary)

Timing: Treatment should occur between June 15 and September 15
Annual beginning in 2008 until eradicated

Although aerial treatment would be the easiest and most effective method at this sub-area because of the dense cover, the ISP's Programmatic EIR does not allow for this delivery system within one quarter mile of residential sensitive receptors. Ground-based applications will continue in 2008, and can begin in June as soon as the plants have sufficient leaf surface area to uptake a lethal dose from an imazapyr application. An amphibious tracked vehicle is the most appropriate equipment for this application because of the scattered nature of the remaining infestation, the difficult terrain, and the long distance from the levee road to the treatment areas. Hauling hose from a truck-mounted sprayer would be problematic, and walking through the dense brackish marsh vegetation with a backpack sprayer would be extremely time-consuming. In addition, visibility on foot would be low, and the added height of the amphibious vehicle would help to survey the surrounding vegetation for scattered patches of hybrid *Spartina*.

Monitoring Needs

Due to the large marsh acreage on this site, as well as access issues, ISP inventory monitoring of this sub-area has been conducted using color-IR aerial photography and heads-up digitizing of the invasive *Spartina* present on the site. As the ISP Control Program and its partners plan treatment of the much smaller, scattered infestations in the future, current year *Spartina* location and area data will be required to efficiently treat the entire infestation each year. Agency staff and vegetation management contractors will require detailed maps to allocate the appropriate resources and to ensure complete treatment within the narrow windows of opportunity available each year.

The dense brackish marsh vegetation on this site makes ground-based surveys very challenging. The ISP will begin a pilot project using aerial monitoring from helicopter in 2008 to inform control work at selected sub-areas, and the characteristics and location of this site make it appropriate for this new reconnaissance method. As part of the Old Alameda Creek and Whale's Tail complex, sub-area 13g is adjacent to other large sites that could be grouped to make the aerial survey more cost effective. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREAS 13H, 13I, 13J: EDEN LANDING (NORTH CREEK, POND 10 & MT. EDEN CREEK)

Sub-Area Partners

Owner(s): CDFG
Manager(s): CDFG
Grantee(s): CWF

Sub-Area Description

Eden Landing Ecological Reserve contains 6,600 acres of former salt ponds that were acquired from Cargill Salt as part of the South Bay Salt Ponds restoration effort. Eden Landing is bordered by Hwy 92 and the San Mateo Bridge to the north and the Alameda Flood Control Channel to the south, with Old Alameda Creek bisecting the complex and light industry and suburban housing to the east. The North Creek, Pond 10, Mt. Eden Creek sub-

areas are part of the initial steps to return tidal exchange to portions of this complex, a long-term collaboration between CDFG, EBRPD, the Wildlife Conservation Board, and a number of municipalities. North Creek is a channel that was opened to tidal action in winter 2005 by excavating a 60-meter section of the levee along the north channel of Old Alameda Creek about 1.3 miles upstream of the mouth. Pond 10 is located in the northwest corner of Eden Landing on the north side of the mouth of Mt. Eden Creek, and this pond was opened up to tidal action in summer 2004. The mouth of Mt. Eden Creek has recently been widened to accommodate greater tidal flows. Both sub-areas are positioned within the large matrix of salt production ponds that are in varying stages of transformation from commercial functions to habitat.

Neither North Creek nor Pond 10 was suitable habitat for *Spartina* until they were recently opened up to tidal exchange. Invasion was amazingly swift, especially along the freshly excavated banks of North Creek. This channel was opened off the north channel of Old Alameda Creek in late 2005, and since that side of the creek was only partially treated in that first year, an abundance of hybrid *Spartina* seed was introduced to North Creek. This pioneering infestation was discovered in 2006, and by summer 2007 it had spread to infest both banks of the new channel for a full mile upstream of the breach, and the cover class had increased dramatically. This linear infestation received an aerial imazapyr application in 2007 as part of the application to retreat Old Alameda Creek and Whale's Tail for the third year.

Pond 10 is maintained at a fairly high water depth, so it was not anticipated that *Spartina* would be able to establish. For this reason it was not originally surveyed in 2005, but the newly colonized cordgrass was found in 2006 along with scattered patches along the banks of Mt. Eden Creek. An island had been created just inside the breach for Pond 10, and the higher elevation edges provided a place for *Spartina* to establish. There are also scattered patches directly adjacent to the breach on the edges of the channels cut by the incoming tide and at the toe of the levee. This pioneering infestation was also treated with an aerial imazapyr application in 2007 as part of the application to retreat Old Alameda Creek and Whale's Tail for the third year.

Although the infestations in these two sub-areas are small relative to the surrounding matrix, totaling less than one acre of actual *Spartina*, their locations scattered over these newly opened areas serves to heighten the threat they pose and therefore the priority level for control. These new systems have no biotic resistance to invasion, so the hybrid *Spartina* has no competition from other plant species and can colonize and spread quickly in any suitable substrate.

A late-season survey of North Creek in 2007 revealed some areas that were missed by the helicopter treatment, and brought to light certain nuances to include in the Site-Specific Plans. The right-angle side channel that begins 200 m from the mouth is heavily infested and has lots of shallowly-inundated mudflat that is open to rapid invasion. This appears to have been missed by the helicopter, along with several other segments along the main channel, including *Spartina* growing up against flood control structures and patches at the toe of the levee. Pond 10 has a number of clones that are several meters in diameter, and Mt. Eden Creek has numerous first-year *Spartina* plants scattered along the channel and on a wider mudflat area in the first kilometer of the watercourse.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr application
Equipment:	Helicopter broadcast (primary North Creek), Truck-mounted sprayer or amphibious tracked vehicle (primary/follow-up North Creek), Airboat (primary for Pond 10/Mt. Eden Creek) Helicopter spot treatment (primary for Pond 10/Mt. Eden Creek)
Timing:	Treatment should occur between June 15 and September 15 Annual beginning in 2008 until eradicated

Depending on the efficacy from the 2007 applications, some adjustments may be made to the equipment used to treat the remaining infestation in 2008. With the difficulties encountered in 2007 along North Creek, it is apparent that an aerial application won't be able to catch all the small patches around weirs and other structures. Since the entire infestation along this channel is directly adjacent to the levee road on either side, a truck-mounted sprayer or amphibious tracked vehicle will need to be used to complete the treatment. An alternative would be to utilize the truck as the primary method, which would be most appropriate if the 2007 control work reduced the infestation significantly and made a ground-based application reasonable.

The infestation in Pond 10 and along lower Mt. Eden Creek contains numerous scattered young *Spartina* plants growing in soft mud that is not adjacent to a levee road. Helicopter broadcast treatment could easily be extended to hit these areas during retreatment of other sub-areas in this complex. To reduce the amount of herbicide over-spray onto the mudflat or marsh, it would be preferable to utilize a helicopter spot treatment technology, such as shortening up the boom or using the spray ball. The advantage of a short boom over the spray ball is that it does not require an additional mobilization effort; during a broadcast aerial application day, the outside boom nozzles could be shut down before a spot-treatment site application. This would leave just the nozzles between the skids on, a reduction of about 70% of the length of the broadcast boom.

Another primary treatment method for the Mt. Eden Creek sub-area would be application by airboat. This equipment is the only thing that could travel across the soft mud to some of these outliers. However, the mobilization effort for the airboat needs to be considered, and there would need to be enough *Spartina* in those areas to justify this expenditure of time and money over another method.

As other ponds or channels in the Eden Landing complex are opened to tidal exchange, they too will be vulnerable to *Spartina* invasion. With the ISP entering its fourth year of Baywide treatment in 2008, dispersal to new sites has been substantially reduced but not altogether eliminated. If infestations are found in any of these ponds during monitoring efforts, the ISP will work with the landowner and appropriate ISP partners to rapidly respond with spot treatment methods and control the *Spartina* within that year if possible.

Monitoring Needs

All areas of the Eden Landing Ecological Reserve that are open to tidal action need to continue to be monitored annually for hybrid *Spartina*. Once propagules have entered the system, they can spread extremely rapidly; with the inaccessible nature of some of these areas, even a small pioneering infestation can be a huge effort to control.

The scattered nature of this infestation requires a detailed mapping effort during monitoring to inform the control work. The scope of the infestation must be documented so the appropriate amount of material is allocated for the work. The location of the *Spartina* must include detailed information to help determine the best type of equipment to deploy for the substrate or other access issues, and to save time navigating to the scattered plants to complete treatment. If early season treatment is conducted, especially using broadcast aerial, then additional monitoring of the completeness of the application is required. Areas missed by the helicopter should receive a follow-up application using a ground-based method appropriate to the terrain. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Whale's Tail Complex, Alameda County, TSN: ISP-2004-13, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original seven sub-areas remain as defined in that plan, and three new sub-areas have been added. The three new sub-areas are in the immediate vicinity of the existing sub-areas, and are extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 15: SOUTH BAY MARSHES COMPLEX, SANTA CLARA & SAN MATEO COUNTIES

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for South Bay Marshes, Santa Clara & San Mateo Counties, TSN: ISP-2004-15, 2005-2007 Control Seasons) dated May 2005. The original two sub-areas remain as defined in that plan, and one new sub-area has been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partners. The grant recipients for this site are:

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource.

San Mateo County Mosquito Abatement District, 1351 Rollins Road, Burlingame, CA 94010; *James Counts, Field Operations Supervisor, (650) 344-8592. james@smcmad.org.* As the Coastal Conservancy grant recipient for the Faber Laumeister sub-area, SMCMAD performed the treatment in 2007 on that site with their personnel and equipment. The marshes of San Mateo County are areas where the SMCMAD regularly conducts mosquito control efforts, and control of the *Spartina* on these sites would potentially diminish the amount of mosquito breeding habitat available that the agency would need to monitor and treat for the insects.

Other Partners:

Santa Clara Valley Water District, 5750 Almaden Expressway, San Jose, CA 95118-3686*; Lisa Porcella, (408) 265-2607 x 2741, lporcella@valleywater.org.* As a mitigation element of the SCVWD's Stream Maintenance Program, the SCVWD proposes to undertake a 5 year program of invasive *Spartina* monitoring and control of up to 10 acres of infestation in the South Bay. In 2003 the SCVWD conducted an extensive mapping and survey effort to identify non-native *Spartina* patches in South San Francisco Bay creeks, sloughs, and non-diked tidelands. The SCVWD will provide the staff, equipment, and money for this project.

US Fish and Wildlife Service, Don Edwards National Wildlife Refuge, 1 Marshland Road, Fremont, CA, 94605*; Joy Albertson, (510) 790-0222 x 31, joy_albertson@fws.gov.* The Don Edwards National Wildlife Refuge (DENWR) recently acquired 10,000 acres of diked 'salt ponds' in the South Bay, which are slated for restoration to tidal marsh habitat in the coming years. Several of these ponds are directly adjacent to already invaded tidal marshes and are therefore at risk of future invasion themselves. The DENWR has implemented control programs on their properties in the past with moderate success, but with the addition of park territory and the increase in invasion pressure they will need assistance from adjacent landowners and managers to help control the threat. The DENWR will be providing consultation and coordination services to the Project.

City of Mountain View, Shoreline Regional Wildlife and Recreation Area, 3070 N. Shoreline Blvd. Mountain View, CA 94043. *Kristina Rockhold Senior Recreation Coordinator City of Mountain View (650) 903-6070, Kristina.Rockhold@mountainview.gov.* The City of Mountain View manages the large shoreline complex known as the Shoreline Regional Wildlife and Recreation Area, which includes large public facilities such as the Shoreline Amphitheatre, and shoreline open space, including tidal marsh areas such as Stevens Creek Marsh and Charleston Slough.

Site Description

Map Site 15: South Bay Marshes Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

15a South Bay Marshes - Santa Clara County **Map**
15b Faber-Laumeister Marsh **Map**
15c* Shoreline Regional Park at Mountain View **Map**

* Sub-area added since the 2005-2007 *Spartina* control plan

The areas covered in this site plan include the shoreline of the South Bay from Coyote Creek in the east, around the southern shoreline of the Bay clockwise to Faber-Laumeister Marsh in East Palo Alto in the west. Within this large area are many marshland habitat types, including restored salt ponds, tidal sloughs, creek deltas, fringing tidal marsh benches, open mudflats, historic tidal marsh plains and other habitat types. In Santa Clara County alone, over 100 miles of undulating shoreline make up the complex area covered in this plan. Much of the area has been developed for light industrial uses, but there are also public parks and trails along portions of the shoreline. Within the City of Mountain View, the Shoreline Regional Wildlife and Recreation area includes the Shoreline Amphitheater where thousands of concertgoers attend events year-round. Some of the marshland areas are inaccessible to the public, like the areas around the mouth of Coyote Slough which are owned by the US Fish and Wildlife Service as part of the San Francisco Bay Don Edwards National Wildlife Refuge.

The infestation of non-native *Spartina* in the South Bay is scattered amongst the sloughs, marshes and creeks of the entire shoreline. In the east, where Coyote Creek empties into the Bay, the infestation is very concentrated along the shoreline near the mouth, where new sediments have been deposited over the last few years. Small and large pioneering clonal patches are here interspersed with native *Spartina*. Also in this area is the infestation around the Knapp Tract, a soon to be restored salt pond system. This infestation has established within an existing native *Spartina foliosa* stand that lines the edges of the marsh. Here the morphologies of the hybrid *Spartina* present various characteristics intermediate to either of the parent plants. The area around the Knapp Tract represents the single largest concentration of non-native *Spartina* in this site.

The rest of the shoreline consists predominantly of scattered, individual clones of *Spartina* spread out along the sloughs and marsh edges that define this part of the Bay. Except in the case of the large infestation at Stevens Creek Marsh in Mountain View, these disparate clones represent a significant time commitment to access and treat, involving driving down long, convoluted levee systems. These infestations are, in general at a stable level as of winter 2007, though the infestation at Knapp Tract will continue to expand and export propagules off site if not comprehensively treated in 2008 and beyond.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 15A: SOUTH BAY MARSHES, SANTA CLARA COUNTY

Sub-Area Partners

Owner(s): Santa Clara County
Manager (s): Santa Clara County Public Works Agency
Grantee(s): CWF

Sub-Area Description

The South Bay Marshes are located at the extreme southern tip of the San Francisco Bay, with both San Mateo and Alameda Counties bordering to the northwest and northeast, respectively. For the purposes of this plan, the area includes over 100 miles of shoreline, and encompasses some 1,750 acres of marshland. This highly diverse area includes extensive current and former salt ponds, restoration marshes, creek channels and sloughs, bay fill, large intact salt marshes, brackish marsh areas, slough edge marshes, pans, islands, mudflats, sand/shell beaches and other marsh habitats. Included within this area are Guadalupe Slough, Coyote Creek, Alviso Slough, Mountain View Slough and San Francisquito Creek. There is a high degree of complexity in the South Bay Marshes that will be enhanced significantly by the work of the South Bay Salt Ponds Restoration Project, which will convert sizable portions of former salt-making ponds to various types of marsh habitat.

Treatment along the shorelines of Santa Clara County has been done since 2004 by the Santa Clara Valley Water District. In 2004, the District worked along the Bay edge and along the sloughs throughout the area using both backpacks and truck-mounted spray equipment to apply glyphosate herbicide to individual scattered clonal patches found mostly along the southern shoreline of the Bay. Efficacy from these treatments was low, and the infestation in 2005 had grown from the levels observed in 2004.

In 2005 and 2006 the District again worked along the levees and shoreline of the large marshland area at the south end of the Bay, targeting the non-native *Spartina* found there with herbicide treatments. These treatments utilized imazapyr herbicide in place of glyphosate. The ISP and the Refuge also aided with selected aerial treatments at the mouth of Coyote Creek where ground-based treatment efforts were not used. The results from the ground-

based treatments were somewhat less than anticipated, but many of the treated areas did show a diminishment in the extent of the plants. Nevertheless, much of the area under the District's management was ripe for new colonization, and many new infestations were discovered and mapped by both the District and the ISP during that time.

In 2007, the District's applicators treated all known areas of non-native *Spartina* infestation accessible by ground and boat. The targeted aerial applications at the mouth of Coyote Creek were also repeated, though it was observed that the infestation there had increased as well since the previous year as a result of many new young plants. Final efficacy assessments of the work done in 2007 will be done in late spring or early summer 2008.

Many of the small, individual clonal patches along the shorelines of Santa Clara County have been significantly impacted by the work that has been done over the last four years. However, the majority of the small patches still support remnant sprigs of non-native *Spartina* that will require treatment in the coming seasons. All areas previously infested will need re-visiting for the foreseeable future.

In addition, new hybrid clones have grown up in existing patches of native *Spartina*, or adjacent to previously treated stands of non-native *Spartina*. An area of great concern is along the shoreline of the Knapp Tract on the southern shoreline of Coyote Creek, near the creek's mouth. This area has rapidly expanded over the last two seasons, and the infestation there has outpaced the ability of ground-based applicators to control effectively. The morphologies presented by the plants in the northeast and northern boundaries around Knapp Tract are diverse. Transect sampling of plant material for genetic analysis was conducted in autumn 2007 in this area, and the results showed a complex mix of cryptic hybrids throughout the area. Aside from Stevens Creek Marsh, discussed below, the areas around Knapp Tract represent the largest infestation in Santa Clara County.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Truck-mounted spray equipment Backpack sprayers Boats Amphibious vehicles Helicopters (aerial applications)
Timing:	June-July start time for all herbicide treatments

Where accessible, the scattered Bay-edge infestations that pepper the shorelines of the marshes and sloughs within the Santa Clara County shoreline can be treated using backpacks and truck-mounted spray equipment, as has been done in the past. For discrete clonal patches that lie farther out on mudflats or within the marsh plain that are not bisected by deep channels, amphibious vehicles can be used to ferry equipment, materials and applicators to treatment locations, or to treat the clones directly with onboard spray equipment. Boats may also be uses to access areas within the main channels or areas where there is no efficient or safe ground access to treatment areas.

In larger areas of infestation, like around the Knapp Tract area, aerial applications of imazapyr herbicide will be used. This method will be employed until the infestations there have been reduced to the extent that ground-based treatment options prove more efficient than aerial applications.

All treatments in the South Bay should be done as early as possible in the growing season. Previous applications in the area have had to wait until post-September 1st to access the marshes, and typical life-history for the *Spartina* in the South Bay has the plants flowering and setting seed at this time of year. Optimal treatment of these plants should occur from June through August, when the plants are actively growing and will more readily uptake herbicide for translocation through plant tissues. Without early season treatments, the infestations in this area will continue to expand, and eradication of the plants in this vulnerable and ecologically important area will not be possible.

Monitoring Requirements

As the infestations in this area have either been diminished as a result of treatments, or have newly expanded with a range of morphologies, detailed genetic analysis of the area will be necessary for some time to come. Especially around known centers of infestation, and selectively along previously uninfested areas, yearly genetic sampling of *Spartina* and the production of maps based on this data will be required for accurate control work. In the Knapp Tract area, yearly parallel transect sampling of the main areas of infestation will be necessary.

SUB-AREA 15B: FABER-LAUMEISTER MARSH

Sub-Area Partners

Owner(s): US Fish and Wildlife Service
Manager (s): US Fish and Wildlife Service
Grantee(s): San Mateo County Mosquito Abatement District

Sub-Area Description

For the purposes of this plan, the area called Faber-Laumeister Marsh includes the marshlands along the shoreline of East Palo Alto from Bay Road at Cooley Landing south to San Francisquito Creek. This roughly 210-acre complex of tidal marshlands is a remnant patch of a much larger historical marshland community, and maintains a high level of species diversity and habitat complexity. The area contains wide meadows of mixed marsh vegetation frequently broken up with sinuous small and large channels lined with dense hedges of *Grindelia stricta* and native *Spartina foliosa*. Large populations of the endangered California clapper rail inhabit this marsh, as well as the salt marsh harvest mouse.

The infestation at Faber-Laumeister marsh is limited to three relatively small clones. One is within the San Francisquito Creek channel where it turns from an east-west orientation to a north-south orientation, a clone along the eastern levee system in the southern section of the marsh, and a clone along the northernmost channel in the southern portion of the marsh. The main marsh plain is otherwise uninfested.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Backpacks for herbicide application

Timing: June-August start-time for herbicide application

Treatment of the plants in this marsh will be relatively straightforward, with applicators walking the marsh to the target clones, using backpack sprayers to treat the plants. Access should be along the levees that border the marsh, and treatment should be done in June or July for the optimum efficacy.

Monitoring Requirements

As has been done in the past, yearly ISP inventory monitoring at this site utilizing GPS mapping will be required to identify the locations of clones in this marsh. Random genetic sampling of clonal patches within the marsh should be undertaken each year where field identification of native *Spartina foliosa* is in question.

SUB-AREA 15C: SHORELINE REGIONAL WILDLIFE AND RECREATION AREA AT MOUNTAIN VIEW

Sub-Area Partners

Owner(s): City of Mountain View
Manager (s): Shoreline Department of Parks and Recreation
Grantee(s): CWF

Sub-Area Description

The City of Mountain View's Shoreline Regional Wildlife and Recreation Area includes several tidal sloughs, Bay-front tidal marsh habitat and restored tidal marsh areas. Two of the main marshes within this area are the Charleston Slough marsh and the Stevens Creek Marsh, both of which have infestations of non-native *Spartina*.

Charleston Slough is a 90-acre restored, formerly-diked salt evaporation pond on the western border of the Recreation Area. The marsh is almost entirely unvegetated with large central expanses of mudflat and channels being the defining features of this marsh. However, along the levee edges that delineate the boundaries of the marsh, scattered populations of marsh vegetation have begun to establish. These include patches of native and non-native *Spartina*, as well as other tidal marsh vegetation.

Stevens Creek Marsh, a smaller marsh at roughly 30 acres, is also a restored formerly diked salt pond, but Stevens Creek is highly vegetated. The marsh is located on the eastern end of the Recreation Area, at the Bayward end of the Stevens Creek Trail. The marsh has well-established populations of native tidal marsh plant species including broad meadows of native *Spartina foliosa*. Within this native matrix however, a sizeable population of non-native *Spartina* hybrids has been expanding over the last 3-5 years.

Treatment work at the Charleston Slough area has been done since 2005, with the Santa Clara Valley Water District spraying the few non-native plants that grew here with herbicide. In 2007, the work was taken up by CWF contracted crews. All areas within the Charleston Slough site have been treated using either backpack sprayers or truck-mounted spray equipment.

2007 was the first year of treatment in the Stevens Creek Marsh site. Crews worked along the levee edges using both backpack sprayers and truck-mounted spray equipment to treat all identified clones in the marsh. Imazapyr herbicide was applied to all plants, and the treatment occurred in late September when most of the plants had finished flowering and were going to seed.

The infestation at Charleston Slough was never large, and what remains after the several seasons of treatment is very stunted and limited to only a few locations in the marsh, especially along the western and northern edges. The plants here are grazed by shorebirds (geese perhaps) and though genetically identified as non-native *Spartina alterniflora* hybrids, are short and distinctly lacking in the typical hybrid vigor found in neighboring stands.

As 2007 was the first year of treatment on the Stevens Creek Marsh site, the infestation as of winter 2007 remains unchanged from its pre-treatment condition. At treatment in 2007, several dozen large clonal patches of variable morphologies were scattered throughout the marsh, and wide swaths of uniform stands of *Spartina* of unknown genotype dominated the marsh. All morphologically obvious clones were targeted in this marsh, and efficacy assessments of the treatments completed here will be done in late spring or early summer 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Backpack sprayers
Truck-mounted sprayers
Amphibious vehicles
Helicopters
Boats

Timing: June start-time for herbicide application

Treatment along the shorelines of Charleston Slough can be readily done using either backpacks or trucks driving along the levees that line the marsh. Any non-native *Spartina* that is found within the wide mudflats in the center of the marsh will be more difficult to treat. Depending on the extent and location of any new clones on the interior, airboats or amphibious vehicles might be used to access the plants for treatment. As of winter 2007, there were no plants within the mudflat areas, let alone non-native *Spartina*.

At the Stevens Creek site, two parallel rows of power lines bisect the marsh lengthwise running north to south. As a result, aerial treatments here will be problematic if they can be done at all. Pilots who would be contracted to do the work will need to do pre-application ground reconnaissance of the site to assure that aerial treatments are possible on this site. Although aerial treatments at the Stevens Creek site would provide the most efficient treatment of this infestation, they may, in fact, not be possible here. As a result, continued use of ground-based treatment will be used, including backpacks, trucks and amphibious vehicles. All of these methods will be used to apply imazapyr herbicide applications to the target plants in the marsh. The use of boats in this particular marsh is not prescribed as the vegetation in this marsh is well developed and areas where a boat could readily navigate are few.

Monitoring Requirements

Both sites within the Recreation Area will require ground-based GPS mapping of the clones in the marsh. This effort will also need to include genetic sampling, as the plants along the shoreline of Charleston Slough are cryptic and difficult to discern morphologically, and the array of morphologies presented by the plants in Stevens Creek is substantial. Complete eradication of the non-native hybrids is the goal in both of these marshes, but Stevens Creek will require especially detailed mapping of the hybrid individuals in the marsh.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for South Bay Marshes, Santa Clara & San Mateo Counties,

TSN: ISP-2004-15, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original two sub-areas remain as defined in that plan, and one new sub-area has been added. The new sub-area is in the immediate vicinity of the existing sub-areas, and is extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-area, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 16: COOLEY LANDING SALT POND RESTORATION, SAN MATEO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Cooley Landing Salt Pond Restoration, San Mateo County, TSN: ISP-2004-16, 2005-2007 Control Seasons) dated May 2005. The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partners

A portion of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

San Mateo County Mosquito Abatement District, 1351 Rollins Road, Burlingame, CA 94010; *James Counts, Field Operations Supervisor, (650) 344-8592. james@smcmad.org* The San Mateo County Mosquito Abatement District (SMCMAD) has been working along the shoreline of San Mateo County since 1953, and has extensive knowledge of the marshes and shoreline as well as the appropriate equipment and expertise for safe, efficient control work in many types of marshland settings. The work done at Cooley Landing in 2005 and 2006 was contracted through S. S. Papadapulos and Associates, Inc., but in 2007 work on this site was done through SMCMAD.

Other Partners:

StarLink Logistics, Inc. (SLLI) One Copley Parkway, Suite 309, Morrisville, NC 27560; *Mike Rafferty, SS Papadapulos & Associates, Inc., 116 New Montgomery St., Suite 9001, San Francisco, CA 94105-3629, (415) 896-9000, mrafferty@sspa.com.* SLLI is the project sponsor for the Cooley Landing Salt Pond Restoration Project. In 1994, the San Francisco Bay Regional Water Quality Control Board (RWQCB) directed Rhone-Poulenc, Inc., to remediate a site adjacent to 1990 Bay Road in East Palo Alto, California (SCR Order 94-042). The remediation resulted in the loss of 3.34 acres of U.S. Army Corps of Engineers jurisdictional wetlands, which required mitigation at a 3:1 ratio. To mitigate for the loss of wetlands occurring as a result of this work, the Cooley Landing Wetland Restoration Mitigation and Monitoring Plan (H.T. Harvey & Associates and Phillip Williams and Associates, 1998) proposed the restoration of 115 acres of tidal wetland at the Cooley Landing site.

Midpeninsula Regional Open Space District, 330 Distel Circle, Los Altos, CA 94022-1404; *Cindy Roessler, Resource Manager, (650) 691-1200, croessler@openspace.org.* Cooley Landing is part of the Ravenswood Open Space Preserve owned by the Midpeninsula Regional Open Space District. Cooley Landing will continue to be part of the Ravenswood Open Space Preserve following completion of the restoration of the former salt pond.

Site Description

Map 1 Site 16: Cooley Landing is a 165-acre salt marsh restoration site located at the northwestern point of the South
Map 2 San Francisco Bay Estuary, south of the Dumbarton Bridge and adjacent to the point where the Hetch-Hetchy Aqueduct makes landfall on the western shore at Menlo Park (see Attachment 3, "*Spartina* Control Site Maps"). The site is a former salt production evaporator pond that is undergoing restoration to tidal marsh. Initial restoration activities were completed between September and December of 2000, and included the excavation of two breaches through the east levee at locations of historic tidal channels. Re-vegetation of the former salt pond is expected to occur through natural colonization. Performance criteria for the restoration of Cooley Landing requires 70 percent cover of salt marsh vegetation and less than five percent cover of non-native vegetation by the tenth year following restoration. Cooley Landing is part of the Ravenswood Open Space Preserve.

Treatment of the non-native *Spartina* at Cooley Landing began in 2003 with mowing implemented on the small patches of non-native *Spartina* that were identified in the channel on the south side of the main marsh, along the southern inner bank of the Bay-side levee, and on the outer bank of the levee. No other treatments were done on the site in this year.

In 2004, applications of glyphosate herbicide were made to a portion of the infestation in the marsh, predominantly along the central wooden walkway that bisects the marsh and around the edges of the levee system that borders the marsh. The infestation at this time was still somewhat limited, though the clones on the outer edge of

the levees continued to expand. These areas were also treated in 2004. Unfortunately, the treatments done in 2004 resulted in very poor efficacy.

In 2005, limited ground-based treatments were again used, including the use of an airboat to access the central, expanding portions of the infestation in the marsh. This year however, saw the beginning of the use of imazapyr herbicide in place of glyphosate. Again the edges of the marsh and the boardwalk areas were targeted, with truck mounted spray equipment and backpacks, respectively. This work resulted in discernable dead areas, but the overall impact on the infestation as a whole was small. As can be typical with the first season of imazapyr application, some treated plants were impacted, but not completely killed. At the beginning of 2006, the infestation was still expanding in the marsh.

In 2006 aerial applications began at Cooley, with a helicopter equipped with a boom flying low over the marsh plain to apply the imazapyr herbicide mixture. Most of the marsh area that contained non-native *Spartina* was treated in this way, and by treatment season in 2007, the majority of the infestation in the marsh was showing signs of being controlled. Notable areas of exception include the zones under the power lines that the helicopter could not treat, and those areas outside of the main marsh.

In 2007, aerial applications were again done on the site, but this time the aerial effort was followed by a ground-based treatment along the periphery of the marsh and within the marsh along the boardwalk. Applicators used trucks along the levees and backpacks within the marsh itself to get at those areas that were inaccessible to the helicopter. Efficacy estimates from this treatment effort will be conducted in late spring or early summer of 2008.

The infestation at Cooley Landing has been diminished by the treatments done on the site, but as of winter 2007, there remain significant clonal patches of non-native *Spartina* in the marsh. The main areas of continued infestation are underneath the power lines that run north-south through the marsh, where helicopter treatments have not been able to access, and near the mouths of the breached levees on the east side of the marsh. These areas contain the extremely heterogeneous mixture of *Spartina* morphologies indicative of the hybrid swarm. There is the potential that the 2007 treatments in these areas will have reduced the extent of these hybrids, but final efficacy assessments of the 2007 work can only occur in late spring or early summer 2008.

An additional area of concern is along the outer edge of the marsh. Areas to the north and northwest of the main portion of the marsh support mixed marsh pickleweed communities and do contain several large non-native hybrid *Spartina* clones. As of winter 2007, there were only a few of these clones and they were all treated earlier in the year, but they could threaten to expand in the area if uncontrolled. The last area of concern at the Cooley Landing site is on the eastern Bay edge of the marsh. This area has received several seasons of control work, yet still supports scattered remnant patches of non-native *Spartina* within sizeable swards of native *Spartina foliosa*. Continued, targeted control work in this area will be very important in controlling the infestation at the site overall.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Amphibious Vehicles
Truck-mounted spray equipment
Backpacks
Boats
Aerial (helicopter) broadcast applications

Timing: June-August start time for ground-based and aerial treatments

The efficacy assessments of the 2007 treatments at Cooley will be used to determine whether one or more treatment methods should be used on the remaining non-native *Spartina* in this marsh. Broadcast aerial applications of imazapyr herbicide to the exposed areas of the marsh (where the marsh is not proximate to power lines) should be completed in early July.

Around this time, either preceding or following aerial applications, the site should be targeted for ground-based treatment in the areas that are either inaccessible to the aerial applications or where the extent of the *Spartina* has been reduced to a level where aerial broadcast applications would be inefficient. For the central portions of the marsh that would be difficult or dangerous to access on foot, amphibious vehicles should be used at low tide to both access the clones targeted for treatment and to ferry materials to applicators working in the marsh. Applica-

tors can also access the central portion of the marsh via the wooden walkway that runs under the power lines on the site. As appropriate, boats can be used at a suitable tide to do treatment or ferry applicators and materials or both. Trucks working along the levees that surround the marsh can access those plants that are within the radius of the hose rig on the truck.

Monitoring Requirements

Cooley Landing Salt Pond was colonized by vegetation during the main expansion of non-native *Spartina* hybrids in the central and south bay in the early 2000's. As a result, the site has supported an extremely heterogeneous mixture of *Spartina* hybrid phenotypes adjacent to native *Spartina foliosa* stands. Field identification of plants targeted for treatment becomes extremely difficult when you combine the occasional sub-lethal effects of herbicide applications that can result in morphological similarities between treated hybrids and adjacent natives, newly establishing native seedlings that are indistinguishable from hybrid seedlings, as well as an undulating substrate that distorts the relative heights of individual *Spartina* plants in the marsh. For these reasons, the *Spartina* in Cooley Landing should be extensively sampled for genetic analysis, and the results of this sampling effort will inform the treatment of the plants on the ground. Parallel transect sampling of all patches of *Spartina* in this marsh will be necessary to determine the location of each of the hybrid individuals found here.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Cooley Landing Salt Pond Restoration, San Mateo County, TSN: ISP-2004-16, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The site boundaries remain as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 17: ALAMEDA AND SAN LEANDRO BAY COMPLEX, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Alameda and San Leandro Bay Complex, Alameda County, TSN: ISP-2005-17, 2005-2007 Control Seasons) dated May 2005. All 13 sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly the project partners. The grant recipients for this site include:

County of Alameda Public Works Agency, 4825 Gleason Drive, Dublin, CA 94568*; Saul Ferdan, Weed and Pest Control Supervisor, (925) 803-7011, saul@acpwa.org*. The County of Alameda Public Works Agency (ACPW), or the Alameda County Flood Control District have jurisdiction over most of the area contained within the Coliseum Channels sub-area in this plan. They also have a partial responsibility for control on the San Leandro Creek Channel. ACPWA aims to control non-native *Spartina* within these channels in order to restore flood control capacity as well as enhance wildlife habitat in the area.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource.

East Bay Regional Parks District, 2950 Peralta Oaks Court, Oakland, California 94605: Peter Alexander, Invasive *Spartina* Coordinator, *(510) 635-0135, palexander@ebparks.org*. EBRPD manages the Martin Luther King Regional Shoreline in Oakland, which includes essentially all of the shoreline within San Leandro Bay. These sites include Elsie Roemer Bird Sanctuary, Arrowhead Marsh, MLK New Marsh, the MLK shoreline, and several others.

City of Alameda, Department of Public Works Clean Water Program, 950 West Mall Square, Room 110, Alameda, CA 94501, *James Barse, (510) 749-5857, JBarse@ci.alameda.ca.us*. The City of Alameda owns and manages the shoreline of both Alameda Island proper, and Bayfarm Island. Within this area are the Elsie Roemer Bird Sanctuary, Alameda Island East, the Oakland Inner Harbor and Bayfarm Island.

Other Partners:

Port of Oakland, 530 Water Street, Oakland, CA 94607. *Carol Jones, (510) 627-1132,cjones@portoakland.com*. The Port of Oakland owns many properties within the Oakland Inner Harbor as well as Fan Marsh on the San Leandro Bay shoreline. The Port typically grants access to ISP Contractors to allow for control work on their lands.

United States Coast Guard, Gail Bouffard, Chief, ISC Environmental Branch, US Coast Guard, Coast Guard Island, Alameda, California, 94501-0000, (510) 437-5775, *gail.m.bouffard@uscg.mil*. US Coast Guard owns Coast Guard Island, and has been cooperative in providing ISP staff access for vegetation and clapper rail monitoring, and *Spartina* control work.

City of Oakland, 250 Frank H. Ogawa Plaza, Suite 4314, Oakland, CA 94612. *Joel Peter, Office of the City Administrator, (510) 238-7276. jmpeter@oaklandnet.com.* The City of Oakland owns portions of the eastern shoreline of the Oakland Inner Harbor. Non-native *Spartina* can be found around some of these areas, and as a result the City of Oakland works with the ISP to gain access to sites and obtain any needed permissions prior to treatments.

State Lands Commission, 100 Howe Ave Suite 100 South, Sacramento, CA 95825-8202, *Dave Plummer, Regional Manager, (916) 574-1900. plummed@slc.ca.gov.* The State Lands Commission (SLC) may have ownership of some areas within the Oakland Inner Harbor. Where the SLC confirms ownership of any area within the OIH, the ISP will coordinate control activities with the SLC.

Site Description

Map Site 17: Alameda and San Leandro Bay Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

17a	Alameda Island South (Elsie, Crown, Crab Cove) Map	17g	Coast Guard Island Map
17b	Bay Farm Map	17h	MLK Marsh Map
17c	Arrowhead Marsh Map	17i	Coliseum Channels Map
17d	MLK Regional Shoreline/Garretson Point Map	17j	Fan Marsh Map
17e	San Leandro Creek Map	17k	Airport Channel Map
17f	Oakland Inner Harbor Map	17l	Doolittle Pond Map
		17m	Alameda Island East (Aeolian Club & East Shore) Map

The area encompassed by this Site-Specific Plan includes all marshlands of the Alameda and San Leandro Bay Area extending from the western tip of Bayfarm Island and San Leandro Channel in the west, to east of Interstate 880 and the Oakland Coliseum in the east. The northern boundary of the site is the Port of Oakland shipping terminals, and the southern edge is 98th Ave on San Leandro Creek. This area supports many diverse habitat types despite the fact that it is directly adjacent to some of the most highly developed land on the West Coast. Within this area there are recently restored tidal marshes, freshwater ponds and upland islands, highly complex and diverse historic marsh habitats that include channels, high marsh, mudflats and pans, thin strip marshes along rip-rapped shoreline, public parks and trails, open mudflats, creek channels and mouths, sandy beach areas, marinas, private residences, commercial areas, industrial manufacturing facilities, shipping, and many other land use types..

The *Spartina* infestations within this site are distributed throughout the habitat types of the area described above. Most notably, Arrowhead Marsh and the Elsie Roemer Bird Sanctuary support the largest infestations of *Spartina* in the Alameda and San Leandro Bay Complex. In sum, before the initiation of treatment in 2005, the shoreline of this site contained roughly 88.5 acres of non-native *Spartina*. This infestation was rapidly expanding into new areas, and has since been reduced, especially along the eastern extent of the Martin Luther King Jr. Shoreline and within the Coliseum Channels. Two main areas, the Elsie Roemer Bird Sanctuary, and Arrowhead Marsh were targeted for phased control work, to minimize any single-season impacts to California clapper rail. Each area, as described below, has had a specific set of treatments, and the current conditions of the infestation at each reflect the level of treatment received. Overall, however, this complex of marshes has had a 50% reduction in the cover of non-native *Spartina* during the 2005-2007 treatment period.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together.

Sub-Areas 17a, 17b, and 17m: Alameda Island South, Bayfarm Island and Alameda Island

Sub-Area Partners

Owner(s): City of Alameda
Manager (s): City of Alameda, EBRPD
Grantee(s): City of Alameda

Sub-Area Description

The three sub-areas grouped here represent the shoreline of the City of Alameda that lie along the San Leandro Channel leading to San Leandro Bay. The Alameda Island South site includes several distinct areas within the stretch of southern Alameda Island, which runs from the west side of Encinal High School in the west to the Bayfarm Island Bridge in the east. Within this area is the shoreline of Encinal High itself, Ballena Bay, the shoreline adjacent to Paden Elementary School, Crab Cove, Robert Crown Memorial State Beach, the Elsie Roemer Bird Sanctuary, and a small portion of marsh that runs from High Street to the Bayfarm Island Bridge. Crab Cove is an East Bay Regional Parks District site with a visitor center and other public park facilities. The area around the cove is restored beach with rip-rap edges to the west and around Ballena Bay. Small areas of marshland are establishing in lower energy areas of Ballena Bay and the Cove. Robert Crown Memorial State Beach is an EBRPD-

managed beach that runs from Crab Cove to the Elsie Roemer Bird Sanctuary in the east. The beach is maintained through yearly sand nourishment and limited grading. A thin upland edge above the beach is bordered by a paved recreational trail adjacent to Shoreline Drive.

Elsie Roemer Bird Sanctuary contains the largest single portion of marshland in this group of sub-areas and extends from a breakwater roughly at the southern end of Park Street, to between Court and High Streets in the east. The marsh is a mixed pickleweed and *Spartina* marsh with a thin fringe on the upper edge of higher marsh species. At the outer edge of the marsh, sandy mudflats extend south toward a deep channel near Bayfarm Island. The marsh has advanced out onto the mudflats with the assistance of the increased accretion rates provided by the dense infestation of non-native *Spartina* hybrids on the site. The marsh itself is relatively new, accreting and expanding over the last two decades, but the area was part of a more extensive historic marsh complex that once included much of Alameda Island as well as Bayfarm Island. This marsh currently contains several habitat types: a thin upper marsh pickleweed/Grindelia zone, a wide mixed *Spartina*/pickleweed zone, and open sandy mudflats. This site is home to the endangered California clapper rail as well as other marsh and shorebird species. The marsh is elongate and extends some 0.75 miles along the shoreline, bulging near the breakwater at the western portion and tapering to the east. The marsh at the Elsie Roemer Bird Sanctuary is a medium-sized marsh, at roughly 17.3 acres, along the southern shores of Alameda Island. The western portion of the marsh is managed by the East Bay Regional Parks District, and the eastern portion by the City of Alameda, though management of the *Spartina* control within the marsh has been done through the City of Alameda.

For the purposes of this plan, the Bayfarm Island sub-area includes the thin strip of marsh that extends along the northern shoreline of Bayfarm Island from the Bayfarm Island Bridge to roughly Aughinbaugh Way. This area has been measured at 8.75 acres and includes mixed pickleweed marsh of varying widths along its length. Beyond the bayward edge of the marsh, a short stretch of sandy mudflat extends to the dredged channel. The shoreline is lined with rip-rap and developed parkland, including a paved recreational trail along Seaview Parkway.

Alameda Island East represents an amalgam of small, patchy mixed marsh areas interspersed amongst the mostly residential development of the Alameda shoreline. Estimated at 7.5 acres, this area extends from the Bayfarm Island Bridge in the west, along the shoreline of Alameda to the northeast, roughly to where the Oakland Inner Harbor (sub-area 17f) begins. Within this area are private docks and residences, schools, marinas and other facilities.

Treatment at the Alameda Island South, East and Bayfarm Island sub-areas has been ongoing since 2005. Each season, the treatments begin in mid-September on a suitable tide. Elsie Roemer has proven to be a particularly difficult site on which to achieve acceptable levels of control. In the first season of treatment a mixture of imazapyr herbicide and a surfactant called Cygnet Plus resulted in very poor efficacy across all sites. In subsequent seasons, the herbicide imazapyr was combined with other surfactants and the results have improved, though there remains a significant percentage of the original infestation on the site.

In the western end of the Alameda Island South site, both airboats and backpack sprayers have been used to treat the clones growing in Ballena Bay and around Paden Elementary School. Trucks, amphibious vehicles, backpacks and some airboat work have been used at Elsie Roemer and extending east to the Bayfarm Island Bridge. Most of the area included within the Alameda Island East site has been treated using airboat, with some augmentation by truck and backpack. All of the fringing marsh that constitutes the infestation along the Bayfarm Island shoreline has been treated with spray truck working along the recreational trail that lines the shoreline.

The infestation within Alameda has proven relatively resilient to treatment efforts thus far. Some areas have decreased in non-native *Spartina* cover on the order of 50%, such as the shoreline along Bayfarm Island and around Paden Elementary School. However, the bulk of the infestation at Elsie Roemer Bird Sanctuary and along Alameda Island East has significantly more cover remaining as of the 2007 treatments, on the order of 75% or more of the initial infestation. Treatment work in 2007 should result in additional control on these sites by the start of the 2008 control season, as a more concentrated mixture of herbicide and surfactant was used in these areas (but still at the maximum label rate). Also, since 2007 was the third year of treatment on these areas, we are likely to see greater efficacy simply by virtue of the herbicide coverage afforded by a thinned *Spartina* canopy from previous treatments. As this site was one of the more established sites in the Bay in terms of the *Spartina* infestation, it is not unexpected that the thick rhizome mat and dense canopy formed by the plants would provide a significant level of protection for the plants during herbicide treatments. As these plants have been thinned each year by treatments, it is increasingly possible to achieve complete coverage on the remaining stands, even from the

ground-based work afforded on this site. As a result, the efficacy of 2007 treatment effort should show a greater reduction in the overall cover at these sites.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers
Boats

Timing: June-July start time for ground-based treatments

Treatment at all of the City of Alameda sites has had to wait until post September 1 each year in order to minimize the potential for any short term effects on the endangered California clapper rail that inhabit the Elsie Roemer Bird Sanctuary and Bayfarm Island. At this time of year, the plants are typically in full flower, and in 2005 and 2006 they were already setting seed when treatment work began. The best time for *Spartina* treatment, based on work done throughout the Bay, is during the July-August main growing season, before the plants are in full flower. Therefore, to complete the eradication of the plants in these three sub-areas, ideal treatment windows would be between June and late August of the year.

Monitoring Needs

All of the infested areas within this sub-area have been monitored with a combination of ground-based GPS surveys and heads-up digitization on orthophotos. Given that the infestation lines the shoreline, typical treatment activities involve moving along the shoreline and treating any non-native *Spartina* identified. In order to make sure that the control efforts target all the hybrid *Spartina* along the shoreline, ground or boat-based monitoring), to generate discrete points, lines or polygons where the plants actually are. This should not require a deviation from established techniques in the area, except perhaps at the Elsie Roemer site and along Alameda Island east where the infestation has been historically digitized.

SUB-AREAS 17C AND 17H: ARROWHEAD MARSH AND MLK JR. WETLANDS PROJECT (MLK NEW MARSH)

Sub-Area Partners

Owner(s): EBRPD
Manager (s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

Arrowhead Marsh is a roughly 47-acre marsh that forms the central part of the East Bay Regional Parks District's Martin Luther King Regional Shoreline in San Leandro Bay. This marsh represents a small remnant of a much more extensive historic marsh complex that once surrounded all of San Leandro Bay. Arrowhead Marsh currently contains a great diversity of habitat types, including marsh pans, small and medium sized channels, open mudflats, high and low pickleweed marsh, and an array of native marsh plant species and associations. It is also home to a sizeable population of the endangered California clapper rail, as well as other marsh and shorebird species. The marsh is bordered by the waters of San Leandro Bay except on the south side, where paved recreational walkways, an interpretive center, a wooden boardwalk and open lawn form the hub of activities for the Martin Luther King Regional Shoreline.

The Martin Luther King Jr. Wetlands Project or MLK New Marsh is the marsh to the southeast of Arrowhead Marsh within the Martin Luther King Regional Shoreline. This marsh was opened to tidal action in 1998, and was designed to provide various habitat types including damped tidal, brackish and freshwater marsh. This plan only addresses the areas subject to tidal action, as the brackish and freshwater systems have not been infested with non-native *Spartina*. The marsh contains newly establishing vegetation throughout its roughly 34.1 acres, with pickleweed and *Spartina* dominating in most areas. Several constructed channels drain the marsh to the north, and the outlet of the marsh is an armored channel that flows into the San Leandro Bay under a pedestrian walkway. There are currently many open mudflat areas within this marsh that have not yet been colonized by vegetation.

Treatment began on both sub-areas in 2006. At Arrowhead Marsh, treatment involved only the use of aerial broadcast applications of imazapyr herbicide to the western half of the marsh, both halves of the tip of the arrowhead, and the small island to the east of the main peninsula. The eastern half of the peninsula was left untreated in accordance with the 'phased treatment approach' authorized by the USFWS as part of the effort to minimize any single season impacts to California clapper rail associated with treatment work. At the MLK New Marsh, treatment was conducted via ground-based applicators, using imazapyr herbicide applied with backpack sprayers working within the central section of the marsh and trucks working along the accessible edges of the marsh.

In 2007, the western half of the Arrowhead Peninsula as well as the small island to the east were again treated via helicopter with imazapyr herbicide applications. The eastern half of the marsh was again left untreated as part of the phased treatment effort in this marsh. The MLK New Marsh was treated aerially for the first time in 2007. The treatment strategy at this site was adapted in response to the limited efficacy seen in the central portions of the marsh that were treated in 2006 via backpack.

As of winter 2007, the infestation along the western portion of the Arrowhead peninsula has been significantly reduced, with high efficacy observed on the upper marsh portions of the marsh plain. Scattered remnant, resprouting plants can be found throughout the area, with some seedling establishment also present. The main areas of continued *Spartina* growth are the lower edges of the peninsula and within the numerous channels within the marsh. The untreated eastern portion of the marsh continues to support large thriving stands of non-native *Spartina* hybrids that are capable of seed export to the treated areas directly adjacent. Control of this as yet untreated portion of the San Leandro Bay complex is extremely important to the overall success of the *Spartina* control effort along both the Oakland and Alameda shorelines.

In MLK New Marsh, the edges of the marsh that were treated in 2006 via truck had very high efficacy, but the central portion of the marsh was much less affected. As of winter 2007, there were very little observable changes visible in this marsh that could be attributed to treatment efforts earlier in the year. Final efficacy assessments of the area will occur in late spring 2008 to inform treatment strategies for the year.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial Truck-mounted spray equipment Amphibious vehicles Boats Backpacks Helicopter spot treatment
Timing:	Mid-July start time for both aerial and ground-based treatments Chemical mowing (if needed) should occur between June 15 and July 1

Pending spring 2008 efficacy assessments of the 2007 treatments in these marshes, treatment strategies will again include aerial applications of imazapyr herbicide where appropriately-sized populations continue to grow. Where the infestation has been significantly reduced, boat or ground-based applications may be required to target scattered *Spartina* individuals within the large marsh complex. Determinations of how to allocate these resources in these marshes will be informed by the results of spring 2008 efficacy assessments.

If the eastern portion of the Arrowhead Peninsula is not treated in 2008, significant seed production from this area may result in the continued re-infestation of adjacent treated marshes. It is extremely important that the entirety of the Arrowhead Marsh area be targeted for non-native *Spartina* control in 2008 and in subsequent years. In the event that, based on California clapper rail population data gathered from the marsh and region, a more conservative approach continues to be required at Arrowhead Marsh, sub-lethal, 'chemical mow' applications of herbicide would be warranted. This technique involves the early-season application of a lower-than-lethal concentration of herbicide to the actively growing plants, such that they are precluded from flowering and producing seed but little or no mortality occurs and the plants return the following year. In this way, the vegetative structure of the plants is maintained as habitat, while the production of both pollen and seed is curtailed. It must be stressed, however, that this is only a temporary control method, will not result in the permanent eradication of non-native *Spartina* from the marsh, and may lead to herbicide resistance in the plants if used repeatedly.

Monitoring Needs

Arrowhead Marsh and MLK New Marsh have historically been mapped using 'heads-up' digitization of the extent of *Spartina* in the marshes. This technique involves the use of office-based GIS software to overlay drawn polygons onto orthophotos, and assign cover classes to the delineated areas with the assistance of limited ground-truthing. In 2008 and beyond, boat and ground-based GPS surveys of both of these marshes will be necessary to identify the exact extent of resprouts, misses and seedlings in treated areas.

Also, significant genetic sampling of the *Spartina* plants in both marshes will inform the Control Program as to which areas are re-establishing native *Spartina* populations and which areas require continued control efforts. Parallel transect sampling encompassing the main portions of the infestations will provide the appropriate level of detail necessary for control work in these marshes.

SUB-AREAS 17D, 17L & 17K: MARTIN LUTHER KING JUNIOR REGIONAL SHORELINE, DOOLITTLE POND, AND AIRPORT CHANNEL

Sub-Area Partners

Owner(s): EBRPD
Manager (s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

The Martin Luther King Regional Shoreline includes most of the shoreline within the San Leandro Bay in Oakland. These three sub-areas were broken out in the original site-specific plans as separate sites. They have been combined here as both the treatment and ownership of these areas is conducted by EBRPD and the sites are all directly contiguous. Sub-area 17d was called the MLK Jr. Regional Shoreline in the original site plans, but this sub-area only represents the northern portion of the shoreline. It was defined as the portion of the shoreline that runs along the eastern portion of San Leandro Bay from Arrowhead Marsh in the south to the northern side of the outlet of the East Creek Channel, which drains both Peralta and Seminary Creeks in Oakland. This area includes the large marsh between East Creek and Damon Slough, called Damon Marsh, which is a wide pickleweed/*Spartina* marsh with an upland edge that borders the adjacent trail. Fringe marsh along a rip-rap shoreline runs from East Creek Mouth to Damon Marsh. The mouth of East Creek Channel contains fringing *Spartina*/pickleweed marsh bordered by a mixed upland and unpaved trail. A wrecked boat is visible at low tide on the mudflats just west of the channel mouth. Damon Slough is an engineered slough with rip-rap shorelines and multi-use recreational pathways on either side of the slough mouth. The pathway crosses the slough slightly upstream of the mouth on a pedestrian bridge. The marsh habitat here consists of a thin band of *Spartina* running along both sides of the Channel. Garretson Point lies to the south of the mouth of Damon Slough, and contains scattered marsh patches that run from the point proper along the shoreline to a channel emptying to the east of the San Leandro Creek Channel.

Also part of the MLK Jr. Regional shoreline, the Airport Channel sub-area consists of the fringing marshes of the portion of the Martin Luther King Regional Shoreline west of Arrowhead Marsh. The scattered patches of marsh that line the rip-rap edges of this area, especially along the eastern edge of Doolittle Drive, represent a thin marsh habitat that serves to connect the larger areas of Arrowhead Marsh in the east to Elsie Roemer and Crown Beach in the west. Within this area are an estimated 20 acres of mixed *Spartina*/pickleweed mid and low marsh habitat, as well as public recreational facilities including a boat launch, Beach Cafe, fishing piers, shoreline trail, public beach, picnic and barbeque areas and a memorial grove.

Doolittle Pond represents the westernmost end of the Martin Luther King Regional Shoreline. It is a square-shaped, formerly-diked area which has been breached in at least two locations to open the pond to tidal influence. The overall acreage of the pond is estimated at 15.1 acres, including the interior portions. Around the interior rim of the pond, where the remnant levees now support unpaved trails, a thin, patchy band of salt marsh habitat has developed amongst the rip-rap edge. Doolittle Pond borders Doolittle Drive to the south and is adjacent to a former landfill to the west.

Treatment along the MLK Jr. Regional shoreline has been conducted by boat, truck, backpack and via aerial applications at Damon Marsh. *Spartina* control work by EBRPD has been ongoing each year since 2005 on various portions of the shoreline.

Along the northern portion of the shoreline, there has been a significant reduction in the cover of non-native *Spartina*, on the order of 75-90%. The same can be said for most of the Airport Channel Area. However, the thicker infestations that are located on the shoreline adjacent to Doolittle Drive in the west, including Doolittle Pond, have had significantly less efficacy. Most of the cover in these areas has been reduced only 10-15%. This will be a main area of focus in the 2008-2010 treatment seasons.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Helicopter: Broadcast aerial Truck-mounted spray equipment Amphibious vehicles Boats Backpack sprayers
Timing:	Mid-July start time for all treatment

The infestations along the MLK Jr. Regional Shoreline are readily accessed by trails and roads that line the entire area. In the past, aerial broadcast applications have been selectively used in the area. Due to the amount of non-native *Spartina* remaining in the area as of winter 2007, it is unlikely that aerial applications will again be necessary in this portion of the Shoreline. However, if inventory monitoring in the spring of 2008 reveals areas of infestation that are sufficient to justify aerial applications, this method will again be used. Otherwise, boats, backpacks and trucks will work along the shoreline, hitting all clumps of non-native *Spartina* that are identified.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring, especially as the infestation dwindles and becomes scattered.

SUB-AREAS 17F AND 17G: OAKLAND INNER HARBOR AND COAST GUARD ISLAND

Sub-Area Partners

Owner(s):	City of Alameda, City of Oakland, Port of Oakland, United States Coast Guard, State Lands Commission
Manager (s):	City of Alameda, City of Oakland, Port of Oakland, United States Coast Guard, State Lands Commission
Grantee(s):	California Wildlife Foundation

Sub-Area Description

The Oakland Inner Harbor sub-area consists of all the small areas of marsh within the Oakland Inner Harbor, including lands along the City of Alameda northeastern shoreline as well as lands along the shoreline of the City of Oakland. This heavily developed area includes commercial, industrial, and residential properties, marinas, parks and many other facilities lining the shoreline. There are areas that include docks, piers, landings, sea walls, open shoreline, rip-rap, and other structures. The tiny marsh areas in the Inner Harbor are scattered and contain very little plant or animal diversity.

The Coast Guard Island site consists entirely of thin fringing marsh bordered by the rip-rap fill that surrounds Coast Guard Island within the Oakland Inner Harbor. The marshes surrounding this island have accreted sediment sufficient to support a thin band of mixed pickleweed/*Spartina* marsh. Beyond this vegetated fringe, the limited mudflats and open water of the Harbor connects this site with the San Francisco Bay. The island itself is mostly reclaimed land, with significant amounts of debris littering the mudflats, and the shallow waters surrounding the island include many sunken ship hulls.

Treatment throughout the Oakland Inner Harbor area has only occurred during the 2007 Treatment Season. Work was done over three days via airboat and trucks working along the shoreline. All known locations of *Spartina* in the area were successfully treated.

Late 2007 estimates of the efficacy of treatments in this area seem to indicate that the applications done here are achieving a high level of control. However, final assessments of the success of control will be reserved until spring 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Boats
Truck-mounted spray equipment
Backpack sprayers

Timing: June-July start time for ground-based treatments

Treatment in these two sub-areas will be done via boats working within the channel, and trucks and backpacks targeting the areas along the shoreline that are inaccessible to boat treatments. In 2007, this work took three days. It is anticipated that in 2008 that effort will need to be repeated, with shorter duration treatments necessary in 2009 and beyond.

Monitoring Needs

As has been done in the past all of the shoreline of the Oakland Inner Harbor will require ground-based GPS surveys for inventory monitoring.

SUB-AREAS 17E AND 17I: COLISEUM CHANNELS AND THE SAN LEANDRO CREEK CHANNEL

Sub-Area Partners

Owner(s): ACPW, EBRPD
Manager (s): ACPW, EBRPD
Grantee(s): ACPW, EBRPD

Sub-Area Description

For the purposes of this plan, the Coliseum Channels sub-area includes the upper portions of the flood control channels that drain into San Leandro Bay, except San Leandro Creek proper which is discussed below as part of sub-area 17e. To differentiate them from the downstream mouths of the channels, the western boundary of these areas is defined as Interstate 880, which runs perpendicular to these channels and west of the Oakland Coliseum. The eastern end can variously be defined as that point where these channels are no longer above ground (culverted or buried), or where tidal marsh plant species are no longer present. These channels are typically steep-sided and degraded, often choked with sediment and copious litter from Coliseum events, and overgrown along their edges with weedy upland species.

For the purposes of this plan, the San Leandro Creek Channel is only that portion of the creek that is downstream of the concrete-lined portion of the channel beginning just upstream of 98th Avenue in Oakland. Along this stretch of creek there are several areas of marshland that have established within the creek channel, especially between 98th Avenue and Hegenberger Road. Downstream of Hegenberger, the channel banks become steeper, and the marsh fringe along the edges thinner. The area encompassed within the Site-Specific Plan for this sub-area is estimated at 3.5 acres and includes only the thin marsh sections along the banks of the creek channel. San Leandro Creek Channel is known as Zone 13, Line P by ACPWA.

ACPWA has been treating the areas within the Coliseum Channels for invasive *Spartina* since 2005. Treatment has utilized amphibious vehicles and trucks working along the edges of the many channel branches in the area. ACPWA regularly revisits their efforts during the season, checking up on the efficacy of early season treatments and re-treating where sections of the infestation have been missed. In the larger channels, amphibious vehicles enable the ferrying of herbicide mixture to treatment areas, and keep personnel out of what is sometimes soft sediment filled with large amounts of litter.

ACPWA also treats the non-native *Spartina* on the upper end of the San Leandro Creek Channel with both amphibious vehicles and trucks. In the lower portion, EBRPD has done the treatment work since 2006, working along the banks of the channel with trucks.

Very little of the pre-treatment levels of *Spartina* in the Coliseum Channels remain as of winter 2007. Although each channel area is different, an overall efficacy estimate on the channels as a whole is in the range of 75%. There are some areas where ACPWA has experienced less efficacy, especially next to the I-880 freeway near the Oakland Coliseum.

In the San Leandro Creek Channel, the lower reaches where it empties into San Leandro Bay are almost entirely clear of non-native *Spartina*. However, starting just below Hegenberger Avenue and running upstream to the concrete-lined portion of the channel, large, contiguous patches of non-native *Spartina* remain.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Amphibious vehicles
Truck-mounted spray equipment
Backpacks

Timing: Mid-July start time for ground-based treatments

Typically treatment in the Coliseum Channels begins in June and continues throughout the summer. This strategy will continue until the plants are removed from the area. Both amphibious vehicles and trucks or backpacks will be utilized during control operations.

The upper reaches of the San Leandro Creek Channel have been treated as early as August, with the lower reaches targeted post September 1. Trucks working along the levee edges are the preferred method for targeting the plants in the channel.

Monitoring Needs

All of the channels in this area will require ground-based GPS inventory monitoring to specifically identify the areas requiring control.

SUB-AREA 17J: FAN MARSH

Sub-Area Partners

Owner(s): Port of Oakland
Manager (s): Port of Oakland
Grantee(s): California Wildlife Foundation

Sub-Area Description

Fan Marsh is a roughly 11-acre marsh located along on the interior of Doolittle Drive at Earhart Road in Alameda. The property is owned by the Port of Oakland and consists of high marsh pickleweed/*Spartina* interspersed with several small channels draining to the Bay to the east of Doolittle Pond.

Treatment of Fan Marsh has only occurred during the 2007 Treatment Season. Crews utilized spray trucks along the edges of the marsh, spraying the plants within the radius of the hose attachment. Crews also used amphibious vehicles to ferry supplies to workers walking the marsh with backpack sprayers. The entire marsh area was treated in this way over a two-day period in September.

As of winter 2007, there was no discernable difference between the pre and post-treatment condition of the *Spartina* in this marsh. Efficacy estimates of the 2007 treatments will occur in spring of 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers
Helicopter: broadcast applications (possible backup strategy)

Timing: June-July start time for ground-based treatments

Treatment in Fan Marsh in 2008-2010 will follow the treatment strategy used in 2007. Trucks, backpacks and amphibious vehicles will work through the marsh, targeting all non-native *Spartina* plants. However, treatment activities should begin in July or August to avoid the September flowering of the *Spartina* plants in the marsh.

Monitoring Needs

As of 2007, the monoculture of non-native *Spartina* in this marsh only justified head's up digitization of this marsh, essentially just drawing a line around the periphery of the marsh and assigning the resulting polygon a very high level of cover. More detailed ground-based GPS surveys of the marsh will be necessary beginning in 2008, and these yearly surveys should become the norm for this marsh.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Alameda and San Leandro Bay Complex, Alameda County, TSN: ISP-2005-17, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

All 13 sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 18: COLMA CREEK AND SAN BRUNO MARSH COMPLEX, SAN MATEO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Colma Creek and San Bruno Marsh Complex, San Mateo County, TSN: ISP-2005-18, 2005-2007 Control Seasons) dated May 2005. All eight sub-areas are the same as defined in that plan. Two previously unidentified species of concern have been called out within the upper reaches of one sub-area (the infestation had not previously reached that point). No other significant environmental factors have been identified. The work described in this plan will continue the work initiated in 2006.

Site Partners

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

San Mateo County Mosquito Abatement District, 1351 Rollins Road, Burlingame, CA 94010; *James Counts, Field Operations Supervisor, (650) 344-8592. james@smcmad.org.*The San Mateo County Mosquito Abatement District (SMCMAD) has been working throughout the area of this plan since 1953, and has extensive knowledge of the marshes and shoreline as well as the appropriate equipment and expertise for safe, efficient control work within these sites. As the Coastal Conservancy grant recipient for this complex, SMCMAD performed all of the treatment from 2005-2007 on these sites with their personnel and equipment. Several of the sub-areas outlined in this plan are areas where the SMCMAD regularly conducts mosquito control efforts, and control of the *Spartina* on these sites would potentially diminish the amount of mosquito breeding habitat available that the agency would need to monitor and treat for the insects.

Other Partners:

State Lands Commission, 100 Howe Ave Suite 100 South, Sacramento, CA 95825-8202, *Dave Plummer, Regional Manager, (916) 574-1900. plummed@slc.ca.gov.* The State Lands Commission may have ownership of some areas within the Colma Creek Area. Where the SLC confirms ownership of any area, the ISP will coordinate control activities with the SLC.

San Mateo County Flood Control District, 555 County Center, 5th Floor, Redwood City, CA 94063-1665, *Brent Spencer, (650) 599-1448, bespencer@co.sanmateo.ca.us* The San Mateo County Flood Control District has been involved with vegetation management and marsh restoration in the area of Colma Creek even before its partnership with ISP. They will continue to provide consultation on the project.

Site Description

Map Site 18: Colma Creek and San Bruno Marsh Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

18a	Colma Creek	**Map**	18e	Sam Trans Peninsula	**Map**
18b	Navigable Slough	**Map**	18f	"Confluence Marsh"	**Map**
18c	"Old Marina"	**Map**	18g	San Bruno Marsh	**Map**
18d	"Inner Harbor"	**Map**	18h+	San Bruno Creek	**Map**

+ Sub-area where previously-unidentified species of concern have been determined to be present

The Colma Creek and San Bruno Marsh complex contains an estimated 101 acres of marshland located along the western shores of the Bay in the City of South San Francisco south of San Bruno Mountain State and County Park and north of San Francisco International Airport. This area was once a thriving marsh complex referred to as Belle Air Island, but it has undergone massive filling and hydrologic alteration as well as decades of industrial land use and, more recently, corporate park development for the biotech industry. The northeast corner of the complex is located at the tip of San Bruno Marsh just south of Point San Bruno at the base of the hill on which the Blue Line Transfer Station sits adjacent to a section of the Bay Trail. Within this San Bruno Canal area, this site complex of eight sub-areas includes San Bruno Marsh, the fringe marsh around SamTrans peninsula, the Confluence Marsh, Inner Harbor and Old Marina areas, and the three channels Colma Creek, Navigable Slough and San Bruno Creek. Most of the complex is located east of Hwy. 101, although all three channels begin on the western

side of this thoroughfare. Within this area there are broad marshlands fringing the industrial fill of South San Francisco, strips of channel bank marshland habitat, expansive open mudflats and low elevation *Spartina* meadows, mid elevation pickleweed (*Sarcocornia pacifica*) marsh plains, brackish creek channels and other tidal marsh systems.

Hybrid *Spartina alterniflora* had come to dominate all of the marshlands within this site complex by 2005, with only scattered populations of native tidal marsh plant species remaining in the area. Most of San Bruno Marsh, as well as the area of the Inner Harbor, were low elevation, unvegetated mudflats before the invasion. Clones of hybrid *Spartina* colonized these areas and eventually coalesced into vast single-species meadows, while accreting sediment and raising the elevation to a level more hospitable for the invader. Dense linear infestations were found along both banks of the three upstream channels and had begun to encroach into the center at narrow areas with sediment accumulation.

Prior to the initiation of treatment, this site complex contained approximately 60 acres of hybrid *Spartina*. Control work with imazapyr began in 2006 on just the upstream areas of Colma Creek and San Bruno Creek, which was successful at significantly reducing the infestation in these areas. With the loss of 85% of the marsh habitat around the Bay in the past 150 years, the dense invasive *Spartina* vegetation that colonized the mudflats in this area had become home to a large population of California clapper rails, despite the fact that this area is fragmented and remote from any other sizable marsh areas on the west bay shoreline. Consequently, a unique treatment phasing strategy was initiated in the downstream marsh areas in 2007. In order to protect the clapper rails from short-term impacts caused by removal of vegetative cover, only a portion of the hybrid *Spartina* was treated with imazapyr at the full concentration, while the rest was treated with a sub-lethal dose to stop seed production and dispersal but maintain the above-ground biomass as refugia (Figure 2). Monitoring in 2008 has shown this method to have been successful, in that the "chemically mowed" areas, which did not produce seed in 2007, showed continued vigorous growth in 2008, and the fully treated areas showed high mortality. This phased approach combined with any regrowth in the other sub-areas leaves approximately 25 acres of hybrid *Spartina* to be controlled in 2008.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 18A: COLMA CREEK

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): San Mateo County Flood Control District
Grantee(s): SMCMAD

Sub-Area Description

The Colma Creek site begins at Linden Avenue in South San Francisco just upstream of Hwy. 101 and runs 1.8 kilometers down to the mouth of the creek, bordered to the north by the upper edge of San Bruno Marsh (Sub-area 18g) and on the south side by the triangular Confluence Marsh (Sub-area 18f). The creek has been straightened and channelized between parallel levees topped with maintenance roads or trails, with two strategically placed bends in the watercourse to reduce the power of flowing stormwater. The upstream banks of the channel are heavily vegetated with *Spartina* below the levees, and the downstream reaches have accreted large amounts of sediment creating areas for fringing marshland composed of pickleweed and *Spartina* to develop on top of these accreted marsh benches. Downstream of the footbridge at the confluence of Colma Creek and Navigable Slough (Sub-area 18b), the marshland habitat along the creek is confined to the northern shore, and the southern shore is concrete lined. The marsh edge drops off sharply to the channel, with stretches of overhanging vegetative mats. There is approximately 15 acres of marsh associated with Colma Creek.

The hybrid *Spartina* had formed a uniform dense linear infestation along much of the channel length with areas up to 10 meters wide in places, tapering as the creekside benches narrow upstream. The plants were only found up to the channel edge where the sharp drop in elevation defines their lower limit. There was an estimated 8.5 acres of hybrid *Spartina* along Colma Creek when treatment began in 2006, with the full six pints per acre concentration of imazapyr applied from amphibious tracked vehicles to the infestation upstream of the footbridge at the confluence with Navigable Slough. This treatment was very effective, resulting in a significant reduction in the

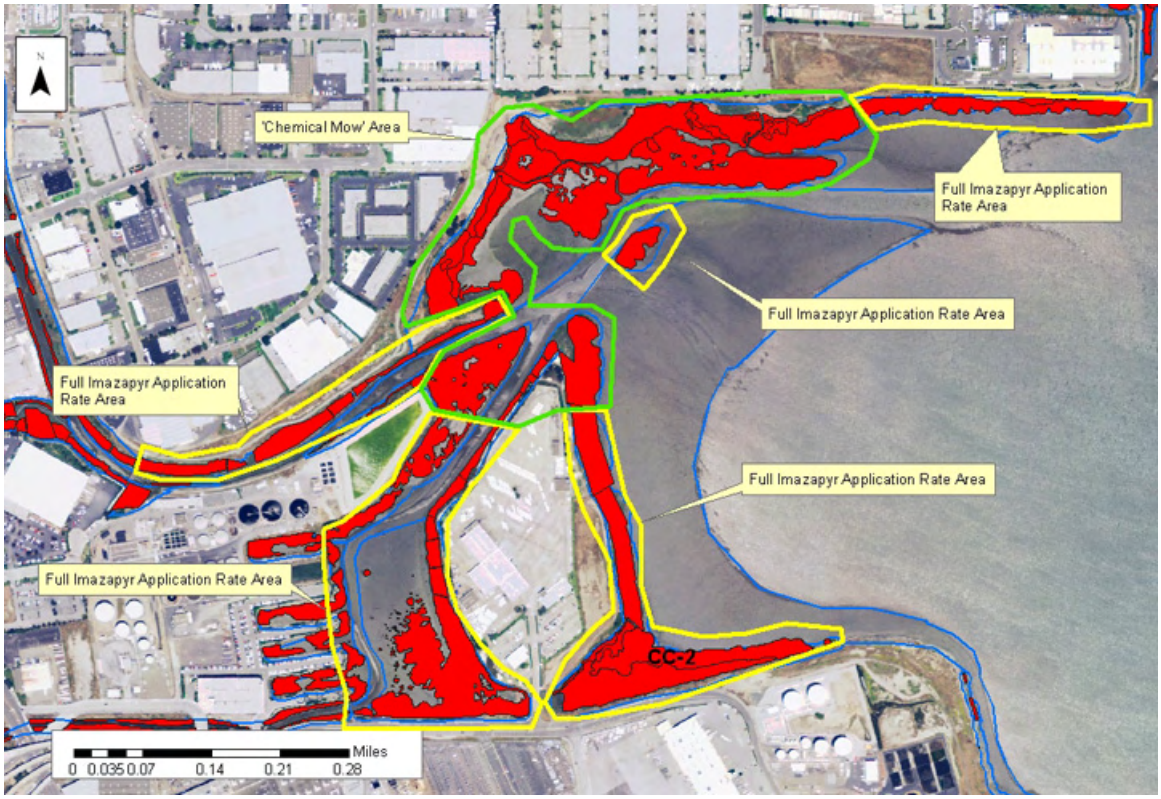

Figure 2. Site 18: Colma Creek and San Bruno Marsh Complex, 2007 Aerial *Spartina* Treatment Zones. Green outline indicates "chemically mowed" areas, yellow outline indicates full herbicide application rate.

infestation and long stretches reduced to stubble. In 2007, these reaches were retreated where necessary, while the stretch downstream of the footbridge was treated for the first time, utilizing a helicopter to apply the imazapyr while it was onsite treating the large marshes.

The reach upstream of the crossing of Utah Avenue contains very little hybrid *Spartina* after two years of comprehensive treatment. A single season of aerial control work downstream appears to have made good progress at reducing that infestation. There are areas at lower elevation along the edges of the channel that have had lower efficacy than the surrounding site. It is estimated that less than one acre of hybrid *Spartina* remains along Colma Creek to be treated in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicle (primary), backpack sprayers (follow-up)

Timing: Treatment should occur between July 15 and September 15
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

Amphibious tracked vehicles will be used to apply imazapyr to the scattered remaining patches of hybrid *Spartina* along Colma Creek in 2008. This method will be used along the entire length of the channel because aerial treatment should no longer be necessary on the downstream reach. It is essential that treatment be scheduled to begin on a receding tide to maximize dry time and complete the eradication at this site with as few additional applications as possible. If the total area of the infestation is sufficiently small, a switch to backpack sprayers may be justified to reduce the effort of mobilization.

Monitoring Needs

With the long length of this channel, detailed maps of the current distribution of hybrid *Spartina* would help the treatment crew to identify only the reaches that need to be included in the application. This would improve efficiency and help make the best use of the narrow treatment windows available. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18B: NAVIGABLE SLOUGH

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

The Navigable Slough site runs 900 meters from the Union Pacific Railroad just east of Highway 101 in South San Francisco to the confluence with Colma Creek just upstream of the pedestrian footbridge for the Bay Trail. This channel is no longer navigable as its name may suggest because it has accreted so much sediment and has not been dredged in some time. The marsh benches below the banks are very wide after years of accretion, and are composed of pickleweed and *Spartina*, dropping off sharply at the narrow channel edge. The channel is lined with levees that are topped with the Bay Trail on the south bank. This site also includes a small pocket of marsh on the south bank of Colma Creek immediately downstream of the footbridge. This wedge of marsh borders the water treatment plant for South San Francisco, and marks the point where marsh vegetation stops on the south bank and is replaced by concrete. The surrounding area is heavily developed with a combination of commercial and light industrial land use. The marsh edge of this channel is estimated at 4.5 total acres.

The hybrid *Spartina* had heavily infested the wide marsh benches along the lower reach of Navigable Slough, with tall, dense vegetation dominating the pickleweed and overhanging the small channel. Upstream of S. Airport Blvd, the benches are narrower and contained a uniform linear band of fringing invasive *Spartina* to a point above Hwy. 101 where the infestation becomes more scattered. There was an estimated four acres of hybrid *Spartina* by the time the site was first treated in 2007, as most of the channel edges had been colonized. The full six pints per acre concentration of imazapyr was applied in 2007 using amphibious tracked vehicles.

This well-established infestation has only been treated once, and the control work occurred late in the season and was done using ground-based methods. It is anticipated that much of the higher elevation stands will have been largely eliminated, but that the lower areas of the marsh benches and along the channel banks will be harder to control. Along with scattered patches remaining closer to the levees, it is estimated that approximately one acre remains to be treated in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicle (primary)
backpack sprayers (follow-up)

Timing: Treatment should occur between July 15 and September 15
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

The key to completing the eradication at this site is to maximize dry time by scheduling the work on a morning receding or low tide. This will improve efficacy at lower elevations and reduce the number of times the site will need to be treated to eliminate all hybrid *Spartina*. Imazapyr will be applied using amphibious tracked vehicles that can transport larger tanks of product out onto the marsh benches to reduce the need for trips back and forth over the marsh to refill. These vehicles also provide a stable platform from which the personnel can complete the application, and utilize more powerful pumps than found on backpack sprayers, which makes it easier to achieve complete coverage efficiently. In future years once the total area of the infestation is sufficiently small, a switch to backpack sprayers may be justified to reduce the effort of mobilization.

Monitoring Needs

ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18C: OLD MARINA

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

The Old Marina site is a decommissioned shipyard area that is bordered to the south by the mouth of San Bruno Creek and the North Access Road to the San Francisco International Airport, with the water treatment plant for South San Francisco on the north side. This shipyard was used to build large concrete barges for World War II, and the old docks are five fingers of fill, three of which are now topped with asphalt and serve as airport parking lots, and the southernmost provides an access point to the Bay Trail and a footbridge over San Bruno Creek. A great deal of sediment has accreted between these docks after they were no longer used for shipbuilding, and these spaces now support marsh vegetation and mudflat. One of these spaces has a block at its mouth that maintains open water with only a thin fringe of mixed marsh vegetation on the edges. The Old Marina is bordered to the east by the Inner Harbor (Sub-area 18d). There is an estimated 5.5 acres of marsh habitat within this site.

Prior to the initiation of treatment, hybrid *Spartina* had come to dominate the accreted sediment between the fingers of fill, and had begun to move out onto the open mudflats of the Inner Harbor to the east. The clones within these rectangular blocks of marsh have begun to coalesce into solid bands of *Spartina*. Within this area, there was an estimated 2.5 acres of hybrid *Spartina* that was first treated in 2007. The full six pints per acre concentration of imazapyr was applied in 2007 using truck-mounted sprayers working from atop the old docks. The *Spartina* spreading out onto the mudflats from the tips of the fingers was treated aerially as part of the adjacent Inner Harbor application in 2007.

The control work on this site appears to have been very effective for the most part. The one space that contains open water due to the block at the mouth does not appear to have received treatment along with the other spaces, possibly missed because the infestation is only a thin band on the edges with no plants down into the water. Less than 0.5 acre of hybrid *Spartina* remains within the Old Marina site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer or backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

Truck-mounted sprayers can be staged on top of the old docks and used to apply imazapyr to the hybrid *Spartina* below by hauling hose down into the marsh. Backpack sprayers could be substituted to reduce the mobilization effort as the infestation area decreases to a reasonable level for this method.

Monitoring Needs

ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18D: INNER HARBOR

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

The Inner Harbor sub-area of the Colma Creek and San Bruno Marsh Complex comprises a rectangular area sheltered by the fill of the SamTrans peninsula (Sub-area 18e) to the east that provided access to the Old Marina (Sub-

area 18c) shipyard area bordering it to the west. To the north of the site is the South San Francisco water treatment plant and Confluence Marsh (Sub-area 18f), while the southern border of the site is the North Access Road to San Francisco International Airport. The mouth of San Bruno Creek (Sub-area 18h) is located in the southwest corner of the Inner Harbor. The area was composed largely of low elevation mudflats before colonization by invasive *Spartina*. Some of the fringing areas below levees and other manmade edges have a thin marsh vegetation component, mostly pickleweed (*Sarcocornia pacifica*). This area is estimated at 15 acres of mudflat and fringing marshland.

Hybrid *Spartina* had spread rapidly through the unvegetated mudflats of the southern half of this site, with circular clones that had coalesced into a meadow. There were also several pioneering large clones in the northern half, and a widening fringe of hybrid *Spartina* along the western edge of SamTrans peninsula. Prior to the initiation of treatment there was an estimated 8.5 acres of hybrid *Spartina* requiring control on this site. The Inner Harbor was treated with the full six pints per acre concentration of imazapyr in 2007 using a helicopter broadcast application.

Preliminary evaluations during the winter of 2007 indicate high efficacy from this first application, leaving approximately 1.5 acres to treat in 2008. Much of the remaining infestation is on the lower elevation edges along the mudflat, but there are also some strips just below the levees that the helicopter didn't hit.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Helicopter broadcast (primary) Amphibious tracked vehicle Truck-mounted sprayer or Backpack sprayers (follow-up along the levees and potentially the primary method for future years)
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

The Inner Harbor site will be treated in 2008 by helicopter broadcast with a full concentration application of imazapyr (i.e. intended to eliminate the remaining infestation). A truck-mounted sprayer or amphibious tracked vehicle will be used to follow-up along the levees in the same season because those areas are difficult for the helicopter to treat effectively. The control work will likely shift entirely to ground-based methods in 2009 to clean up the last remaining patches and should not require the mobilization costs of a helicopter application. With the soft mud on this site, amphibious tracked vehicles will probably be the most effective method for this work, to allow personnel to reach the outer clones for treatment and reduce return trips over the marsh to refill. The edges along N. Access Road and the SamTrans peninsula could also be completed by hauling hose from a truck-mounted sprayer, or by using backpack sprayers. Since most of this site is at a very low marsh elevation, it will be essential to schedule the application on a receding morning tide to maximize dry time and efficacy.

Monitoring Needs

ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18E: SAMTRANS PENINSULA

Sub-Area Partners

Owner(s):	State Lands Commission
Manager(s):	San Mateo County Transit District (SamTrans)
Grantee(s):	SMCMAD

Sub-Area Description

The SamTrans Peninsula site is a roughly diamond-shaped area where the marsh was filled and covered with asphalt for this county public transportation agency to store and maintain their buses. To the south it is connected to the North Access Road for San Francisco International Airport by a thin strip of paved fill. The Inner Harbor (Sub-area 18d) borders SamTrans peninsula to the west, with Confluence Marsh (Sub-area 18f) to the north on the

other side of the narrow channel that connects Inner Harbor to the Bay. The entire peninsula has a fringe marsh edge at the toe of the rip-rap that is composed of pickleweed, *Spartina*, and alkali heath (*Frankenia salina*) and is wider on the eastern outboard side. This site also includes the larger marsh section to the east of the base of the peninsula that extends approximately 500 meters to the east along the mainland shoreline. This marsh area is more diverse than the narrow fringe marsh at the base of the rip-rap levees, and is as much as 100 meters wide where it meets the peninsula. Within this area there is an estimated 14 acres of marshland habitat.

Prior to the initiation of treatment, the infestation of hybrid *Spartina* within this site had come to dominate the fringe marsh on the eastern and western shoreline of the peninsula, and formed a broad meadow of coalesced clones on the southeast side. The hybrid *Spartina* was growing at very low elevations on previously unvegetated open mudflats, and had formed uniform monocultural stands. The estimated 8.5 acres of non-native *Spartina* on this site were treated with imazapyr by helicopter for the first time in 2007. A portion of the northern tip of the peninsula (see Figure 2) was treated with a sub-lethal dose of imazapyr to chemically mow the cordgrass with the intention of stopping seed production and dispersal while maintaining the above-ground biomass to reduce potential short-term impacts to the California clapper rails from vegetation removal. The rest of the site was treated with the full six pints per acre concentration to eliminate the hybrid *Spartina*.

A preliminary evaluation of the first treatment season showed two distinct zones based on the two concentration levels of imazapyr applied. The area at the tip of the peninsula that was chemically mowed has uniform green growth returning, while the area of full concentration consists of stubble and standing necromass with only the patchy regrowth characteristic of a single application in a low elevation marsh area. Approximately 2.5 acres of hybrid *Spartina* remains within the SamTrans Peninsula site.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Helicopter broadcast (primary), Amphibious tracked vehicles Truck-mounted sprayers Backpack sprayers
Timing:	Treatment should occur between July 1 and September 1 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

The remaining infestation on all areas of the SamTrans Peninsula site will be treated by helicopter with the full six pints per acre concentration in 2008 to eliminate the hybrid *Spartina* as efficiently as possible. Ground-based methods will need to be used for follow-up along the levees and on the southern edge along North Access Road since the helicopter boom has difficulty achieving complete coverage on those areas. These follow-up applications should be conducted no more than three weeks after the helicopter work. This will enable the applicators to see color changes in any properly treated plants to reduce overapplication, while also conducting the control work when the plants are actively growing and before they have set seed. Amphibious tracked vehicles will be used to transport personnel and product into the broader south marsh, which will reduce return trips to fill up. Truck-mounted sprayers can work the rest of the edge of the peninsula from the adjacent maintenance road. Backpack sprayers may be used in future years to reduce the mobilization effort once the infestation covers a smaller area. Since most of this site is at a very low marsh elevation, it will be essential to schedule the application on a receding morning tide to maximize dry time and efficacy.

Monitoring Needs

The marsh area in the southeastern portion of the site is relatively large and could be very time consuming to survey for isolated plants during treatment. ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18F: CONFLUENCE MARSH

Sub-Area Partners

Owner(s):	State Lands Commission, City of South San Francisco
Manager(s):	City of South San Francisco

Grantee(s): SMCMAD

Sub-Area Description

Confluence Marsh consists of a fragmented 7-acre area of marshland that forms an arrowhead shape between the mouths of Colma Creek and San Bruno Creek. SamTrans Peninsula (Sub-area 18e) sits across the San Bruno Creek mouth channel to the south, and San Bruno Marsh (Sub-area 18g) is located across the Colma Creek mouth to the north. Confluence Marsh sits in the center of this site complex, jutting out towards the open bay from the peninsula that contains the South San Francisco water treatment plant. The marsh tapers to a narrow fringe as it extends back southwest into the Inner Harbor (Sub-area 18d) towards the Old Marina (Sub-area 18c). It is composed of relatively low elevation pickleweed and *Spartina* marsh, with several large patches of open mudflat remaining uncolonized by marsh vegetation.

Hybrid *Spartina alterniflora* had come to dominate almost the entire area of Confluence Marsh by the time treatment began. Clones had coalesced into solid meadows, and the interior marsh channels had become clogged with linear infestations of invasive cordgrass. The estimated 5.5 acres of non-native *Spartina* on this site were treated with imazapyr by helicopter for the first time in 2007. The majority of the site (see Figure 2) was treated with a sub-lethal dose of imazapyr to chemically mow the cordgrass with the intention of stopping seed production and dispersal while maintaining the above-ground biomass to reduce potential short-term impacts to the California clapper rails from vegetation removal. The rest of the site, primarily the strip of fringe marsh extending southwest into the Inner Harbor to the Old Marina, was treated with the full six pints per acre concentration to eliminate the hybrid *Spartina*.

A preliminary evaluation of the first treatment season showed two distinct zones based on the two concentration levels of imazapyr applied. The majority of the arrowhead of marsh was chemically mowed and has uniform green growth returning, while the area of full concentration consists of stubble and standing necromass with only the patchy regrowth characteristic of a single application in a low elevation marsh area. Approximately 3.5 acres of hybrid *Spartina* remains within the Confluence Marsh site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Aerial helicopter treatment (primary)
Amphibious tracked vehicle
Backpack sprayers (follow-up, primary in future years)

Timing: Treatment should occur between July 15 and September 15 (full concentration)
Chemical mowing (if needed) should occur between June 15 and July 1
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

An aerial application of imazapyr will be used to continue control efforts at Confluence Marsh in 2008. Results from the 2008 California clapper rail breeding season surveys on this site will be used to determine the level of treatment to be conducted. If clapper rail population trends continue to be positive or static, then the remaining hybrid cordgrass will be treated with the full six pints per acre concentration to eliminate the hybrid *Spartina* as efficiently as possible. If the observed clapper rail population trends raise concern, then the majority of Confluence Marsh will be chemically mowed again to stop seed production and dispersal while maintaining potential refugia. Any regrowth in the areas that were treated with the full concentration in 2007 will receive that same level of treatment again in 2008. Ground-based methods will need to be used for follow-up along the levees since the helicopter boom has difficulty achieving complete coverage on those areas. These follow-up applications should be conducted no more than three weeks after the helicopter work. This will enable the applicators to see color changes in any properly treated plants to reduce overapplication, while also conducting the control work when the plants are actively growing and before they have set seed. Amphibious tracked vehicles will be used to transport personnel out onto the marsh plain, which will reduce return trips to fill up. In the future, once the infestation has been sufficiently reduced, backpack sprayers may be utilized to reduce mobilization costs.

Monitoring Needs

ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18G: SAN BRUNO MARSH

Sub-Area Partners

Owner(s): State Lands Commission, City of South San Francisco
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

San Bruno Marsh constitutes the largest marsh in this area of West San Francisco Bay, and serves as the northern border of San Bruno Canal and this ISP site complex. This low elevation *Spartina* marsh has established on the open mudflats that begin on the north side of the mouth of Colma Creek (Sub-area 18a) and continue north and east approximately 1.2 km along the South San Francisco shoreline that contains corporate parks and the Blue Line Transfer Station built on fill above the bay. A segment of the Bay Trail runs along the short upland transition zone of this entire site. Just east of the confluence of Colma Creek and San Bruno Creek (Sub-area 18h) is a 0.65-acre island included in the site that supports mostly *Spartina* as well as gumplant (*Grindelia stricta*) and pickle-weed on a higher elevation point near the center. The San Bruno Marsh site encompasses some 35 acres of marsh-land, mudflat, island and channel.

This site is dominated by broad hybrid *Spartina* meadows that established and coalesced on the wide, low-elevation mudflats. The hybrid swarm characteristic of this *Spartina* invasion is clearly visible at this site. Although the clones have coalesced, many different plant morphologies are visible across the meadow, and even beyond the physical traits they each have slightly different characteristics such as the timing of flowering or senescence. The island offshore of the confluence of the creeks was created by *Spartina* trapping and accreting sediment due to its robust size and thick culm density. Prior to the initiation of treatment, the site contained an estimated 20 acres of hybrid *Spartina*.

This site was first treated with imazapyr in 2007 using a helicopter broadcast application. Only two areas of this marsh were treated with the full six pints per acre concentration to eliminate the hybrid *Spartina*. This included the 450-meter long eastern portion where the infestation narrowed as well as the island east of the confluence of the two creeks (see Figure 2) The majority of the site was treated with a sub-lethal dose of imazapyr to chemically mow the cordgrass with the intention of stopping seed production and dispersal while maintaining the above-ground biomass to reduce potential short-term impacts to the California clapper rails from vegetation removal.

A preliminary evaluation of the first treatment season showed two distinct zones based on the two concentration levels of imazapyr applied. The majority of San Bruno Marsh was chemically mowed and has uniform green growth returning, while the two areas of full concentration, including the 0.65-acre island, contain stubble and standing necromass with only the patchy regrowth characteristic of a single application in a low elevation marsh area. Approximately 15 acres of hybrid *Spartina* remain within this site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Aerial helicopter treatment (primary)
Amphibious tracked vehicle or
Backpack sprayers (follow-up, primary in future years)

Timing: Treatment should occur between July 15 and September 15 (full concentration)
Chemical mowing (if needed) should occur between June 15 and July 1
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

An aerial application of imazapyr will be used to continue control efforts at San Bruno Marsh in 2008. Results from the 2008 California clapper rail breeding season surveys on this site will be used to determine the level of treatment to be conducted. If clapper rail population trends continue to be positive or static, then the remaining

hybrid cordgrass will be treated with the full six pints per acre concentration to eliminate the hybrid *Spartina* as efficiently as possible. If the observed clapper rail population trends raise concern, then the majority of San Bruno Marsh will be chemically mowed again to stop seed production and dispersal while maintaining potential refugia. Any regrowth in the areas that were treated with the full concentration in 2007 will receive that same level of treatment again in 2008. Ground-based methods will need to be used for follow-up along the levees and around areas of shoreline plantings since the helicopter boom has difficulty achieving complete coverage on those areas. These follow-up applications should be conducted no more than three weeks after the helicopter work. This will enable the applicators to see color changes in any properly treated plants to reduce overapplication, while also conducting the control work when the plants are actively growing and before they have set seed. Amphibious tracked vehicles will be used to transport personnel out onto the marsh plain, which will reduce return trips to fill up. The short upland transition zone of this site is adjacent to a section of the Bay Trail, so truck-mounted sprayers could potentially be used for the follow-up in these areas. In the future, once the infestation has been sufficiently reduced, backpack sprayers may be utilized to reduce mobilization costs.

Monitoring Needs

Due to the large size of this marsh, ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 18H: SAN BRUNO CREEK

Sub-Area Partners

Owner(s): State Lands Commission, City of South San Francisco
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

San Bruno Creek is a channelized tidal system that constitutes the southwest corner of this site complex. The site begins just west of Hwy. 101 and east of 7th Avenue in an area of unincorporated San Mateo County called 7th Avenue Park sandwiched between the northeast corner of the City of San Bruno and San Francisco International Airport. The channel vegetation is composed of mostly freshwater species for the first 200 meters until it flows under San Bruno Ave and begins to take on a more brackish character. The creek flows north under Hwy. 101 and a cluster of onramps, then turns east and flows 700 meters along North Access Road, through tide gates, and out to the rectangular Inner Harbor area (Sub-area 18d) bordered by the Old Marina (Sub-area 18c) to the west and SamTrans Peninsula (Sub-area 18e) to the east. The mouth of San Bruno Creek is actually in the northwest corner of the Inner Harbor, where it flows between Confluence Marsh (Sub-area 18f) and SamTrans Peninsula and joins Colma Creek (Sub-area 18a). Both banks of the creek contain a fringe marsh component along their length, with an estimated 5.5 acres of habitat lining the channel in this sub-area.

Prior to the initiation of treatment, the banks of San Bruno Creek downstream of Hwy. 101 were dominated by a continuous linear infestation of tall, dense hybrid *Spartina*. These invasive plants had accreted a great deal of sediment that created benches that were narrowing the channel. Upstream of the highway the infestation consisted of a lower density linear infestation with scattered individual plants establishing. San Bruno Creek was first treated with imazapyr in 2006 using amphibious tracked vehicles along the accreted benches and creek banks. This application was very effective, and the area was retreated with the same method in 2007. In 2006, the monitoring crew first discovered hybrid *Spartina* in the upstream reach west of Hwy. 101 and north of San Bruno Boulevard (previously thought to be too brackish to support the cordgrass), and this area was first treated in 2007 during the control work downstream.

The infestation has been significantly reduced in San Bruno Creek, especially in the lower reaches where it had developed into a thick monoculture but has been treated twice. There are still some low density linear infestations from San Bruno Blvd downstream to Inner Harbor, along with some scattered plants under the highway onramps near Airport Blvd. In autumn 2007, a single new large clone was discovered further upstream, approximately 170 meters south of San Bruno Blvd., in a predominantly freshwater environment.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary) downstream of San Bruno Blvd. ONLY Manual removal for clone in 7th Ave. Park upstream of San Bruno Blvd.
Equipment:	Amphibious tracked vehicle (primary), truck-mounted or backpack sprayers (follow-up)
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

Imazapyr will be applied to any remaining hybrid *Spartina* downstream of San Bruno Blvd. in 2008 using amphibious tracked vehicles along the benches and banks of the channel. If retreatment is needed in future years, the equipment may transition to backpack or truck-mounted sprayer to lower mobilization costs if the infestation area has been sufficiently reduced.

The new individual clone in the channel upstream of San Bruno Blvd. in 7th Ave. Park will be controlled manually because it is in an area known to support the threatened California red-legged frog (*Rana aurora draytonii*) and the endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*). Since this plant is sufficiently large, tarp covering may be used to smother the plant. The tarps will need to be securely fastened to the marsh surface and left in place for at least one year. Follow-up on this plant may involve digging once it has been reduced to an appropriate size for this method.

Monitoring Needs

ISP monitoring should provide the applicators with detailed maps of the current distribution of hybrid *Spartina* to ensure comprehensive treatment and improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Colma Creek and San Bruno Marsh Complex, San Mateo County, TSN: ISP-2005-18, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

All eight sub-areas are the same as defined in that plan.

Two previously unidentified species of concern, the threatened California red-legged frog (*Rana aurora draytonii*) and the endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), have been determined to be present within the upper reaches of sub-area 18h: San Bruno Creek. Amphibians and reptiles are known to be adversely affected by contact with imazapyr herbicide and surfactants. Red-legged frogs generally reproduce during the winter and early spring, and may be present at the site as larvae or adults from spring through fall. San Francisco garter snakes breed during the spring and summer, and generally bear live young from late July to early September.

To minimize potential adverse impacts to California red-legged frogs and San Francisco garter snakes, no herbicide will be used in the upper reaches of San Bruno Creek. The single young clone present there will be initially treated by covering, with follow-up digging of any new sprouts. The site will be carefully inspected for presence of red-legged frogs or San Francisco garter snakes prior to covering or digging, and USFWS biologists will be consulted before proceeding if any are discovered.

At the other seven sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the areas treated in 2005-2007, and the potential environmental impacts resulting from treatment are expected to also be less, with no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 19: WEST SAN FRANCISCO BAY COMPLEX, SAN MATEO COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for West San Francisco Bay Complex, TSN: ISP-2005-19, 2005-2007 Control Seasons) dated May 2005. All 18 sub-areas are the same as defined in that plan, and no new species or other factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partner

The work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

San Mateo County Mosquito Abatement District, 1351 Rollins Road, Burlingame, CA 94010; *James Counts, Field Operations Supervisor, (650) 344-8592. james@smcmad.org* The San Mateo County Mosquito Abatement District (SMCMAD) has been working throughout the area of this plan since 1953, and has extensive knowledge of the marshes and shoreline as well as the appropriate equipment and expertise for safe, efficient control work within these sites. They are the Coastal Conservancy grant recipient for this complex, and performed all of the treatment from 2005-2007 on these sites with their personnel and equipment. Several of the sub-areas outlined in this plan are areas where the SMCMAD regularly conducts mosquito control efforts, and control of the *Spartina* on these sites would potentially diminish the amount of mosquito breeding habitat available that the agency would need to monitor and treat for the insects.

Site Description

Map Site 19: West San Francisco Bay Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

19a	Brisbane Lagoon	Map	19j	Easton Creek Mouth	Map
19b	Sierra Point	Map	19k	Sanchez Marsh	Map
19c	Oyster Cove	Map	19l	Burlingame Lagoon	Map
19d	Oyster Point Marina	Map	19m	Fisherman's Park	Map
19e	Oyster Point Park	Map	19n	Coyote Point Marina/Marsh	Map
19f	Point San Bruno	Map	19o	San Mateo Creek /Ryder Park	Map
19g	Seaplane Harbor	Map	19p	Seal Slough Mouth	Map
19h	SFO	Map	19q	Foster City	Map
19i	Mills Creek Mouth	Map	19r	Anza Lagoon	Map

This site complex of 18 sub-areas includes all tidally influenced areas of the western San Francisco Bay in San Mateo County from the county line near Candlestick Point in the north to just south of the San Mateo-Hayward Bridge. This stretch of shoreline is highly developed, including several small marinas, tidal lagoons, numerous flood control channels, small fragmented patches of remnant marsh, and the mouths of several creeks and sloughs. A wide range of land uses can be found here, from San Francisco International Airport to light and heavy industry, to both commercial and residential development. There are large mudflat areas, little nooks of *S. foliosa* and pickleweed (*Sarcocornia pacifica*), and many kilometers of armored shoreline both on the bayfront as well as surrounding the lagoons further inland. A separate Site-Specific Plan for the Colma Creek/San Bruno Marsh Complex (Site 18) has been developed to specifically address the *Spartina* treatment approaches for that area, and those areas are therefore not included in this plan.

The infestations of non-native *Spartina* in this complex were well established when ISP treatment began in 2005, with approximately 85 net acres requiring control within an estimated 350 acres of marsh habitat. In many cases, there is only a relatively thin band of appropriate habitat for the *Spartina* to invade, and at most of these sites the majority of the available area had already been infested to some degree. Hybrid *Spartina alterniflora* can be found along the rip-rap of shoreline development and around the rims of the protected lagoons, in remnant or newly formed pickleweed marsh, along creeks and channels, amongst sand/shell beaches, within the one large established marsh, and on the mudflats offshore. There is also one lone infestation of *S. densiflora* at a single sub-area of this complex. These infestations have had varying degrees of treatment since 2005, many with one to two years but some with three seasons of imazapyr applications. The control work has reduced the hybrid *Spartina* significantly in all cases, but several seasons of follow-up are still required to eliminate the problem from all 18 sub-

areas. There is less than ten acres of non-native *Spartina* remaining in the West San Francisco Bay complex that will need treatment in 2008.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 19A: BRISBANE LAGOON

Sub-Area Partners

Owner(s): City of Brisbane, Universal Paragon, SamTrans Joint Powers Authority
Manager(s): City of Brisbane
Grantee(s): SMCMAD

Sub-Area Description

Brisbane Lagoon is a 120 acre triangular lagoon in the City of Brisbane that tapers to a point at its southern end. The lagoon is bordered to the west by Caltrain railroad tracks and Bayshore Boulevard, to the east by Sierra Point Parkway and the Bayshore Freeway (Hwy. 101), and to the north by Lagoon Way and the area of the Lagoon Holding Pond. The northwest corner of the lagoon is spanned by the Tunnel Avenue Bridge and contains roughly 2 acres of marsh habitat. The western shore of the lagoon is mostly rip-rap adjacent to the CalTrain tracks, with a small (roughly 0.5 acre) bulb of marsh centered at the midpoint. The southern tip of the lagoon contains a shell beach fronting approximately 7.5 acres of pickleweed (*Sarcocornia pacifica*) marshland. The eastern side of the marsh consists mostly of rip-rap adjacent to Sierra Point Parkway interspersed with small marsh areas and car pull outs. The main central portion of the lagoon is open water even at low tide. Included in this site is a manmade tidal channel north of the Lagoon Holding Pond that runs more than 700 m from the Bay to a pump house just west of Tunnel Avenue.

Hybrid *Spartina alterniflora* was well distributed around the entire shoreline of the lagoon when treatment was initiated in 2006, totaling approximately five acres. The three areas with some native marsh habitat component (the northwest corner, bulb at the midpoint of the west shore, and the western half of the southern tip) were the most heavily infested, with a rapidly expanding infestation along the rip-rap of the eastern shore. The site was treated in 2006 using imazapyr applied from backpack sprayers and truck-mounted sprayer. Some areas of the western shore were done by backpack because access is restricted along the railroad tracks. Although these applications were done late in the season and the resulting efficacy was lower than expected, many of the scattered plants in the rip-rap had been significantly reduced. Previously the northwest corner of Brisbane Lagoon had the densest concentration of hybrid *Spartina* in the site, but this area saw the highest efficacy from the work in 2006 and was reduced by 90% or more. Retreatment was conducted in 2007 using the same methods but at the more optimal time of late August. A follow-up application occurred in September on some scattered plants that were missed in the pickleweed marsh of the southern tip.

Although there are still numerous scattered *Spartina* points around Brisbane Lagoon, most represent a single plant or a small proportion of a previously larger clone. There are no longer any continuous stands such as the area around the bulb on the west shoreline or the northwest corner. Several patches that spread from the site were discovered in 2007 along the bayfront on the other side of Hwy. 101, approximately 100 m east of the lagoon. An additional infestation was found in December 2007 in a tidal channel that crosses under Tunnel Ave. approximately 900 m north of Lagoon Way. Including these new, previously untreated plants, approximately 2000 ft^2 will need to be treated in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer
Backpack sprayers

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

All remaining hybrid *Spartina* plants should be treated with imazapyr in 2008, using a combination of the equipment listed above. A crew can use a truck-mounted sprayer along the upland edge on the north and east sides of

the lagoon, hauling hose down to treat the scattered plants remaining in the rip-rap. The truck can also be used to ferry material to crews with backpack sprayers walking the marsh of the southern tip. Access issues along the railroad in the west require that it be approached with backpack sprayers to treat any remaining plants along the rip-rap and on the marsh bulb. The new plants along the bayfront east of the lagoon can be treated by truck or backpack, while the channel north of the Lagoon Holding Pond must be treated by backpack since it is too far from the road to use a truck.

Monitoring Needs

This site is relatively large and will require detailed *Spartina* distribution maps to enable the treatment crews to efficiently perform the application without having to search the entire site for the remaining plants. The full extent of the infestation in the channel north of the Lagoon Holding Pond is still unknown because of its recent discovery. As the infestation is reduced to the final plants, some may need to be genetically tested if they are stunted and thereby appear more like *S. foliosa* than hybrids. This issue is most likely to occur in the areas with remnant marsh and some component of *S. foliosa* that must be differentiated from potential hybrids. Most of the cordgrass along the rip-rap is relatively easy to distinguish from the native.

SUB-AREA 19B: SIERRA POINT

Sub-Area Partners

Owner(s): Opus West, Sierra Point Marina
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

This 4-acre site consists of the northwestern corner of the square-shaped peninsula of Sierra Point in the City of Brisbane. It is bordered to the south and west by the northbound onramp for the Bayshore Freeway (Hwy. 101), to the east by a vacant lot and corporate park development along Marina Boulevard, and to the north by San Francisco Bay. The area consists of a narrow channel flowing down the center of the site lined with pickleweed benches, transitioning quickly in the upstream extent to brackish marsh plants such as alkali bulrush (*Bolboschoenus maritimus*).

This site was not treated for the first time until 2007, and by this point it had expanded substantially from the area of hybrid *S. alterniflora* estimated in 2005. The channel had filled in with invasive cordgrass, as had the pickleweed marsh at the mouth, and the large clones on the mudflat of the Bay were coalescing into a continuous meadow. The site was heavily infested with hybrid *Spartina* up to the transition to brackish vegetation that was able to still able to outcompete the invasive cordgrass and resist colonization. SMCMAD treated the site with imazapyr in 2007 using a truck-mounted sprayer. The infestation had also started to spread east along the bayfront shoreline, and seven individual *Spartina* plants were found along the shoreline of the Sierra Point Marina on the northeastern corner of the peninsula.

Since 2007 was the first year of treatment on this established infestation, and there was a dense cover of *Spartina* at low elevation on the mudflats and in the channel, it is expected that there will need to be retreatment on 15-25% of the original infestation. The scattered plants in the Sierra Point Marina will also need to be treated. The total area of invasive *Spartina* remaining at Sierra Point is less than 0.5 acre.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer, backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

The large infestation along the channel and mudflats will be treated with imazapyr using a truck-mounted sprayer and hauling hose down to the site. The small patches of hybrid *Spartina* in the marina section will be treated with imazapyr using either a truck or backpack sprayers depending on access issues.

Monitoring Needs

Marinas are very difficult areas to survey comprehensively for *Spartina* because there are usually issues of access and there are so many little pockets where the plants can establish. Eventually each marina around the Estuary will have to be exhaustively surveyed including, at minimum, walking or kayaking around all of the individual boat slips. The current known infestation at the Sierra Point Marina is along the upland edge that can be surveyed fairly easily by walking along the shoreline.

As with most sites that had well established populations of *Spartina*, there may need to be an expansion of genetic testing if the final plants in the infestation are stunted by previous herbicide applications and are difficult to identify conclusively.

SUB-AREA 19C: OYSTER COVE

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

The Oyster Cove site is located at the northern city limit of South San Francisco. It is bordered to the west by Caltrain railroad tracks and the Bayshore Freeway (Hwy. 101), to the north by office buildings on Shoreline Court, to the south by a large corporate park on Oyster Point Boulevard, and to the east by the small Oyster Cove Marina on the Oyster Point peninsula. There is a two acre pickleweed (*Sarcocornia pacifica*) and *S. foliosa* marsh on the southwest side of the small cove that the marina occupies, and the native marsh vegetation stretches out into the main cove to the west. Most of the remainder of this area is rip-rap or concrete-lined shoreline adjacent to office parks and large hotels.

Due to the limited time available in 2005 after the Biological Opinion was issued, the first treatment at this site was in 2006. The rectangular cove that constitutes the western arm of this site had little *Spartina* because of an inhospitable shoreline. The infestation was concentrated in two clusters. The remnant patch of marsh adjacent to Oyster Cove Marina had become dominated by hybrid *Spartina* that was clogging the small channels and was prograding out onto the adjacent mudflats to the north and around the corner to the west. The second concentration was the northern shoreline of the cove off Shoreline Court. *Spartina* had colonized the northwestern corner and established a linear infestation at the base of the rip-rap in this area that is protected from full wave energy. The entire infestation was treated with imazapyr in 2006 utilizing a truck-mounted sprayer and running hose down to the plants from the paved shoreline trail.

The infestation has been reduced in both of the two clusters where it had established. Both areas continue to have a small presence of *Spartina*, mostly clones at lower elevation that tend to be harder to fully eliminate. The current distribution can be found along the mudflat on the northern shoreline and in the channels and mudflat edge of the marsh by the marina. There is approximately 500 ft^2 of hybrid *Spartina* remaining that needs treatment in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer or backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

The remaining hybrid *Spartina* on the site will be treated with imazapyr in 2008, either using a truck-mounted sprayer or backpack sprayers. Although the remaining area should be small, manual removal would still be time prohibitive. Some plants along the northern shoreline are rooted in rip-rap and cannot be effectively removed, while others are part of previously large clones with an abundance of below-ground biomass.

Monitoring Needs

As mentioned previously in the description of Sierra Point, the marina at this site will need to be exhaustively surveyed since there has been an adjacent population of invasive *Spartina* capable of dispersing. Marinas are very difficult areas to survey comprehensively for *Spartina* because there are usually issues of access and there are so

many little pockets where the plants can establish. Eventually each marina will have to be exhaustively surveyed including, at minimum, walking or kayaking around all of the individual boat slips. No *Spartina* has ever been recorded on the edges of this marina although it is only 20 m from the active infestation.

SUB-AREA 19D: OYSTER POINT MARINA

Sub-Area Partners

Owner(s): City of South San Francisco
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

This site is located on the eastern end of Oyster Point in South San Francisco, just north of Marina Blvd., approximately one mile east of Hwy. 101. The tip of the peninsula to the north is the site of a corporate park located at the end of Oyster Point Rd. The 600-berth marina runs east to west and has a lifeguard station and public beach on the western shoreline. The borders of the marina are rip-rap, while the public beach is an open sandy stretch with little marsh vegetation.

Hybrid *Spartina* had established a significant presence on this site relative to the small amount of appropriate habitat. Prior to the initiation of treatment in 2006, the largest clones were growing on the western side of the marina, on either side of the public swimming beach, while the greatest concentration of plants was found on the eastern half of the marina along the rip-rap embankments. Approximately 0.5 acre of hybrid *Spartina* was treated with imazapyr in 2006 using backpack sprayers.

The infestation consists of numerous very small points of *Spartina* distributed over the site in the same general footprint that existed before control work began. This is most likely the result of a late application in 2006, which accounts for a small percentage of regrowth over much of the infestation but little complete elimination. The highest concentration of individual plants is still in the eastern half of the marina, mainly along the shore of the peninsula at the midpoint of the marina that contains Harbormaster Road. There is also one newly discovered small plant (a second could be pulled immediately) on the perpendicular shoreline north of the marina. The total area of hybrid *Spartina* remaining at Oyster Point Marina is expected to be less than 100 ft^2 in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)
Manual removal (follow-up in appropriate substrate)

Equipment: Backpack sprayers
Shovels or similar tools

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

An imazapyr application continues to be the most appropriate treatment method at this site due to the rip-rap substrate of the marina which makes complete removal of the roots impossible with manual means. The herbicide will be applied by backpack sprayer to the scattered tiny plants remaining after the previous treatment. Manual removal may be used to follow-up in the area adjacent to the public beach because of the ease of removal from that sandy substrate.

Monitoring Needs

As with the nearby Oyster Cove and Sierra Point Marinas, no *Spartina* has yet been identified within the boat slips or interior, only along the shoreline. Marinas are very difficult areas to survey comprehensively for *Spartina* because there are usually issues of access and there are so many little pockets where the plants can establish. Eventually this marina will have to be exhaustively surveyed including, at minimum, walking or kayaking around all of the individual boat slips.

SUB-AREA 19E: OYSTER POINT PARK

Sub-Area Partners

Owner(s): City of South San Francisco

Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

Oyster Point Park is a 33-acre park located immediately to the south of Oyster Point Marina (Sub-area 19d). This site is 3.5 acres, including just the small channel that drains to the bay and the channel mouth. The channel runs west to east some 350 meters along the base of a steep slope. Marina Boulevard runs along the top of this slope and constitutes the northern border of the park. The mouth of the creek is a mixed marsh habitat with some sandy beach deposits. The entire marsh area at the outlet is surrounded by extensive rip-rap shoreline, which borders grassy parkland on the interior. The site continues south along the shoreline approximately 200 meters to a right-angle bend in the shoreline.

Hybrid *Spartina* had become well established at this site prior to the initiation of treatment in 2006, with approximately 1.5 total acres. The channel contained a continuous low density infestation for most of its length, and large clones were prograding out onto the mudflats at the mouth and at a bend in the shoreline beginning approximately 150 meters to the south. Amphibious tracked vehicles were used to access the site and apply the imazapyr to the hybrid *Spartina*. In 2006, the channel and a portion of the mouth were treated. The efficacy of the application in 2006 was reduced by both late timing (plants already senescing) and insufficient dry time from the incoming tide. The result was very little mortality, and most of the site needed to be retreated in 2007, as well as expanding treatment to the rest of the mouth and the other large clones to the south.

The linear infestation in the channel has showed the greatest reduction from treatment. It is no longer continuous along the entirety of the channel, and was found to be less than 1% cover of hybrid *Spartina*. The large clones at the mouth and on the southern mudflats have been reduced but will need retreatment. Approximately 0.25 acre of hybrid *Spartina* is still present on the site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicle
Backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

The key to successful treatment at this site appears to be timing. It is essential that the application be scheduled around a receding tide to achieve longer dry time and improve efficacy. The site will be accessed by amphibious tracked vehicle to apply the imazapyr to the remaining hybrid *Spartina* in 2008. In future years, backpack sprayers may be appropriate for cleaning up the remaining infestation.

Monitoring Needs

Detailed maps of the current distribution of *Spartina* on this site will be provided to the treatment crew to assist with their planning and improve efficiency. It will be important to know the full extent of what needs treatment since the application must occur within a narrow tidal window to achieve better efficacy.

SUB-AREA 19F: POINT SAN BRUNO

Sub-Area Partners

Owner(s): State Lands Commission, Genentech (adjacent property)
Manager(s): City of South San Francisco
Grantee(s): SMCMAD

Sub-Area Description

This site is defined as a 1.7 kilometer stretch of Bay shoreline in South San Francisco extending north approximately 250 meters from the northern border of Point San Bruno Park, and south approximately one kilometer from the tip of Point San Bruno to the eastern end of San Bruno Marsh (Sub-area 18g) at the outlet of San Bruno Canal and Colma Creek (Sub-area 18a). This sub area consists of three main areas of mixed marsh habitat interspersed with sandy beaches. The northern end of this site contains rocky cliff faces fronting the Bay, whereas the

southern end contains a shallow marsh bordered by corporate parks to the west. Near the southern extent of the site, a 2.5 acre slice of remnant marsh cuts west about 300 meters between two plateaus that are now covered with a new infestation of corporate park.

Prior to the initiation of treatment in 2007, hybrid *Spartina* at this site was found in several expanding clusters, with scattered plants along several stretches of the shoreline. There were numerous very small patches of hybrid *Spartina* along the shoreline from Point San Bruno Park north to the shoreline bend where ISP Sub-area 19e (Oyster Point Park) begins. A large cluster of coalescing clones could be found in a cove at the southern base of Point San Bruno, with a few scattered plants along the shoreline at the base of the cliff areas at the east end of East Grand Avenue. The last cluster is located in the eastern portion of the small remnant marsh east of Jamie Court, and extends out onto the bayfront and mudflats. These areas totaled an estimated 3.5 net acres of *Spartina* that were treated with imazapyr for the first time in 2007. Approximately 25% of the infestation was treated directly by boat, while the remainder was completed by backpack sprayers using material ferried to the applicators by boat.

Since 2007 was the first year of treatment on this infestation, and there were several areas with a dense cover of *Spartina* at low elevation on the mudflats and in the remnant marsh, it is expected that there will need to be re-treatment on 15-25% of the original infestation. The scattered plants along the rest of the shoreline may have been reduced by a higher proportion, leaving an estimated total of 0.5 acre.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Boat or hovercraft Backpack sprayers
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

The challenge for this site is balancing the need to access the site by boat, while also needing to allow enough dry time for the imazapyr to enter the plants before being inundated by the tide. The hovercraft could be employed for this purpose, eliminating the need for standing water after treatment. Treatment crews could approach on a receding tide, perform the application, and motor off across the mudflats when finished, maximizing potential dry time. The imazapyr will be need to be applied by backpack sprayer because of the patchy nature of most of the infestation, as well as the distance from the Bay in some of the heavily infested areas such as the remnant marsh near the south end of the site.

Monitoring Needs

With such an intensive mobilization effort required at this site, it will be important for the treatment crew to have detailed maps of the current infestation in order to plan the amount of product to transport, and minimize the amount of searching and guesswork required while on site. Plants in some of the higher elevation areas (e.g. the remnant marsh) may need to be tested genetically to verify their hybrid status and inform treatment. However the majority of the infestation at Point San Bruno is easily distinguished from native *S. foliosa* due to the elevation at which it is growing (and normally also because of the robust features of the plants).

SUB-AREA 19G: SEAPLANE HARBOR

Sub-Area Partners

Owner(s):	US Coast Guard and San Francisco International Airport (adjacent landowners)
Manager:	San Francisco International Airport
Grantee(s):	SMCMAD

Sub-Area Description

Seaplane Harbor sub-area is a cove in the northeastern corner of San Francisco International Airport (SFO, Sub-area 19h), and contains a heavily developed shoreline with a US Coast Guard Air Station and other airport infrastructure. It is located just south of the City of South San Francisco, with the North Access Road following the western shoreline of the cove from north to south, and the open water of San Francisco Bay to the east. This site also covers the 600 m of pickleweed marsh and sand/shell shoreline from the eastern edge of the SamTrans Pen-

insula (Sub-area 18e in the Colma Creek complex) to the northern edge of the Harbor cove. The shoreline at this site has only limited marsh habitat beyond a high rip-rap border. Seaplane Harbor includes approximately 0.75 acres of marshland habitat that is highly fragmented and varies in depth along the rip-rap edge of the Harbor.

Hybrid *S. alterniflora* was present in widely scattered patches at this site, mostly along the northern and western shoreline of the cove, with very little along the southern edge. The majority of the plants were young and small, with a number of moderately-sized clones getting established too. Approximately 0.25 acre of invasive cordgrass was treated with imazapyr for the first time in 2007 utilizing the SMCMAD hovercraft to approach the infestation at low tide to maximize dry time. Plants were either treated directly from the hovercraft, or an applicator was deployed with a backpack sprayer to complete the control work.

Since most of the infestation is composed of small individual plants, any retreatment required in 2008 should be minimal. It is anticipated that less than 500 ft^2 of scattered individual hybrid *Spartina* plants will need retreatment in 2008.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Hovercraft Backpack sprayers
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

Due to the effort to deploy to the site via hovercraft, an imazapyr application is still the most appropriate control method at this site as opposed to manual removal. The treatment efforts at this site can also be paired with the larger applications at the adjacent SFO site. Control work may be done directly with the hovercraft spray gun, or by deploying personnel with backpack sprayers to walk the shoreline.

Monitoring Needs

The treatment crew would be able to improve efficiency and greatly reduce their time on this site if provided detailed hybrid *Spartina* distribution maps prior to the application. They could pinpoint just the areas they need to work in as opposed to surveying the entire cove while trying to make the best use of the narrow window of opportunity afforded by the tide and wind.

SUB-AREA 19H: SFO SHORELINE

Sub-Area Partners

Owner(s):	San Francisco International Airport
Manager(s):	San Francisco International Airport
Grantee(s):	SMCMAD

Sub-Area Description

The San Francisco Bay shoreline perimeter of San Francisco International Airport (SFO) includes seven distinct edges with varying degrees of marsh development based on exposure and accretion, totaling approximately 25 acres. There are two large runway strips that jut out into the Bay, the longer running roughly southeast to northwest with the shorter strips running perpendicular. The largest area of marsh is along the runways running southwest to northeast along the southern shoreline of SFO, just east of Hwy. 101. This protected cove has accreted substantial sediment and has prograded marsh out as much as 200 meters from the concrete and fill. At the Millbrae Avenue security gate to the runways, a large culvert empties a concrete flood control channel that draws stormwater from the airport complex. Two other areas of minimal pickleweed marsh have developed, one on the northeast side of the junction of the two runway strips and the other just south of Seaplane Harbor to the northwest of the shorter runways at the end of the N. Access Road. Both of these face the open Bay, and hence are subject to greater wave energy resulting in less accretion. There are extensive mudflats to the south of the airport complex as well as some shell beach development. The 500 meters of shoreline along Bayfront Park in the City of Millbrae are included in this site, down to the border with the City of Burlingame.

The infestation of hybrid *Spartina* at SFO was well established and continuing to expand before treatment was initiated in 2007. The majority of the infestation was along the southern shoreline of the runways beginning at the intersection of Millbrae Ave. and Bayshore Hwy. and running northeast 1.1 kilometers to the crossing of the other runway strip. This marsh had become dominated by large hybrid *Spartina* clones that were coalescing into a continuous meadow. Several large clones had also colonized the mudflats to the south, adjacent to the channel created by the outflow from the culvert moving stormwater away from SFO. Moving counterclockwise around the airport shoreline, there were only minimal small patches of cordgrass on the southeastern approach to the longer southeast-northwest runway because of limited habitat suitability, but the marsh by the upland bulb on the northeastern side at the junction with the perpendicular runway had become moderately infested with small to medium patches of invasive cordgrass. Finally, the two sides of the southwest-northeast runway were also clear because of inhospitable habitat, but the shoreline to the northwest up to Seaplane Harbor (Sub-area 19g) has some marsh development and had become moderately infested.

Treatment of the approximately 7.5 acres of *Spartina* at this site was complex, requiring multiple pieces of equipment for the imazapyr application as well as SFO security clearance for the crews to come ashore even outside of the runway fences. The main infestation along the southern shoreline was treated by a large crew with backpack sprayers. Since there was no efficient way to cross the channel at this location at low tide, the crew of applicators were escorted inside the gate by airport security and then back out onto the marsh. A SMCMAD truck was stationed outside the Millbrae Gate to refill the backpacks. The mudflat clones and the remainder of the entire shoreline were treated using SMCMAD's hovercraft, which could access the infestation at low tide without any water (providing for the necessary dry time). The hovercraft would return to the channel downstream of the culvert, pull up on the marsh edge, and get refilled from the batch truck using a long hose. This treatment effort took three days.

The large established infestation on the southern shoreline has only been treated once and by backpack sprayers, so it is anticipated that patches and individual plants will return in 2008. The smaller, expanding stands in the two other portions of marsh on this shoreline will see some regrowth, but the scatted individual plants on the armored shoreline of the runway approaches may have been largely eliminated in one application. Approximately one total net acre of *Spartina* is expected to remain in 2008.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Hovercraft Backpack sprayers Amphibious tracked vehicles
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

After working out the kinks in the first treatment year, one obvious way to improve efficiency became evident. Amphibious tracked vehicles can transport much more product than individuals carrying backpack sprayers, and can cover the distance back to the refilling truck much faster. Since airport security has given tentative approval to this method, the plan is to take the amphibious vehicles through the gate with security escorts, and then out onto the marsh for treatment. The remainder of the infestation will be treated by hovercraft again to access the plants at low tide without needing to come through the airport runway fences with escorts.

Monitoring Needs

With 7.5 kilometers of shoreline at the SFO site, and complications due to security escort coordination and refilling of spray equipment, it will be important for the treatment crews to have accurate maps of the current size and distribution of the remaining infestation at this site. The applicators should be able to go directly to areas that need treatment without needing to wander large areas by hovercraft, Argo, or on foot.

SUB-AREA 19I: MILLS CREEK

Sub-Area Partners

Owner(s):	State Lands Commission, City of Burlingame (adjacent lands)
Manager(s):	San Mateo County Flood Control District

Grantee(s): SMCMAD

Sub-Area Description

At the mouth of Mills Creek is a 2.5-acre pickleweed and *S. foliosa* marsh located to the east of Hwy. 101 and the Bayshore Highway, between Mahler Road and Burlway Road in the City of Burlingame. Commercial development borders the site to the north and south with restaurants and hotels to serve the airport community. This site follows the channelized Mills Creek southwest 300 meters under Hwy. 101, and then another 400 meters under Rollins Road to the Caltrain tracks at California Drive. Included in this site is the bayfront shoreline on either side of the mouth, north to Bayfront Park by SFO and south to the Ramada Inn.

Hybrid *Spartina alterniflora* had begun to dominate the marsh at the mouth of Mills Creek and had developed some large clones out on the mudflats up to 50 meters offshore. There were also scattered plants along the bayfront both north and south of the large mudflat clones. The infestation runs upstream for only about 100 meters west of Bayshore Hwy before disappearing. It reappears as a dense, continuous linear stand from the west side of Hwy. 101 to Rollins Rd. and beyond to approximately 70 meters before reaching the railroad tracks. At this upstream point the infestation in the channel consists of a couple of large clones and the vegetation is transitioning to brackish plants. The estimated acreage for this site was three acres before treatment began.

In 2006, imazapyr was applied to the hybrid *Spartina* in the marsh at the mouth and in the first stretch of channel east of Hwy. 101 using amphibious tracked vehicles. Unfortunately the cordgrass at the mouth had senesced early and treatment was not very effective. In 2007, the hovercraft was used to access the offshore clones in the soft mud for their first treatment, and to also apply the imazapyr to the scattered shoreline infestation to the north and south. Both an amphibious tracked vehicle and spray truck were used on the marsh at the mouth and in the first stretch of Mills Creek channel upstream. The remaining channel infestation west of Hwy. 101 was treated for the first time in 2007 using backpack sprayers due to limited access.

The large clones on the mudflats were well established and have only been treated once, so it is anticipated that they will require additional control work on 15-20% of their original area. The cover of non-native *Spartina* has been reduced substantially in the marsh at the mouth and in the first stretch of the creek upstream, with less than 500 ft^2 of scattered plants remaining. The hybrid *Spartina* upstream of Hwy. 101 has only been treated once, and relatively late in the season, leaving approximately 1000 ft^2 of remaining patches.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Hovercraft, backpack sprayers, truck-mounted sprayer, amphibious tracked vehicle

Timing: Treatment should occur between July 15 and September 15
Treat on a receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

The offshore mudflat clones and shoreline adjacent to the site will again be treated with imazapyr using a hovercraft to access the plants in the mud that is too soft to use an amphibious tracked vehicle. The remaining infestation in the marsh at the creek mouth is spotty, and can be treated with either backpack sprayers or hauling hose from a truck-mounted sprayer (it should be unnecessary to deploy an amphibious tracked vehicle for this small area). Both stretches of creek channel upstream will be treated with imazapyr from backpack sprayers due to access issues of using any larger equipment.

Monitoring Needs

There is quite a bit of healthy *S. foliosa* in the marsh section of this site, which may make identification of hybrids more challenging, especially those stunted by a previous application. This may require an expansion of genetic testing to provide the treatment crew with the current status of the infestation.

SUB-AREA 19J: EASTON CREEK

Sub-Area Partners

Owner(s): State Lands Commission, City of Burlingame (adjacent lands)
Manager(s): San Mateo County Flood Control District
Grantee(s): SMCMAD

Sub-Area Description

The mouth of Easton Creek is located 160 meters east of the Bayshore Highway adjacent to the Hwy. 101-Broadway interchange (Exit 419) in the City of Burlingame. The channelized creek runs through high density commercial development, including hotels and restaurants supporting the SFO airport community, and has thin strips of pickleweed marsh on either bank. Along the bayfront south of the mouth, there is a wider band of *S. foliosa* and pickleweed marsh extending south to a cove at the intersection of Airport Blvd. and Bayshore Hwy. The habitat along the shoreline both southeast and north of the creek mouth and cove contains little marsh vegetation below the heavy rip-rap armoring the shoreline.

Prior to the initiation of treatment in 2006 on this site, the hybrid *Spartina* at Easton Creek was undergoing a rapid expansion into the available habitat. Large clones were growing rapidly in the soft mud up to 100 meters offshore from the mouth, as well as several along the shoreline to the north. The *S. foliosa* stands of the cove to the south were being converted to thick stands of hybrid plants, with scattered individual patches extending down the rip-rap shoreline to the southeast. The infestation extended upstream to Bayshore Hwy in scattered patches and low density linear stands. Imazapyr was applied to most of the infestation in 2006 using several amphibious tracked vehicles working simultaneously in the thick mud. Several of the more remote mudflat clones could not be reached with this equipment, and a quickly rising tide lowered the efficacy a bit on the low elevation areas. In 2007 the entire site was treated, using the hovercraft to reach all the shoreline clones, and amphibious tracked vehicles along the rip-rap and in the lower reach of the channel. The extent of the creek infestation was discovered in 2007, with a moderate infestation running 200 meters upstream of Hwy. 101 to Rollins Road, with scattered patches of hybrid *Spartina* found another 100 meters further on to the railroad tracks. These areas were treated with imazapyr using backpack sprayers.

The large mudflat clones offshore of the mouth of Easton Creek that were treated in 2006 and 2007 have been significantly reduced, but several large established clones have only received an imazapyr application once. The extensive root mass, 2.5 meter height of the plants, and low elevation location will require multiple applications to fully eliminate. Scattered patches of hybrid *Spartina* can be found in the largely native *S. foliosa* of the southern cove. Individual plants can be found at the base of the rip-rap shoreline for 700 meters southeast of the cove, and for approximately 250 meters north of the mouth towards Mills Creek (Sub-area 19i). The infestation in the lower reach of the channel is now very low density along its length, but the reach upstream of Hwy. 101 still has scattered plants after only one season of treatment. Approximately 0.25 acre of hybrid *Spartina* remains over the various habitats of this site.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Hovercraft Backpack sprayers Amphibious tracked vehicles
Timing:	Treatment should occur between July 15 and September 15 Treat on a receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

Hovercraft will again be used to access the mudflat clones and shoreline to apply imazapyr to the remaining regrowth. This will enable treatment to be scheduled on a receding tide to maximize dry time and efficacy. Amphibious tracked vehicles can be used to access the plants that are still present in the rip-rap in the southern portion of the site, as well as in the cove and along lower reaches of the creek. Imazapyr will be applied to the *Spartina* upstream of Hwy. 101 by backpack sprayers as the applicators walk the creek.

Monitoring Needs

Due to the extensive *S. foliosa* in the southern cove prior to the invasion, genetic testing may be required to determine if any previously treated plants that are stunted are of hybrid origin and need to be treated in 2008 or beyond. Monitoring of the current distribution and abundance of hybrid *Spartina* in the upstream reaches of the creek will enable the treatment crews to plan their work and improve efficiency by reducing search time and stream walking in this difficult environment.

SUB-AREA 19K: SANCHEZ MARSH

Sub-Area Partners

Owner(s): State Lands Commission, City of Burlingame (adjacent lands)
Manager(s): City of Burlingame
Grantee(s): SMCMAD

Sub-Area Description

Sanchez Marsh is a 20-acre restored tidal marsh in the City of Burlingame. Hwy. 101 runs along its southern border, with the bridge of Anza Boulevard and the contiguous Burlingame Lagoon (Sub-area 19l) just beyond to the east, and recreation areas including the Burlingame Golf Center and the ball fields of Bayside Park to the north and west. Sanchez Creek flows north through Hillsborough and Burlingame and turns 90 degrees east just before flowing into the western tip of Sanchez Marsh. The site has extensive stands of *Spartina foliosa* in the western portion surrounding large PG&E power line towers that run east-west down the center of the marsh. The majority of the eastern portion is open mudflat at low tide with a meandering channel draining into Burlingame Lagoon and eventually to the Bay. Above rip-rap banks on the northern side the upland slopes to meet a paved recreation trail, while the southern edge of the marsh is mainly pickleweed (*Sarcocornia pacifica*) and gumplant (*Grindelia stricta*).

Prior to the initiation of treatment in 2005, the western half of Sanchez Marsh had become dominated by hybrid *S. alterniflora*, and the infestation was spreading rapidly to the southern edge and had begun to colonize the wide areas of mudflat in the eastern half. There was also a small infestation of *S. densiflora* in the southeastern corner of this marsh, next to the Anza Boulevard Bridge. This was the only infestation of this species south of the Bay Bridge, and is most likely the result of restoration activities in the marsh that borrowed plant material from *S. densiflora* infested marshes in Marin County. Treatment began in 2006 on an estimated two acres of invasive *Spartina* in Sanchez Marsh. Imazapyr was applied to the target plants using several amphibious tracked vehicles. This control work was very successful in the western portion of the site, but less so in the eastern portion and on the *S. densiflora*. This may have been a result of insufficient dry time, since the tides flood the site from the east. In addition, treatment may have been too late for the *S. densiflora* at this site, and Baywide ISP surveys confirmed that this was a bumper year for seedlings of this species. The entire site was retreated in 2007, once again using imazapyr delivered from amphibious tracked vehicles.

The infestation of hybrid *S. alterniflora* at this site has been reduced substantially by two seasons of treatment with imazapyr. There are a handful of scattered plants in the western portion where there was previously a meadow of invasive cordgrass, and selective treatment has allowed the native *S. foliosa* on the site to thrive. Control on the small *S. densiflora* population has been less dramatic, but it is still confined to a very small area. Interestingly, a rare *Spartina densiflora* X *S. foliosa* hybrid has been genetically confirmed on the eastern edge of this site. The total remaining infestation at Sanchez Marsh is small, with approximately 1000 ft^2 of hybrid *S. alterniflora* and less than 500 ft^2 of *S. densiflora* and its hybrid.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicles

Timing: Treatment should occur between **July 1** and August 1
Annual beginning in 2008 until eradicated

Amphibious tracked vehicles will be used to access the infestation at Sanchez Marsh in 2008 to apply imazapyr to the remaining invasive *Spartina* plants. The application should be timed to occur as early as possible in the treatment season, since *S. densiflora* normally flowers by June and we need to stop seed production from this species to complete the eradication.

Monitoring Needs

Genetic analysis will be very important to the final control work on this site. There is a healthy population of *S. foliosa* in Sanchez Marsh that we want to preserve while eliminating the non-native *Spartina*. The monitoring crew will need to sample questionable plants, obtain lab results, and produce detailed maps to assist the treatment crews so they can focus on just the target species. There is also the rare occurrence of hybrid *S. densiflora* on the site that the genetics lab at UC Davis will continue to investigate for its scientific value.

SUB-AREA 19L: BURLINGAME LAGOON

Sub-Area Partners

Owner(s): City of Burlingame (adjacent lands)
Manager(s): City of Burlingame
Grantee(s): SMCMAD

Sub-Area Description

Burlingame Lagoon is a 46-acre tidal lagoon in the City of Burlingame, the majority of which is open water at low tide with scattered mudflat areas. It is bounded to the south by Hwy. 101, to the west by the adjoining Sanchez Marsh and the Anza Boulevard Bridge, and to the east by commercial development on Beach Road and Lang Road. Beyond the rip-rap on the northern border of this site are the extensive parking lots of Anza Airport Parking. The southern edge of the lagoon has the thickest band of pickleweed marsh on the site at the toe of the rip-rap slope, while the rest of the perimeter has a very minimal edge of mixed marsh vegetation. A canal from the northeastern corner runs approximately 400 meters to connect the lagoon to tidal exchange with the Bay just beyond the overpass of Airport Blvd.

In 2005, hybrid *S. alterniflora* was only found on the southwest corner of this site near a thin strip of open space adjacent to Hwy. 101 up against the Anza Boulevard Bridge. By the first year of treatment in 2006, other scattered plants had been discovered along the rip-rap on the northern bank of the lagoon and some low density linear infestations had been found in the central and eastern stretches of the southern bank. These were very difficult to access for treatment because the soft mud of the lagoon and the minimal marsh vegetation edge. A truck-mounted sprayer rolled along the narrow shoulder of Hwy. 101 deploying a hose through the freeway fence, while backpack sprayers were used on the northern end. In 2007, a number of *S. densiflora* plants were discovered in three areas of Burlingame Lagoon. The first was in the southwestern corner adjacent to the *S. densiflora* infestation in the contiguous Sanchez Marsh, with a second cluster at the midpoint of the northern bank where a finger of upland reaches out to a set of PG&E power line towers, and one additional plant by the canal in the northeastern corner. The difficulties experienced during treatment in 2006 caused SMCMAD and the ISP to revise the treatment strategy. In 2007, imazapyr was applied to most of the non-native cordgrass using a boat that entered the lagoon from the canal to the Bay, while the larger patches in the southwestern portion were treated from an amphibious tracked vehicle.

The majority of the remaining *Spartina* at the site is concentrated in the southwestern corner where it was heaviest before treatment began. There are some low density linear infestations of hybrid *S. alterniflora* here at the transition from mudflat to marsh and some scattered *S. densiflora* still present. Along the length of the northern and southern rip-rap shorelines are scattered individual plants of hybrid *Spartina*, with a handful of *S. densiflora* found only on the north side. An estimated 1000 ft^2 of invasive *Spartina* remains in Burlingame Lagoon, the majority of which is hybrid *S. alterniflora* with a small percentage of *S. densiflora.*

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicles, boat, backpack sprayers

Timing: Treatment should occur between July 1 and August 1
Annual beginning in 2008 until eradicated

The infestation at Burlingame Lagoon will be accessed by boat and amphibious tracked vehicle in 2008 to apply imazapyr to the remaining invasive *Spartina* plants. The application should be timed to occur as early as possible in the treatment season, since *S. densiflora* normally flowers by June and we need to stop seed production from this species to complete the eradication. Applicators with backpack sprayers may also be used in the more accessible areas and when the infestation has reduced to the point that deploying the other equipment is unnecessary.

Monitoring Needs

Since this small infestation of invasive cordgrass is still widely scattered around the perimeter of the lagoon, it will be important to provide treatment crews with detailed maps of the current populations to eliminate guesswork and raise the efficiency of the control work at the site.

SUB-AREA 19M: FISHERMAN'S PARK

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of Burlingame
Grantee(s): SMCMAD

Sub-Area Description

Fisherman's Park is a very small 0.5-acre marsh patch on the shoreline border between the City of Burlingame and City of San Mateo. It is situated in a small corner of the Bay bounded to the west and south by Airport Boulevard and to the east by Peninsula Beach of Coyote Point County Recreation Area. There is a section of sand/shell beach which fronts a small pickleweed marsh containing a PG&E electrical tower. The borders of the marsh area are the rip-rap edges of an unpaved recreational trail.

The infestation of hybrid *Spartina* at Fisherman's Park consisted of several large clones and scattered small plants concentrated at low elevation in the southwest corner of the site, with a number of additional plants just below the rip rap along the western shoreline. The site was first treated with imazapyr in late September 2005 from a truck-mounted sprayer, but the efficacy was low due to timing and inundation soon after the application. The site was retreated in 2006 and 2007 using the same methods.

If any hybrid *Spartina* remains on this site in 2008, it is expected to be less than 100 ft^2, and will most likely be some regrowth from the large clones that were at the lowest elevation in the sandy substrate.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)
Manual removal (follow-up in sandy substrate)

Equipment: Truck-mounted sprayer
Backpack sprayer

Timing: Treatment should occur between July 15 and September 15
Treat on a low or receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

An imazapyr application is the preferred method of control at this site because most of the original infestation consisted of large clones, so regrowth would be connected to large underground rhizomes. Breaking these roots while digging can stimulate vegetative growth, and complete removal is rarely feasible with hand tools. In addition, some of the scattered plants along the western shoreline are rooted in the rip-rap. It appears that dry time may be an issue at this site with the lower elevation plants, so the application should be scheduled around an appropriate low tide.

Monitoring Needs

Monitoring will continue on all infestation sites until a minimum of three years of no hybrid *Spartina* is reached.

SUB-AREA 19N: COYOTE POINT MARINA & MARSH

Sub-Area Partners

Owner(s): County of San Mateo
Manager(s): County of San Mateo
Grantee(s): SMCMAD

Sub-Area Description

This site is located in the Coyote Point Recreational Area in the City of San Mateo, northeast of the Poplar Creek Golf Course. There are several distinct areas encompassed by this site. Along the northern shoreline is San Mateo Point, a rare remaining area of cobble beach with steep cliffs and tall rock outcrops at the water line. To the southeast of this area is the marina, with docks and moorage facilities surrounded by rip-rap levees. The eastern portion of the site consists of a sheltered marsh area surrounded by sand/shell beach berms that form a compressed "U" shape with a wide opening to the Bay.

Hybrid *Spartina* had invaded all of the diverse areas of this site to varying degrees before treatment was initiated in 2005. Several large clones could be found amongst the cobbles and rock features of San Mateo Point, with scattered plants spreading out across the beach from the core. Within the marina, invasive *Spartina* lined the interior rip-rap levees protecting the area, and was also interspersed with the moorages and docks. In the partially sheltered marsh outboard of the marina's east levee, *Spartina* has spread rapidly through the soft, unvegetated mud forming large circular clones that had started to coalesce into a meadow, hugging the edge of the sand/shell berms. The small cove directly south of Coyote Point was becoming dominated by hybrid clones that had lined the marsh shoreline beyond a short berm of shell beach. The total infestation was approximately 10 acres over the diverse areas of this site.

The site was partially treated in 2005, with imazapyr applied by amphibious tracked vehicles and truck-mounted sprayers. With limited time in that first year, the focus was on the marina and the marsh to the east. In 2006, the entire infestation was treated with imazapyr, although the outliers on San Mateo Point were inundated soon after the application and saw little efficacy. However, treatment with amphibious tracked vehicles in the sheltered marsh to the east and southern cove killed the majority of the infestation. Truck-mounted sprayers were used in the marina itself and had moderate efficacy. The site was retreated in 2007 using the same equipment, and the application to the infestation at San Mateo Point was made on a more appropriate low tide.

The hybrid *Spartina* infestation at Coyote Point Marina & Marsh has been reduced by over 90% since 2005. The previously large clones at the sheltered eastern marsh, San Mateo Point, and the southern cove are now largely stubble with a small percentage of regrowth. The marina infestation has been reduced to just scattered plants along the rip-rap and docks, and along the shoreline south of the site. Approximately 0.25 acre of hybrid *Spartina* remains in these areas.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Amphibious tracked vehicle, truck-mounted sprayer or backpack sprayer
Timing:	Treatment should occur between July 15 and September 15 Treat on a low or receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

Imazapyr will be used in 2008 to retreat any hybrid *Spartina* left at Coyote Point Marina & Marsh. The marsh and mudflat to the east, southern cove and shoreline, and beach at San Mateo Point will all be treated from amphibious tracked vehicle. A truck-mounted sprayer or backpack sprayer will be used to treat the areas of the marina.

Monitoring Needs

Marinas are very difficult areas to survey comprehensively for *Spartina* because there are usually issues of access and there are so many little pockets where the plants can establish. However they are also very difficult areas to treat for *Spartina*, and the applicators should not have to walk the entire site surveying while conducting the control work. This marina will have to be comprehensively surveyed, including around all of the individual boat slips, and maps provided to the applicators to streamline their work and ensure that the entire infestation is treated.

Genetics are also an issue on parts of this site. The shoreline south of the marina down to San Mateo Creek has many cryptic *Spartina* plants that need to be genetically verified to determine the extent of the infestation. Any areas of pure *S. foliosa* with no adjacent hybrids will be preserved.

SUB-AREA 19O: SAN MATEO CREEK/RYDER PARK

Sub-Area Partners

Owner(s):	City of San Mateo (adjacent lands)
Manager(s):	City of San Mateo
Grantee(s):	SMCMAD

Sub-Area Description

San Mateo Creek begins up in the San Francisco State Fish & Game Refuge, and emerges from Lower Crystal Springs Reservoir to flow through Hillsborough to its mouth in the newly developed City of San Mateo's Ryder

Park just northeast of J. Hart Clinton Drive. The vegetated channel banks are approximately 10-15 meters wide, rising from the creek at a moderate slope. The creek flows under a large pedestrian footbridge and out onto long mudflats at the mouth, with no remnant marsh component except for the mixed marsh vegetation below the rip-rap banks.

Prior to the initiation of treatment, hybrid *Spartina* had formed a number of large clones that were coalescing on the mudflat north of the mouth of San Mateo Creek. There were also several mid-sized clones up to 100 meters from the mouth below the rip-rap of Shoreline Park to the south, and scattered new colonizers along the north shoreline of Ryder Park. A thick linear infestation of *Spartina* was dominating both banks of the creek for approximately 300 meters upstream to the south of Clinton Drive. Upstream of S. Norfolk Street the infestation was at a lower density, thinning out to scattered patches further up at the Hwy. 101 interchange at 1.2 kilometers from the mouth.

The site contained approximately three acres of hybrid *Spartina* in 2005 when SMCMAD first treated a portion with imazapyr. Amphibious tracked vehicles were used to access the clones on the mudflat offshore, and to treat the first stretch of the creek up to Clinton Dr. This work occurred late and not on an optimal tide because of the late start and overwhelming work load in 2005, so efficacy was minimal. Treatment in 2006 occurred on September 8 just after California clapper rail breeding ended and they were able to access the site. The mudflat clones and lower channel were again treated with imazapyr from amphibious tracked vehicles, and they returned to treat the upper channel with backpack sprayers. The hybrid *Spartina* in the upper channel was reduced significantly by these applications, but the control work on the mudflat and lower channel was not as successful, possibly due to limited dry time. Amphibious tracked vehicles were used again in 2007 to apply the imazapyr to both the mudflat and the areas of the channel that are still infested, and special notice was paid to the appropriate tides when the work was scheduled.

Efficacy on the mudflat clones was much higher in 2007, with the majority of their previous footprints reduced to stubble, and just a small percentage of regrowth from the large below-ground biomass. The channel infestation has been reduced to scattered linear patches in the middle and lower reaches, and individual *Spartina* plants in the upper channel. The upstream extent of the channel infestation is at Gateway Park at the intersection of E. 3rd Avenue and S. Humboldt Street. There is approximately 0.25 acre of hybrid *Spartina* left along the channel and mudflats of San Mateo Creek.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary)
Equipment:	Amphibious tracked vehicle, backpack sprayer
Timing:	Treatment should occur between July 15 and September 15 Treat on a low or receding tide to maximize dry time for low elevation *Spartina* Annual beginning in 2008 until eradicated

The remaining infestation of hybrid *Spartina* at San Mateo Creek will be treated in 2008 with imazapyr using amphibious tracked vehicles to access the mudflat clones and lower channel. The upstream areas of the channel may be treated either by the same piece of equipment, or by backpack sprayers in areas of more difficult access. It is possible that a truck-mounted sprayer could be used at some of the road crossings where hose could be lowered to an applicator on the banks of the channel.

Monitoring Needs

With the long channel component of this site, the San Mateo Creek site is relatively large and needs current *Spartina* distribution data to inform treatment. Monitoring efforts must be completed prior to treatment, and detailed maps of the size, distribution, and upstream extent of the infestation must be provided to the monitoring crews.

In addition, the shoreline north of the creek up to Coyote Point Marina has many cryptic *Spartina* plants that need to be genetically verified to determine the extent of the infestation. Any areas of pure *S. foliosa* with no adjacent hybrids will be preserved. There are also some questionable areas upstream where Hwy. 101 crosses the channel.

SUB-AREA 19P: SEAL SLOUGH MOUTH

Sub-Area Partners

Owner(s): City of San Mateo (adjacent lands)
Manager(s): City of San Mateo
Grantee(s): SMCMAD

Sub-Area Description

The mouth of Seal Slough is located in the City of San Mateo on its eastern border with Foster City. The site begins 200 meters upstream of the crossing of J. Hart Clinton Drive and a pedestrian footbridge spanning the channel, at tide gates that restrict water exchange and transform the upstream slough into the sinuous, 6-kilometer-long Marina Lagoon that is lined with residential properties. This portion of the site is characterized by large mudflats that have accreted in the absence of scour from the full volume of the slough. On the downstream side of the bridge to the north, the mouth of the waterway opens to a 300 meter-wide cove bordered by a 70 acre tidal marsh to the east and the large hillside of Shoreline Park to the west above a heavily armored bank. The marsh contains small channels, mudflats, pans, high marsh pickleweed (*Sarcocornia pacifica*) and gumplant (*Grindelia stricta*) stands, sand/shell beach berms along most of the bayfront, and PG&E power line towers anchored in the western edge at the mouth. To the east of the marsh is a recreation complex including the Mariners Point Golf Links. In 2006, CalTrans began a mitigation project by excavating a sinuous channel to the Bay on the eastern edge of the marsh.

Prior to the initiation of treatment in 2005, Seal Slough contained the largest hybrid *Spartina* infestation in the West San Francisco Bay site complex, with approximately 45 acres of invasive cordgrass. Hybrid *Spartina* had heavily infested the large marsh east of the mouth, with long linear stands clogging the channels, and large clones colonizing the mudflat offshore and the sand/shell beaches on the bayfront, coalescing into a monocultural meadow on the open pickleweed plain. There are several noticeably-different hybrid forms in this marsh, and they have successfully exploited all the available niches present, from high marsh to mudflat. At the base of the PG&E power lines by the mouth of the slough the clones had coalesced into a meadow that stretches under the adjacent bridges and out onto the mudflats. A large meadow of hybrid *Spartina* had also formed on the western mudflats in the area between Clinton Drive and the tide gates, with a smaller linear infestation on the eastern side of the channel. Finally, there are several scattered clones in the rip-rap on the east side of the golf links, and a linear infestation in the rip-rap west of the mouth at the base of the hill on Shoreline Park.

Treatment began late in the 2005 season at a portion of this site, using multiple amphibious tracked vehicles to apply imazapyr to the accessible *Spartina* on the marsh plain. In 2006, the strategy changed to incorporate a more appropriate application method for this infestation, an aerial broadcast of imazapyr on the marsh plain that could be conducted before September 1 to achieve higher efficacy than later season ground-based work. This was very successful at reducing the infestation on the mid-marsh, but the lower elevation bayfront on the north and west along the channel had lower efficacy. Amphibious tracked vehicles were used to treat the areas around the PG&E towers and on the mudflats south of the bridge by the tide gates. By 2007 the infestation was down to approximately 18 acres, much of which was not accessible by helicopter, and the strategy switched back from broadcast aerial to ground-based work on the entire site. The remaining infestation of hybrid *Spartina* was treated with imazapyr by 3-4 amphibious tracked vehicles over a two-day period.

The greatest reduction in hybrid *Spartina* on the site was on the marsh plain, where only widely scattered patches remained over the original infestation footprint. There is a greater proportion of the infestation remaining in the low elevation areas along the bayfront to the north and west, amongst the deeper pockets by the power line towers, and in the small channels throughout the marsh. The mudflat meadow near the tide gates south of Clinton Dr has also been greatly reduced, with large areas of stubble from the many dead *Spartina* stems, and just scattered areas of regrowth. The remaining hybrid *Spartina* infestation is approximately 3-5 acres distributed over the diverse sections of this site, but concentrated in the low elevation areas.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicle (primary)
Helicopter (possible for bayfront and marsh plain channels)

Timing: Treatment should occur between July 15 and September 15
Treat on a low or receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

The remaining infestation at Seal Slough will be treated with imazapyr in 2008. Amphibious tracked vehicles may be used for all of the applications to this site, but a helicopter may be utilized for work in some low elevation areas such as the bayfront clones and the linear stands in the marsh channels. Helicopter applications are the most efficient and consistent treatment systems, and could be employed for a portion of this relatively small infestation during a day when other West Bay applications are occurring at nearby Bair & Greco Islands. However there are a number of areas of this site that must be treated using ground-based methods, such as the areas under the power lines and the mudflats and channel banks by the tide gates, and amphibious tracked vehicles are the most appropriate equipment for that task.

Monitoring Needs

Because of the large size of this site, detailed maps of the current distribution of *Spartina* will need to be provided to the treatment crew to assist with their work. This is true both of guiding ground-based treatment over the large 70-acre marsh, as well as informing the helicopter pilot if one is used. An accurate assessment of the size of the remaining infestation will also be used to plan the labor needed for the effort (crew size and number of days) as well as the amount product to purchase.

Many of the remaining infested areas of Seal Slough are very low elevation, and any *Spartina* growing in these zones will be easy to identify as hybrids and subsequently treat. But as with other sites that previously had a large infestation, there will inevitably be pockets on the marsh plain that are hard to distinguish from native *S. foliosa*. These questionable plants will need to be tested and mapped accordingly to inform treatment.

SUB-AREA 19Q: FOSTER CITY

Sub-Area Partners

Owner(s): Foster City (adjacent lands)
Manager(s): Foster City
Grantee(s): SMCMAD

Sub-Area Description

This site includes approximately 2.5 kilometers of west San Francisco Bay shoreline extending from the San Mateo-Hayward Bridge (Hwy. 92) south to the mouth of Belmont Slough (Sub-area 02a), which is included as part of a separate Site-Specific Plan for the Bair & Greco Island complex. The Foster City shoreline is heavily reinforced with rip-rap armament, with a paved section of the Bay Trail along the top of the levee and Beach Park Boulevard to the southeast running parallel. Most of this shoreline consists of mudflat at the base of the levee, but two stretches of strip marsh and sand/shell beach have developed. The first extends from just north of Marlin Avenue to just south of Tarpon Street, and the second is across from Bowditch Middle School at Swordfish Street where an area of upland fill juts out from the shoreline. The words “Foster City” have been formed with large rocks on this upland strip, and are clearly visible on the aerial photographs.

Hybrid *Spartina* had colonized the two areas of sand/shell beach and strip marsh on this site. In 2005, the clones were large and starting to coalesce, and the adjacent mudflat had also become invaded and was experiencing rapid expansion due to a lack of biotic resistance in the soft, unvegetated mud. The total area of non-native *Spartina* on the site was approximately 2.5 acres, including scattered plants along the shoreline at the base of the rip-rap. The site was first treated with imazapyr late in the growing season in 2005 using amphibious tracked vehicles to access the site, search the shoreline, and treat the target plants. Similar to many other sites in that year, efficacy was low because plants had started to senesce by that point and were not translocating the herbicide. The entire infestation at this site was retreated with imazapyr earlier in September in 2006, again using amphibious tracked vehicles. This application was very effective at eliminating the majority of the coalescing clones in the heaviest area of infestation. The remaining low density linear infestations and scattered individual plants received a follow-up application in 2007 involving 1-2 Argos over the course of two days.

The infestation at this site has been reduced by more than 95% since 2005. The linear infestations have become stretches with scattered patches of hybrid *Spartina* now that the large clones have been removed. There are still some scattered individual plants at the northern edge of the site across from Gull and Marlin Avenues. Approxi-

mately 1000 ft^2 remains to be treated along shoreline of the Foster City site. There have not been any hybrid *Spartina* plants identified in the northern portion of the shoreline from Gull Avenue up to the San Mateo Bridge.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Amphibious tracked vehicle (primary), backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Treat on a low or receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

Imazapyr will be used to treat the remaining plants at this site in 2008. Due to the length of shoreline and ease of access, amphibious tracked vehicles are the most efficient method for finding and treating the scattered remaining plants. When the infestation is reduced to just a single patch or two, backpack sprayers may be substituted to eliminate the mobilization cost of using an amphibious tracked vehicle.

Monitoring Needs

With the 2.5 kilometer stretch of shoreline that this site represents, it will be important for the treatment crews to receive an updated map of the current distribution of invasive *Spartina* to limit the searching they need to do in conjunction with treatment. This will increase efficiency and allow the applicators to maximize the dry time afforded by the narrow treatment windows.

SUB-AREA 19R: ANZA LAGOON

Sub-Area Partners

Owner(s): State Lands Commission, City of Burlingame (adjacent lands)
Manager(s): City of Burlingame
Grantee(s): DMCMAD

Sub-Area Description

Anza Lagoon is an 11-acre tidal pond within the City of Burlingame that is surrounded by commercial development supporting the SFO airport community including several hotels and restaurants. On the northern side is a 55 meter-long break in the heavy rip-rap that connects the lagoon to full tidal exchange. The mixed marsh areas within the lagoon consist of an undulating fringe along the perimeter below the steeply sloping rip-rap edges. A small upland park is located on its northwestern side at the end of Anza Boulevard, from which a pedestrian pathway runs around the periphery of the lagoon. Airport Boulevard runs along the southern end of the site, with Burlingame Lagoon less than 100 meters beyond.

The majority of the perimeter of Anza Lagoon was infested with hybrid *S. alterniflora* when treatment began in 2006, although some sections were still more scattered. The invasive cordgrass had formed a thick band dominating the elevation around mean high tide and up onto the pickleweed just below the rip-rap edge. Imazapyr was applied in 2006 using a truck-mounted sprayer stationed on the paved perimeter trail with the applicators hauling hose down to the edge of the lagoon. The infestation was reduced by 90% after just this first application, undoubtedly benefiting from the mid-August timing, but hybrid *Spartina* was still scattered around much of the lagoon in a low cover class. In 2007, retreatment followed a similar course, applying imazapyr to the remaining plants utilizing a truck-mounted sprayer.

The highest concentration of hybrid *Spartina* at Anza Lagoon remains on the northern shore adjacent to the park, and in the small southern lobe of the waterbody. The lightest areas of infestation are at the northern neck where the tidal exchange occurs and on the western shoreline, both represented by just a handful of scattered plants. There is less than 1000 ft^2 of hybrid *Spartina* remaining at Anza Lagoon after two seasons of treatment.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Truck-mounted sprayer (primary)
Backpack sprayers

Timing: Treatment should occur between July 15 and September 15
Treat on a low or receding tide to maximize dry time for low elevation *Spartina*
Annual beginning in 2008 until eradicated

Any hybrid *Spartina* remaining in Anza Lagoon will be treated with imazapyr in 2008 using a truck-mounted sprayer. The paved perimeter trail makes access easy to the target plants, which makes the truck an appropriate level of mobilization, but a backpack sprayer may also be used to complete the eradication since the area remaining is so small. Regrowth at the low elevation extent of the infestation points to a need to maximize dry time to get the best possible efficacy.

Monitoring Needs

Monitoring will continue on all infestation sites until a minimum of three years of no hybrid *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for West San Francisco Bay Complex, TSN: ISP-2005-19, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

All 18 sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 20: SAN LEANDRO AND HAYWARD SHORELINE COMPLEX, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for San Leandro and Hayward Shoreline Complex, Alameda County, TSN: ISP-2005-20, 2005-2007 Control Seasons) dated May 2005. The original 17 sub-areas remain as defined in that plan, and six new sub-areas have been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to one or more project partner. The grant recipient(s) for this site include:

City of San Leandro, 835 East 14th Street, San Leandro CA, 94577, *Delmarie Snodgrass, (510) 297-5197, dsnodgrass@ci.san-leandro.ca.us*. The ISP will work with the City of San Leandro to implement non-native *Spartina* control efforts on the properties along the San Leandro Shoreline that are owned by the City.

County of Alameda Public Works Agency, 4825 Gleason Drive, Dublin, CA 94568*; Saul Ferdan, Weed and Pest Control Supervisor, (925) 803-7011, saul@acpwa.org*. The County of Alameda Public Works Agency, or the Alameda County Flood Control District (ACFCD) have been controlling non-native *Spartina* within the channels along the East Bay shorelines since roughly 2003, though regular flood reduction maintenance activities prior to 2003 likely also resulted in some control of *Spartina*. ACFCD worked with the ISP since the 2004 control season and has been a grantee and active partner with the ISP's efforts beginning in that year. The ACFCD aims to control non-native *Spartina* within the channels of the East Bay in order to restore flood control capacity as well as enhance wildlife habitat in the area.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Steve Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource.

East Bay Regional Parks District, 2950 Peralta Oaks Court, Oakland, California 94605: Peter Alexander, Invasive *Spartina* Coordinator, *(510) 635-0135, palexander@ebparks.org*. EBRPD manages the marshes and levees of the Hayward Regional Shoreline south from the southern border of the City of San Leandro to the Hayward-San Mateo Bridge. The District has been controlling *Spartina* along the shoreline since the mid 1990's, and has been working with the ISP since 2000 to develop and implement *Spartina* control strategies on all of the marshes within these shoreline areas.

Other Partners:

Port of Oakland, 530 Water Street, Oakland, CA 94607. *Carol Jones, (510) 627-1132 cjones@portoakland.com*. The Port of Oakland owns many properties within the Oakland Inner Harbor as well as Fan Marsh on the San Leandro Bay shoreline. The Port typically grants access to ISP Contractors to allow for control work on their lands.

Site Description

Map Site 20: San Leandro and Hayward Shoreline Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

20a	Oyster Bay Regional Shoreline Map	20l	Johnson's Landing Map
20b	Oakland Metropolitan Golf Links (formerly Lew Galbraith) Map	20m	Cogswell Marsh, North Map
		20n	Cogswell Marsh, East Map
20c	Dog Bone Marsh Map	20o	Cogswell Marsh, South Map
20d	Citation Marsh Map	20p	Hayward Shoreline Outliers Map
20e	East Marsh Map	20q	San Leandro Shoreline Outliers Map
20f	North Marsh Map	20r*	Oakland Airport Shoreline and Channels Map

20g	Bunker Marsh	**Map**	20s*	HARD Marsh	**Map**
20h	San Lorenzo Creek & Mouth	**Map**	20t*	San Leandro Marina	**Map**
20i	Bockmann Channel	**Map**	20u*	Estudillo Creek Channel	**Map**
20j	Sulfer Creek	**Map**	20v*	Hayward Landing Canal	**Map**
20k	Hayward Landing	**Map**	20w*	Triangle Marsh	**Map**

* Sub-area added since the 2005-2007 *Spartina* control plan

The area encompassed by this Site-Specific Plan includes the marshlands of the San Leandro and Hayward shoreline, Alameda County, extending south from the Oakland Metropolitan Golf Links and Oakland International Airport in the north to the San Mateo-Hayward Bridge in the south. A separate Site-Specific Plan for Oro Loma Marsh (TSN:ISP-2004-07) has been developed to specifically address the *Spartina* treatment approaches for that area, and is therefore not included in this Plan. Excluding Oro Loma, there are 23 sub-areas addressed in this plan. These marshland areas range from large, complex restored marsh systems to channel-bank fringe marsh areas. They line the east shore of the Bay, providing a natural border between the highly urbanized and developed areas of the cities of San Leandro, San Lorenzo, and Hayward and the open waters of the Bay. Much of this area is regularly used for passive recreational activities along portions of the Bay trail, within EBRPD lands, and other trails throughout the area.

The infestations of non-native *Spartina* that constitute the San Leandro and Hayward Shoreline Complex are located along the shoreline in many types of habitats. Invasive *Spartina* can be found along the rip-rap of shoreline fill and levees, in remnant or newly formed pickleweed marsh, along channels emptying into the bay, amongst sand/shell beaches, within large established marsh restoration sites, on shallow Bay-edge mudflats, and in small coves and sheltered marsh areas along the Bay edge. In all sub-areas, where non-native *Spartina* was rapidly expanding into the existing habitat, the infestation has been significantly reduced.

Treatment Approach

The treatment approach for all sub-areas is described below. Where possible, sub-areas with significant similarities have been grouped together. Sub-areas for this site are listed geographically from north to south.

SUB-AREA 20R: OAKLAND AIRPORT SHORELINE AND CHANNELS

Sub-Area Partners

Owner(s): Port of Oakland
Manager(s): Port of Oakland
Grantee(s): California Wildlife Foundation

Sub-Area Description

This sub-area is composed of the highly developed shoreline surrounding the Oakland International Airport. This area includes channel-edge fringe marsh habitat, rip-rapped bay fill, shallow marsh pan areas adjacent to the airport's main runway, and a mixed marsh fringe surrounding a small mudflat area bounded by a sand dune upland transition. The entire area is controlled by the Port of Oakland with special access permissions required by the Federal Aviation Administration (FAA).

The first season of treatment on this site was in 2007. Treatments were conducted via truck on the southern portion of the airport, and backpacks were used over the rest of the infestation. Treatment was done by Aquatic Environments, Inc, through the California Wildlife Foundation under the auspices of the ISP. The efficacy of these treatments will be assessed in the spring of 2008 to inform treatment in summer of 2008.

There are four main areas of infestation along the border of the airport. The first and largest portion of the infestation lies in the southeast corner of the airport, where it borders East Bay Regional Parks District's Oyster Bay Regional Shoreline Park, and the Port of Oakland's Oakland Metropolitan Golf Links. The infestation here forms a thick band of non-native *Spartina* fringe marsh running roughly east-west, bordered by a low, rip-rapped levee on its upper edge and open mudflats below.

The second area is composed of a handful of scattered clones along and within the rip-rap that composes the southern edge of the airport. The clones here are mostly small and can be accessed via the maintenance road that runs along the top of the levee.

The third area of infestation is composed of only two or three small clones. This portion of the infestation lies just north of the main runway of the airport, in a low area of brackish pans bordered by pickleweed and saltgrass marsh. The clones are located amongst native *Spartina* stands.

The fourth (second largest area of infestation at the airport) is located on the northernmost portion of the airport property. This is a tidal wetland area composed of restored marshland and a north-south running channel with a tidal-gate outlet on the north end. The area is bordered by a sand dune complex to the west and commercial development to the east. The non-native *Spartina* in this area is composed of large, circular clones inhabiting the pickleweed/*Spartina* zone in the marsh. There are roughly a dozen large clones in this area.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial (primary method) Amphibious vehicles Truck-mounted spray equipment Backpacks
Timing:	Mid-July start time for both aerial and ground-based treatments

The southern portion of the infestation at the airport will require an aerial application (via helicopter broadcast) in 2008. The large infestation in the southeast portion of the airport is currently for efficient ground-based applications. This work will be done in conjunction with the aerial work undertaken under the auspices of the ISP with the East Bay Regional Parks District on the infestation directly adjacent that lines the shoreline of Oyster Point Regional Shoreline Park. In the 2009 and 2010 *Spartina* control seasons, the infestation should only require follow-up treatments with truck, backpack or amphibious vehicle to treat the remaining plants on the site.

The two, small, central portions of the infestation at the airport will only require truck or backpack to treat the infestation, as the patches of *Spartina* are small, easily accessible and spread out along the shoreline. This work will be undertaken each treatment season until the plants are gone.

The large infested area in the north portion of the airport will require the use of amphibious vehicles to efficiently access the marsh areas that are infested with non-native *Spartina*. The infestation is spread along the edges of the channel in this area, and treatment via backpacks in 2007 necessitated repeated re-supply trips to a truck parked on the adjacent levee. In addition, the soft marsh substrate in this area made accessing several target clones dangerous, and in one case, impossible. An amphibious vehicle could traverse the marsh edge much more quickly to deliver the herbicide to the target areas more safely and efficiently.

Monitoring Needs

The Oakland International Airport site is currently composed of scattered infestations that line the shoreline at various points. It will be critical that the inventory monitoring in this area accomplishes two main goals: 1) to complete detailed ground-based surveys of the entirety of the shoreline as has been done in the past, and, 2) to extensively sample the two infestations on the northern side of the airport as there is putatively native *Spartina* in this area. Pre-treatment knowledge of the genetic distribution of the plants in this area will be extremely important.

SUB-AREA 20A: OYSTER BAY REGIONAL SHORELINE

Sub-Area Partners

Owner(s):	EBRPD
Manager (s):	EBRPD
Grantee(s):	EBRPD

Sub-Area Description

Oyster Bay Regional Shoreline is a 157-acre park managed by the EBRPD that is located just to the south of the Oakland International Airport. The site was formerly a landfill and has been converted to various parkland uses. For the purposes of this plan the Oyster Bay Regional Shoreline sub-area includes two main portions of the shoreline proper. The first is a channel located on the northern shore of the park at the western terminus of Davis Street in San Leandro, on the southern edge of the Oakland International Airport. This area consists of fringing mixed

marsh habitat along the channel edges extending out from the filled shoreline. A channel that drains the Oakland Metropolitan Golf Links (Sub-Area 20b) empties into the eastern portion of this area. The second portion of this sub-area is the long channel that runs parallel to Neptune Drive in San Leandro and borders the southeastern edge of the park. This area has channel-edge fringing marsh consisting of mixed pickleweed/*Spartina*. For the purposes of this plan, these two areas constitute some 15 acres of marshland.

Treatment on the northern portion of this infestation has been undertaken during both the 2006 and 2007 Treatment Seasons using aerial broadcast herbicide applications. Work on this portion of the site was done by Alpine Helicopters, Inc. through the EBRPD under the auspices of the ISP. Treatment on the southern portion of this infestation has been done using trucks and hoses during both the 2006 and 2007 Treatment Seasons. This work was done by both the EBRPD and the Alameda County Department of Agriculture through EBRPD under the auspices of the ISP. Both areas are accessible to ground-based personnel.

The northern portion of this infestation has shown a mixed level of efficacy as of winter 2007. There are significant portions of this infestation that are dead as a result of treatment, but some of the lower elevation plants survived the 2006 treatments. As of winter 2007, the portions that re-sprouted after 2006 seemed to have suffered some additional mortality as a result of the treatments in 2007, but final assessments of the infestation in this area will occur in spring of 2008. It is very likely that this area will only contain scattered plants by this point.

The southern portion of the infestation showed equally good results in 2007 from the previous treatments. All remaining plants were targeted in 2007. Many of the remaining plants within this section were in the lower elevation areas near the mouth of the channel in the south. It is likely that the majority of any plants remaining here at the outset of the 2008 Treatment Season will be in the lower elevation portions of the channel proper as well as the mouth.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial Truck-mounted spray equipment Backpack sprayers
Timing:	Mid-July start time for both aerial and ground-based treatments

The northern portion of the infestation will again be targeted for aerial broadcast application of herbicide in 2008, pending the efficacy assessments done on the site in spring of 2008. If aerial applications are not warranted, then ground-based treatment approaches, including amphibious vehicle, truck or backpack will be used to treat the remaining plants at the site. In the 2009 and 2010 Treatment Seasons, ground-based treatment will become the primary method for this area.

The southern portion of the infestation will be approached with ground-based treatments as it has in past treatment seasons. This will continue until the plants are eradicated from the site.

Monitoring Needs

As in other areas, the two main areas of infestation at this site will require detailed GPS based ground assessments of the locations of the non-native *Spartina* in the area. As the majority of the *Spartina* in the northern portion of the Oyster Bay Regional Shoreline Park site is non-native, all *Spartina* here will be targeted for removal. However, the area in the south of the Park is composed of mixed stands of native and non-native *Spartina*, and will require extensive genetic analyses of the plants in the marsh to inform control in the area.

SUB-AREA 20B: OAKLAND METROPOLITAN GOLF LINKS

Sub-Area Partners

Owner(s):	Port of Oakland
Manager (s):	Port of Oakland
Grantee(s):	ACPWA

Sub-Area Description

Oakland's Metropolitan Golf Links is a Port of Oakland-owned golf course located just east of the Oakland International Airport, between Airport Drive and Doolittle Drive. For the purposes of this plan, this sub-area only in-

cludes the small tidal channel that bisects the southern portion of the course and drains to the bay through Oyster Bay Regional Shoreline (sub-area 20a) and Oakland Airport Shoreline and Channels (sub-area 20r). This small channel contains an estimated 1.0-acre of marsh habitat within thin channel. This channel is known as Zone 13, Line C by ACPWA.

This site was treated during the 2006 Treatment Season via truck, but was not treated during the 2007 season. Access was granted by the greens keeper of the golf course, and treatment was initiated before the course was open for the day. Crews drove the banks of the channel and sprayed the plants from above.

The infestation along the channel banks is relatively unchanged from its pre-treatment condition of early 2005. The first-year treatment in 2006 showed relatively little efficacy, which can occur with first-year treatments. The lack of follow-up in 2007 allowed the plants to fully recover from any sub-lethal effects that may have occurred as a result of the treatment in 2006. As a consequence, the infestation here remains at pre-treatment levels, and will be approached as an intact infestation for the purposes of control.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment

Timing: Mid-July start time

Treatment along the channels will involve the use of truck-mounted spray equipment, driving along the edges of the channel. Applicators here will approach the infestation from either side of the channel. This work will be repeated in the 2009 and 2010 treatment seasons as necessary.

Monitoring Needs

This site will require, as has been done in the past, ground-based GPS surveys of the plants along the channel as part of normal yearly inventory monitoring, especially as the infestation dwindles and becomes more scattered.

Sub-Areas 20c, 20d, 20e, 20f, 20g, 20q, and 20t: Dog Bone Marsh, Citation Marsh, East Marsh, North marsh, Bunker Marsh, San Leandro Shoreline Outlier Clones, and San Leandro Marina

Sub-Area Partners

Owner(s): City of San Leandro
Manager (s): City of San Leandro
Grantee(s): City of San Leandro

Sub-Area Description

This seven sub-area grouping of the San Leandro & Hayward Shoreline consists of the marshes, channels and shoreline within the City of San Leandro. The bulk of this site contains the five large restored marshes south of the San Leandro Marina: Dog Bone Marsh, Citation Marsh, North Marsh, Bunker Marsh and East Marsh. The other two sites consist of the developed shoreline along the bayfront including San Leandro Marina and San Leandro Shoreline Outlier Clones. Each is described below.

The Dog Bone Marsh sub-area is a small, diked marsh area at the southwestern end of Tony Lema Golf Course in San Leandro. The marsh is adjacent to the Bay edge, and tidal fluctuation is permitted through gated culverts in the levee along the west side of the marsh. The vegetation within this marsh is dominated by *Spartina*, with scattered amounts of pickleweed and other marsh plants along the upper fringe. For the purposes of this plan, this marsh contains 4.2 acres of marshland.

Citation Marsh is a large restored marsh adjacent to the residential development of the City of San Leandro. For the purposes of this plan, this marsh is estimated at 112 acres of mixed pickleweed habitat, constructed channels, open mudflat, pans, scattered upland areas, old levee systems and ponded areas. There is a high degree of establishing in this marsh, and its tidal prism is somewhat damped by the fact that it is located inland of several other formerly diked restoration marshes.

East Marsh is a medium-sized, formerly diked restored marshland along the western extent of residential development within the City of San Leandro. For the purposes of this plan, the marsh has been estimated at 45 acres of mixed pickleweed plain, with scattered pans and ponded areas. The marsh drains through a small gate in the levee system along the west side, and much of the eastern and southern portions of the marsh are fairly uniform pickle-

weed dominated mid to high marsh. There are only a couple of small channels that drain the interior portions of the marsh.

North Marsh is a large, restored marshland located to the south and east of the Tony Lema Golf Course in the City of San Leandro. For the purposes of this plan, this marsh is estimated at 93 acres of constructed channels, open mudflats, pans, scattered upland areas, mixed pickleweed marsh and ponded water, all draining through an open tidal gate in the western levee that borders the site.

Bunker Marsh is a medium-sized marsh on the San Leandro shoreline just north of Robert's Landing and the San Lorenzo Creek Mouth (sub-area 20h). This 31.7 acre marsh is surrounded by levees and raised berms and is exposed to full tidal action through a wide breach in the levee system on the south side of the marsh. Bunker Marsh contains several habitat types, including open mudflat in the lower central portion of the marsh, small channels, and large sections of mixed *Spartina*/pickleweed marsh plains.

The San Leandro Marina consists of a public park, Marina Park, located off Monarch Bay Drive near Fairway Drive, which is a 30-acre regional park that borders the San Leandro Shoreline. The San Leandro Marina is part of the San Leandro Shoreline Recreation Area. The marina is a full service marina with 455 berths, a free launch ramp and two yacht clubs. The shoreline of the marina is essentially made of steep rip-rap fill edges, with very little true tidal marsh habitat development.

The San Leandro Shoreline proper, for the purposes of this plant, consists of the westernmost Bayfront edge of San Leandro from the southern end of the Oakland International Airport to the San Lorenzo Creek Channel. There are several types of shoreline habitat along this stretch of the San Francisco Bay, but all are fringing marsh habitat with little plant species diversity. Included within this area is a short stretch of tidal channel north of the EBRPD's Oyster Bay Regional Shoreline Park at the western terminus of Davis Street, and the rip-rap and sandy beach areas south of the San Leandro Marina.

Spartina treatment work on the populations within the San Leandro Marshes and shoreline has been ongoing since the 2005 Treatment Season. The main shoreline areas have been treated with truck-mounted spray equipment working along the accessible levees. This includes the scattered populations along the interior of the Marina, along the Estudillo Creek Channel, the San Leandro Shoreline, the northern periphery and western edge of North Marsh and all of Dog Bone Marsh. The bulk of the large interior marshes, including North, Bunker and a portion of Citation Marsh have been treated using broadcast aerial applications via helicopter. Aerial operations require that the ISP and its partners observe a ¼ -mile buffer distance from residential development to the east. Within the buffered area, treatments have been done using spray trucks with long (up to 900 ft) hoses and crews walking the marsh plain.

While each of the individual marshes within the San Leandro portion of the shoreline shows somewhat different results from treatment, there are some general trends throughout. Areas that have been treated via aerial applications show very high efficacy, on the order of 90% throughout treated sections of marsh. Ground-based treatments via truck have slightly less efficacy as of the 2007 Treatment Season, but still at relatively high levels – in the 80% range. The *Spartina* infestation within all of these marshes now consists of scattered remnant populations mixed within the overall marsh vegetative structure. Along the Marina, there are small clonal patches within the rip-rap. Dog Bone Marsh has shown great efficacy, and small resprouting patches remain where a thick monoculture existed in 2005. Within North Marsh, the 2006 aerial treatments resulted in the main infestation being severely curtailed, with buffer areas along the north and west portions remaining untouched. These were targeted for both aerial and ground-based treatments in 2007, and as of winter 2007 these areas look to have been significantly reduced as well. The large infestation within Citation Marsh was not treated aerially due to the proximity to residential housing. This area was partially treated in 2006, but was targeted in its entirety in 2007 via truck and hose. The efficacy of this treatment will be determined in late spring 2008. Bunker Marsh has shown good efficacy from the 2006 aerial treatments with the eastern edge showing less success as a result of ground based treatments. The area was more comprehensively treated in 2007, with efficacy assessments pending.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: broadcast aerial (primary method)
Amphibious vehicles
Truck-mounted spray equipment

Backpack sprayers
Helicopter: spot treatment

Timing: Mid-July start time for both aerial and ground-based treatments

From the previous two treatment seasons (2006 & 2007), these eight sub-areas have been targeted for treatment via both ground-based and aerial (helicopter) broadcast applications of imazapyr herbicide. This dual approach has resulted in a significant reduction in the non-native *Spartina* cover within the sites. The remaining portion of the marsh that still contains non-native *Spartina* is not contiguous, and presents difficulties in regards to access and approach.

During the 2008 Treatment Season, helicopter broadcast applications may again be warranted within the larger marshes of North, Citation, and Bunker Marshes, pending early spring efficacy estimates of the 2007 Treatment Season. The use of aerial applications will be necessary if large, contiguous sections of the infestation re-appear, or if the net coverage of scattered resprouting clones within the marsh is large enough to make aerial applications more efficient than ground-based treatments.

Ground-based treatment options (amphibious vehicles, trucks or backpacks) will be again be employed in 2008 and in subsequent years. This is especially true within areas proximate to residential areas. It is anticipated that the treatments in 2009 and 2010 will rely exclusively on ground-based treatment methods to 'mop-up' the remaining stands of *Spartina* in these marshes. As the infestations in these marshes move toward eradication, ground-based spot treatment will become the primary treatment method within the entirety of the San Leandro shoreline.

Monitoring Needs

All areas within this portion of the shoreline will require ground-based GPS surveys for inventory monitoring. In previous monitoring efforts, the large and difficult-to-access restored tidal marshes that constitute the bulk of the area were mapped using heads-up digitization in GIS in the office. As the infestations in this area decrease as a result of treatment efforts, it will become necessary to know the exact location of resprouting or missed plants within the marshes. Ground-based GPS surveys will satisfy the needs of the Control Program in this regard. Since inventory monitoring already uses ground-based GPS survey techniques on the other marsh areas in this portion of the plan, no changes would be necessary.

Starting in 2008, and continuing through 2010 (and beyond as necessary) each of the larger marshes (Citation, North, East and Bunker) should have parallel transect sampling of *Spartina* plant material done for genetic analysis. As the non-native portion of the *Spartina* population in these marshes diminishes, it will become extremely important that the Control Program have detailed genetic information on the locations of populations to target for treatment. A comprehensive, yearly genetic sampling of these marshes will satisfy that need.

SUB-AREA 20H: SAN LORENZO CREEK AND MOUTH (ROBERT'S LANDING)

Sub-Area Partners

Owner(s): City of San Leandro, EBRPD
Manager (s): ACPWA, City of San Leandro, EBRPD
Grantee(s): City of San Leandro, EBRPD

Sub-Area Description

The San Lorenzo Creek and Mouth sub-area encompasses the wide delta that has formed over the last couple of decades at the mouth of San Leandro Creek as well as a portion of the channel itself (known as Zone 2, Line B by ACPWA). Also known as Robert's Landing, for the purposes of this plan this area is estimated at 44.4 acres of marshland. The alluvial fan that has formed at the mouth of the channel has rapidly accumulated sediment and vegetation, and in contrast to the conditions present on the site currently, aerial photographs taken of the area in the mid-1980's show very little build up of sediments offshore. When sub-area 20g and the surrounding marshes were restored as part of a larger marsh restoration plan, sedimentation in the area had increased to such an extent that it was necessary to dredge a large channel through a broad area that had formerly been open Bayfront mudflat and shoreline sand/shell beach. Since its formation this delta has been colonized by mixed pickleweed/ *Spartina* stands, with non-native *Spartina* dominating.

Beginning in 2006, and continued in 2007 the wide delta of this sub-area was treated almost exclusively via helicopter broadcast applications of imazapyr herbicide. Treatments occurred on a single day in July each year. A thin

band of marsh adjacent to the multi-use trail that runs atop the levee at the eastern border of the marsh, just south of the San Lorenzo Creek Channel proper was treated in 2007 via ground-based truck-mounted spray equipment.

Very little of the pre-treatment infestation within this sub-area remains as of winter 2007. Aerial applications within this area have proven to be very effective. There are some remnant patches of plants along the eastern edge of the marsh, up against the levee, and a few resprouting patches within the main portion of the marsh itself. However, overall, the infestation in this area has been reduced by as much as 98% overall.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: broadcast aerial
Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers

Timing: Mid-July start time for both aerial and ground-based treatments

Treatment within this area may again require another season of aerial broadcast applications if there are a greater amount of resprouts or missed plants than have yet been seen in this marsh. However, it is more likely that ground-based treatments utilizing trucks, amphibious vehicles or backpack sprayers will be the more likely option for treatment in this area.

Monitoring Needs

Over the course of the 2008-2010 control seasons (and beyond) this site will increasingly require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. Previous mapping efforts (prior to 2008) have relied heavily on 'head's-up digitization' of the infestation within the marsh, which utilizes office-based GIS technology to digitally delineate non-native *Spartina* infestations on an orthophoto of the site. Since the overall size and general contiguity of the infestation has decreased dramatically, this relatively coarse mapping strategy will be unable to discern the location of scattered, small resprouts or newly establishing plants. The exact location of the individual plants within the marsh will be of paramount importance to control efforts, especially in terms of budgeting time and resources for control.

Sub-Areas 20I, 20J, 20U and 20V: Bockmann Channel, Sulfer Creek, Estudillo Creek Channel and Hayward Landing Canal

Sub-Area Partners

Owner(s): ACPWA, City of San Leandro, EBRPD
Manager (s): ACPWA
Grantee(s): ACPWA

Sub-Area Description

The four creek channels in this section constitute the main channels that separate the marshes in the San Leandro and Hayward shoreline. They are grouped here because each of them has a relatively small infestation of non-native *Spartina*, and are generally managed by ACPWA.

Bockmann Channel: This channel forms the northern boundary of Oro Loma Marsh and runs along the south side of the Oro Loma Sanitation District's water treatment plant. For the purposes of this plan, Bockmann Channel is defined as the mouth of the channel as it enters the Bay just south of the treatment plant in San Lorenzo, and the portion of the channel upstream of the mouth to the tide gates roughly 180 meters upstream, past the maintenance overpass. This sub-area encompasses some 4.7 acres of fringing channel-edge marshland and deltaic low-marsh *Spartina* habitat. This channel is known as Zone 2, Line N by ACPWA.

Sulfer Creek Channel: The tidal portion of Sulfer Creek Channel runs along the southern boundary of Oro Loma Marsh on the Hayward Regional Shoreline, roughly due west of the north end of the Hayward Air Terminal. The channel contains benches of vegetated sediment, especially on the north side, that are dominated by pickleweed with scattered stands of gumplant. This channel is known as Zone 2, Line K by ACPWA.

Estudillo Creek Channel: The main tidal reach of Estudillo Creek Channel runs from Wicks Ave in San Leandro west to the Bayfront. There are essentially three main sub-divisions of the channel in the area: 1) the mouth of the

channel upstream for roughly 180 meters to a set of tidal gates, 2) the 1,200 meter channelized portion of the creek upstream of the tidal gates to a railroad crossing and, 3) upstream of the railroad crossing to Wicks Avenue in San Leandro including two main branches that diverge above the crossing. The tidal marsh habitat within this channel consists of steep fringing channel edges bordered with mud bottoms and topped with upland weedy annuals. This channel is known as Zone 13, Line A by ACPWA.

Hayward Landing Canal: This channel drains into the Bay at Hayward Landing, and the tidal portion of the channel continues roughly 1,200 meters upstream past the EBRPD Winton Ave maintenance facility where the channel bends to the south. The channel edges contain mixed marsh vegetation, with benches of sediment on mainly the north side. This channel is known as Zone 4, Line A by ACPWA.

The lower portion of the Estudillo Creek channel has been treated by the City of San Leandro during both the 2006 and 2007 control seasons via truck. The upper portion of the channel has been treated by ACPWA since 2004, also via truck. The middle section of the channel remains to be treated, although in previous treatment seasons there was very little non-native *Spartina* in this area requiring control.

Both Bockmann & Sulfer Creeks have been treated since 2004 by either EBRPD or ACPWA via truck working along the levees that line the creeks. Neither of these creek channels has had large amounts of *Spartina*, with the possible exception of the mouth of Bockmann Creek, where the small delta there did support a healthy population of non-native *Spartina* in 2005. However, most of the non-native *Spartina* in these two creeks was scattered in very few discrete clumps within otherwise native plant communities.

The Hayward Landing Canal has also been treated by both EBRPD and ACPWA since 2005. ACPWA has utilized amphibious vehicles on the upper sediment benches near the EBRPD Winton maintenance yard, as well as trucks where the infestation is accessible.

2007 inventory monitoring of the infestations in these channel areas shows that both the Sulfer Creek and Bockmann Creek channels are relatively free of non-native *Spartina*, with very few small clones or resprouts remaining within these areas.

The lower portion of the Estudillo Creek channel, downstream of the tidal gates, as well as the upper portion above the railroad right of way, has shown a significant reduction of the initial infestations located there. Only small remnant patches remain in these areas. However, inventory monitoring of the central portion of the channel has shown a significant increase during the 2007 season. This area historically was free of non-native *Spartina*, and this population is new as of 2007.

Similarly, the Hayward Landing canal has been well controlled at both the upper and lower ends of the channel, with the central portion also being reduced. However, the central portion of the channel does yet contain scattered resprouting sections of the historic infestation that will require continued vigilance.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Amphibious vehicles Truck-mounted spray equipment Backpack sprayers
Timing:	June-July start time ground-based treatments

All of these areas can be accessed via the levee systems that border both sides of the channels. All of them have maintenance or recreational trails or paths that run atop the levees. Treatment along all of these channels can be accomplished using trucks with spray equipment, and in the case of the wider portions of channels like the Estudillo Creek channel above the railroad right of way, amphibious vehicles where the bed of the channel is wide and sediment-filled.

Monitoring Needs

ISP inventory mapping of these channels has historically used ground-based GPS mapping of the infestations located there. This would need to be continued in these areas until eradication.

SUB-AREAS 20K, 20L, AND 20P: HAYWARD LANDING, JOHNSON'S LANDING AND HAYWARD SHORELINE OUTLIER CLONES

Sub-Area Partners

Owner(s): EBRPD
Manager (s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

This group of sub-areas describes the roughly 3.2-mile shoreline west of the Bayfront levee system of the Hayward Regional Shoreline, running from the Bockmann Creek Channel in the north to the Hayward-San Mateo Bridge in the south. The bulk of this area consists of broad, open mudflat extending bayward, small deltaic areas formed by the outlets of Bockmann and Sulfer channels, Hayward Landing Canal, and rip-rapped levee edges.

All of the non-native *Spartina* in these areas has been treated by EBRPD since 2004 or earlier, except some of the numerous clonal patches near the Hayward-San Mateo Bridge, which were first treated in 2007. Treatment in these areas is highly dependent on proper low-tide opportunities in the summer, as the broad mudflats where some of the larger and more remote clones are located are inundated at even a medium tide.

With the exception of the clonal patches near the Hayward-San Mateo Bridge, most of the other infested areas along the shoreline have been controlled. Roughly 95% of the initial infestation has been removed in the area, although there are isolated resprouts, new seedlings and missed plants identified each year.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Helicopter: broadcast aerial
Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers

Timing: June-July start time for both aerial and ground-based treatments

Treatment method choice along the shoreline is reliant upon yearly assessments of the returning infestation mapped there. Where clonal patches are far out on mudflats, aerial applications may be used during aerial treatments of adjacent marshes. Many of these areas are accessible at low tide via amphibious vehicle or by foot, where backpack or truck-mounted spray equipment can be used.

Monitoring Needs

Over the course of the 2008-2010 control seasons (and beyond) the Hayward Shoreline will require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. The exact location of the individual plants within the overall site complex will be of paramount importance to control efforts, especially in terms of budgeting time and resources for control.

SUB-AREAS 20M, 20N, AND 20O: COGSWELL MARSH NORTH, EAST AND SOUTH

Sub-Area Partners

Owner(s): EBRPD
Manager (s): EBRPD
Partner(s): EBRPD

Sub-Area Description

Cogswell Marsh in Hayward consists of three main sections, herein called north, east and south. Cogswell Marsh was opened to full tidal action in 1980 and since that time has developed into a mid to high marsh pickleweed plain, interspersed with constructed channels. The northern portion of Cogswell Marsh covers a 36-acre area, which drains to the south in a wide mouth that it shares with the adjacent 100-acre Cogswell Marsh East. All of the marshes at Cogswell are surrounded by levees except where they open to the Bay. Only small, scattered patches of gumplant can be found along the channel banks in this marsh. Upland islands were included within each of these three restoration marsh sections to provide higher marsh or low upland habitat refugia. The southern

portion of Cogswell Marsh covers a 52-acre area, which drains to the west in a wide mouth to the Bay. The southern marsh is surrounded on all sides by levees.

The *Spartina* treatments in this marsh have occurred in phases as directed by the US Fish & Wildlife Service. In an effort to minimize any potential for short-term adverse affects to the endangered California clapper rail, the treatments here have been in discrete sections, with a central portion of the eastern section of the marsh remaining untreated through the 2007 Treatment Season. All treatments have been done via broadcast aerial applications of imazapyr.

In 2005 the southernmost portion of Cogswell Marsh East was treated, while all other areas in the marsh remained untreated. In 2006, this area was again treated, along with the entirety of both the eastern and northern portions of the marsh. All of these treatments resulted in high efficacy. In 2007, these areas were retreated, though the area requiring treatment was relatively small, relegated to small missed patches and resprouts.

The main infestation in Cogswell Marsh that remains is the untreated central section of the eastern portion of the marsh. This area contains a large swath of untreated, healthy *Spartina* meadow. The other areas of the northern, eastern and southern sections of the marsh have achieved efficacies in the range of 95% to 100%. There are still, however, scattered resprouts and missed plants throughout the entirety of the site that will require continued treatment.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr herbicide application
Equipment:	Helicopter: broadcast aerial Amphibious vehicles Truck-mounted spray equipment Backpack sprayers
Timing:	Mid-July start time for both aerial and ground-based treatments

In the previous three treatment seasons, these three sub-areas have been treated with helicopter broadcast applications of imazapyr herbicide. This approach has resulted in a significant reduction in the non-native *Spartina* cover within the site in treated areas. The remaining portion of the marsh that yet contains non-native *Spartina* has two main components, a contiguous stand in the central portion of Cogswell East, and a disparate remnant population scattered throughout the rest of the marsh area.

During the 2008 treatment season, helicopter broadcast applications may again be warranted, especially within the untreated area in Cogswell east, pending early spring efficacy estimates of the 2007 Treatment Season. For those areas not large or contiguous enough for broadcast aerial applications, ground-based treatment options (amphibious vehicles, trucks or backpack sprayers) will be employed, or, alternately, targeted aerial spot applications. Regardless of the treatment method used in 2008, it is anticipated that the treatments in 2009 and 2010 will rely exclusively on ground-based treatment methods to 'mop-up' the remaining stands of *Spartina* in the marsh. As the infestation at this site moves toward eradication, ground-based spot treatment will become the primary treatment method at the site.

Monitoring Needs

Over the course of the 2008-2010 treatment seasons (and beyond) this site will increasingly require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. Previous mapping efforts (prior to 2008) have relied heavily on 'head's-up digitization' of the infestation within the marsh, which utilizes office-based GIS technology to digitally delineate non-native *Spartina* infestations on an orthophoto of the site with limited ground-truthing. Since the overall size and general contiguity of the infestation has decreased dramatically, this relatively coarse mapping strategy will eventually be unable to discern the location of scattered, small resprouts or newly establishing plants. The exact location of the individual plants within the overall site complex will be of paramount importance to control efforts, especially in terms of budgeting time and resources.

SUB-AREA 20S: HARD MARSH

Sub-Area Partners

Owner(s):	EBRPD
Manager (s):	EBRPD

Grantee(s): EBRPD

Sub-Area Description

This marsh area is a restored tidal marsh that was opened to tidal action in the late 1980's. Much of the marsh is dominated by wide, open mudflats at low tide, while the dominate vegetation over the remainder of the site is pickleweed. Numerous low upland islands are scattered throughout the marsh, which is surrounded by trails that can be accessed via the EBRPD Hayward Shoreline Interpretive Center located at the western end of Breakwater Avenue in Hayward.

Treatment within this site has occurred just during the 2007 treatment season via airboat working within the marsh to access the clones that are spread throughout the marsh area. The infestation within this marsh is in the initial phases of colonization, spread out amongst the edges of the marsh throughout the breached levees and higher marsh edges. In sum, there is less than ½ an acre spread throughout the marsh in small clones.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Airboat
Amphibious vehicles
Truck-mounted spray equipment
Backpack sprayers
Helicopter: spot treatment

Timing: June-July start time for both aerial and ground-based treatments

Treatment within HARD Marsh can be accomplished by a number of methods, with airboat treatments representing perhaps the most efficient method for moving within the soft mud of the interior portion of the marsh. Where possible, ground-based treatments may be utilized, including truck-mounted spray equipment and/or backpack sprayers. There is also the potential of using targeted aerial spot applications in this marsh if access to some clonal patches becomes problematic with the other methods available.

Monitoring Needs

Over the course of the 2008-2010 control seasons (and beyond) this site will require detailed, ground-based GPS surveys of the remnant populations of non-native *Spartina* present. The exact location of the individual plants within this marsh will be of paramount importance to control efforts, especially in terms of budgeting time and resources for control.

SUB-AREA 20W: TRIANGLE MARSH

Sub-Area Partners

Owner(s): EBRPD
Manager(s): EBRPD
Grantee(s): EBRPD

Sub-Area Description

Triangle Marsh existed as somewhat of an enigma along the Hayward Regional Shoreline in terms of the *Spartina* control effort. A tidal marsh dominated by pickleweed and containing several meandering channels, it is located between Cogswell Marsh to the south and Oro Loma Marsh to the north, both highly infested systems, with Cogswell Marsh being one of the most heavily infested marshes in the bay. Additionally, Triangle Marsh has its main tidal exchange directly adjacent to the mouth of the channel at Hayward Landing, also an area with an established population of non-native *Spartina*. However, until 2007, Triangle Marsh remained utterly *Spartina*-free. In 2007 however, a dozen or so small non-native *Spartina* plants cropped up here. Despite its resistance to invasion thus far, this marsh is highly susceptible to increased invasion by non-native *Spartina*.

No previous treatments have occurred in this marsh. Within triangle marsh there are roughly one to two dozen small *Spartina* sprouts scattered within the pickleweed and along the channel edges. The plants are young, and have not yet grown much beyond 0.5 meter or so in diameter.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Truck-mounted spray equipment
Backpack sprayer

Timing: June-July start time for ground-based treatments

Ground-based treatments in Triangle Marsh should be sufficient to eradicate the non-native *Spartina* found there. Either trucks equipped with spray equipment, or backpack sprayers, will enable workers walking directly in the marsh to apply the herbicide to target plants. The entire marsh is surrounded by a trail system on levees, so accessing the infested areas of the marsh will be straightforward.

Monitoring Needs

As the infestation in Triangle Marsh is one of small, scattered *Spartina* sprouts, the marsh will require ground-based GPS mapping to identify the specific locations of the plants. This effort will need to be repeated each year.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for San Leandro and Hayward Shoreline Complex, Alameda County, TSN: ISP-2005-20, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original 17 sub-areas remain as defined in that plan, and six new sub-areas have been added. The six new sub-areas are in the immediate vicinity of one or more of the existing sub-areas, and are extremely similar in physical and ecological character to at least one original area. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 21: IDEAL MARSH, ALAMEDA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Ideal Marsh, Alameda County, TSN: ISP-2005-21, 2005-2007 Control Seasons) dated May 2005. All two sub-areas are the same as defined in that plan, and no new species or other factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2005.

Site Partner

The *Spartina* control work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to the project partner. The grant recipient for this site is:

US Fish and Wildlife Service, Don Edwards National Wildlife Refuge, 1 Marshland Road, Fremont, CA, 94605*; Joy Albertson, (510) 792.4275 ext. 31, joy_albertson@fws.gov.*The Don Edwards San Francisco Bay National Wildlife Refuge (DENWR) owns and manages Ideal Marsh. In 2003 they acquired more than 15,000 acres of diked 'salt ponds' in the South Bay that are slated for restoration in the coming years. Several of these ponds are adjacent to invaded tidal marshes and are therefore at risk of future invasion themselves. The DENWR had implemented control work on their property prior to the partnership with the Invasive *Spartina* Project, but they will need a coordinated regional effort including continued participation from adjacent landowners and managers to help eliminate the *Spartina* threat.

Site Description

Map Site 21: Ideal Marsh includes two sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

21a Ideal Marsh North **Map**
21b Ideal Marsh South **Map**

Ideal Marsh is a 180-acre wetland restoration site located on the eastern shore of the San Francisco Bay Estuary that was allowed to naturally restore to unrestricted daily tidal exchange. The site is bordered to the north by the mouth of the Alameda Flood Control Channel (Sub-area 1a), with the shoreline marshes of Ideal Marsh extending approximately 2.5 miles south to a point within a mile of the Dumbarton Bridge where a levee cuts back to the shoreline. Levees along the eastern edge of this site separate it from decommissioned salt evaporator ponds, and the Coyote Hills are visible one mile to the east towering above the marsh plain.

Ideal Marsh was heavily infested with more than 90 acres of hybrid *Spartina alterniflora* prior to the initiation of treatment in 2005. These plants occupied all habitat types present in both the north and south marsh including dominating the mid marsh pickleweed (*Sarcocornia pacifica*), clogging even some of the wider interior channels, and colonizing open mudflats, sand/shell beaches, and eroding marsh scarps. Ideal Marsh represented a fertile stepping stone between the more than 100 contiguous infested acres of the Alameda Flood Control Channel and the lightly colonized marshes of the Don Edwards San Francisco Bay National Wildlife Refuge south of the Dumbarton Bridge.

Its position in the landscape made Ideal Marsh a high priority for control, and aerial broadcast treatment with imazapyr began in 2005. The 2005 work was conducted late in the season due to the September arrival of the Biological Opinion, and the resulting efficacy was reduced. In 2006, Ideal Marsh was again treated with imazapyr by aerial helicopter broadcast, and this work was conducted in mid July at the optimal time relative to the biology of the hybrid *Spartina*. In this second year, there was a focus on treating the interior channels by flying at a slower speed and following the sinuous course of each waterway. These efforts were highly effective, reducing the infestation by more than 95% and eliminated the need for broadcast aerial work in 2007. Due to scheduling issues and a limited number of appropriate contractors to perform ground-based applications in the Bay Area salt marshes, Ideal Marsh was treated by ground-based methods in 2007.

The north marsh infestation has been largely eliminated by the successful treatment, as was the bayfront fringe and mudflat *Spartina* over the entire 2.5 miles of both the north and south sub-areas. There are still tall patches in several of the deep internal channels, and the southern marsh plain is dotted with numerous small patches and individual stems. But no coalesced meadow areas or even intact individual circular clones remain at Ideal Marsh. There is approximately one acre of hybrid *Spartina* left on the two sub-areas of this site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment

Equipment: Backpack sprayers
Truck-mounted sprayer
Amphibious tracked vehicle

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

Treatment at Ideal Marsh will transition from aerial helicopter applications to ground-based work in 2008 due to the success of previous work. Hybrid *Spartina* in the wide eastern channel of the south marsh, and in other areas near the levee road, can be treated by truck-mounted sprayer. Control work on the open marsh plain will be conducted by a crew with backpack sprayers walking the marsh and searching out the scattered small patches. In more concentrated pockets, the crew may benefit from the use of an amphibious tracked vehicle to transport product out to the treatment area without necessitating return trips to the levee to refill the backpacks. The channel work should be conducted first and on a receding tide to allow for the appropriate dry time.

Monitoring Needs

Due to the large scale of this site, ISP inventory monitoring of Ideal Marsh has been conducted using color-IR aerial photography and heads-up digitizing of the invasive *Spartina* present on the site. As the ISP Control Program and its partners plan treatment of the much smaller, scattered patches of hybrid *Spartina* in the future, the current location and area data will be required to efficiently treat the entire infestation each year. Vegetation management contractors will require detailed maps to allocate the appropriate resources and to ensure complete treatment within the narrow windows of opportunity available each year. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Ideal Marsh, Alameda County, TSN: ISP-2005-21, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

Both sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 22: TWO POINTS COMPLEX, CONTRA COSTA COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Two Points Complex, Contra Costa County, TSN: ISP-2005-22, 2005-2007 Control Seasons) dated May 2005. The original five sub-areas remain as defined in that plan, and one new sub-area has been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The sites in the Two Points complex have numerous landowners, ISP partners, and engaged stakeholders. The State Coastal Conservancy grant recipient that will contract all of the treatment work is:

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Stephen Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org*

The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* Control Plans on all sub-areas in the Two Points complex.

Site Description

Map Site 22: Two Points Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

22a	Wildcat Marsh	Map	22d	Stege Marsh	Map
22b	San Pablo Marsh	Map	22e	Hoffman Marsh	Map
22c	Rheem Creek Area	Map	22f*	Albany/South Richmond Shoreline	Map

* Sub-area added since the 2005-2007 *Spartina* control plan

The Two Points Complex refers to a series of tidal marshes and shoreline areas in northeastern San Francisco Bay and southeastern San Pablo Bay. The complex stretches from Albany in the south, past Point Richmond and Point Molate and around Point San Pablo to just south of Point Pinole in the north. With the exception of two restored tidal marshes and some large mudflat areas, this complex is along heavily developed shoreline with light and heavy industrial land use as well as some housing and several small marinas. The segment north of Point San Pablo includes some large remnant pickleweed (*Sarcocornia pacifica*) and *Spartina foliosa* marshes that are recovering from numerous abusive commercial enterprises in the 19th and 20th centuries. These marshes are adjacent to heavy industry, including a Chevron refinery and a chemical manufacturing plant, as well as a regional landfill and transfer station. Just beyond the northern extent of the complex is Point Pinole Regional Shoreline, an East Bay Regional Park District holding that is covered under a separate ISP Site-Specific Plan (Site 10).

The pioneering hybrid *Spartina alterniflora* infestations included in this complex were still quite small when the ISP initiated Baywide treatment in 2005, totaling less than three acres. Small hybrid *Spartina* clones were expanding across the pickleweed plain and in the narrower channels of both the newly restored marshes as well as the larger intact sites. The sheltered mudflat coves of the northern segment were being rapidly invaded as clones expanded vegetatively and began to coalesce into meadows. Since 2005, several new individual patches have been found colonizing the 12 km of developed shoreline between Albany and the Richmond-San Rafael Bridge (Sub-area 22f), and the infestation also expanded into Giant Marsh (Sub-area 10c) just south of Point Pinole. There are now six sub-areas in the Two Points complex.

Treatment from 2005-2007 has significantly reduced the hybrid *Spartina* populations at some sites in this complex, while other segments have been more difficult to control because of early senescence and limited windows for treatment each year. Several of the sub-areas are relatively large restored or remnant marshes dominated by pickleweed (*Sarcocornia pacifica*) with a full native marsh plant assemblage and well developed channels. These sites may still contain some small to medium-sized individual clones of hybrid *Spartina*, but do not have any coalesced meadows or cordgrass prograding the marsh out onto mudflat, and imazapyr has reduced the footprint of

many clones to a small fraction of their original area and height. Where invasive *Spartina* is present at these sites, it has been reduced by treatment to pockets of scattered plants or seedlings. There are two heavily infested coves of native *Spartina foliosa* that have senesced much earlier than the surrounding *Spartina*, and this precluded treatment in both 2006 & 2007, so the focus will be on early season applications in 2008 and beyond. The remaining sites consist of widely scattered individual plants, and fortunately these areas only contain a thin band of appropriate habitat for *Spartina* invasion.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 22A: WILDCAT MARSH

Sub-Area Partners

Owner(s): Chevron (adjacent lands)
Manager(s): Chevron
Grantee(s): CWF

Sub-Area Description

Wildcat Marsh (also known as Chevron Marsh) is a 350-acre marsh located at the mouth of Wildcat Creek on the shores of southeastern San Pablo Bay, immediately north of the Point Richmond peninsula. There is a large tract of marsh to the east of Wildcat Creek that is bordered on the north by the West County Landfill and Transfer Station on a small peninsula jutting out into the Bay. On the west side of Wildcat Creek is a smaller peninsula of pickleweed and *S. foliosa* marsh bordered to the west by an extensive mudflat cove and the Chevron refinery at the base of the Point Richmond peninsula.

The infestation on this site was in the very early stages of development when it was first treated with imazapyr in 2005. The majority of the hybrid *Spartina* was located on the marsh peninsula west of the mouth of Wildcat Creek and on the edges of the mudflat cove adjacent to Chevron. There were also a number of hybrid *Spartina* points along the edge of the larger marsh on the eastern banks of Wildcat Creek, but plants had not yet colonized or spread throughout the interior. Treatment was implemented each year from 2005 through 2007, with the contractor transporting pre-mixed backpack sprayers out to the site by boat launched from an old boat ramp off the northwest corner of the adjacent landfill property. By 2007, the infestation had been reduced from a total area of less than one acre to a handful of small clusters of plants, some regrowth over a small proportion of previously treated large clones, and some widely scattered small individual plants. These were treated with imazapyr in 2007 on an optimal tide and before the plants had set seed.

Many of the points from previous years were free of invasive *Spartina* at the time of treatment in 2007. The treatment contractor and ISP Control Program supervisor surveyed large areas of marsh on foot, especially on the small marsh peninsula west of Wildcat Creek mouth. This sub-area is expected to contain little hybrid *Spartina* in 2008, requiring treatment on approximately 100-200 ft^2. The primary remaining area of infestation is a tiny cove on the southeastern side of the marsh peninsula, which had a continuous, crescent-shaped stand of hybrid *Spartina* at low elevation in 2005 and has lower efficacy from treatment than other portions of the site. The other area which has been slower to respond to treatment includes several patches in the northwest corner of the larger marsh east of Wildcat Creek. Some suspect plants were found during a monitoring survey in October 2007 along the northern edge of this larger marsh, and their genetics will need to be assessed in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer, access by boat

Timing: Treatment should occur between July 15 and September 15
Outgoing tide to improve dry time on low elevation clones
Annual beginning in 2008 until eradicated

The area of Wildcat Marsh adjacent to the Chevron refinery is a secured area, which requires annual notification (through Martin Swinderman) so that their personnel do not become alarmed at the presence of either the treatment or monitoring crews. As in previous years, the site will be accessed by boat to retreat any remaining

Spartina, but the work should be scheduled around an outgoing tide to allow for better dry time on the most persistent low elevation clones. If hybrid *Spartina* is confirmed in the new area mentioned above, these plants will be accessed by a service road around the perimeter of the landfill to reduce the mobilization effort.

Monitoring Needs

Due to the large marsh matrix of this sub-area, as well as the effort required to mobilize to the site by boat on an appropriate tide, detailed monitoring maps will need to be provided to the treatment contractor to facilitate the effort. Many of the remaining infestation areas of this site are highly cryptic, so genetic testing will be needed to confirm the elimination of hybrids from the site. This phenomenon has applied to both regrowth from treated clones as well as newly discovered plants over the past three years. In addition, the large eastern marsh needs to be comprehensively surveyed on the ground to insure that no hidden pockets of invasive *Spartina* are expanding on the remote edges of the marsh plain or down in the channels. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 22B: SAN PABLO MARSH

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of Richmond
Grantee(s): CWF

Sub-Area Description

San Pablo Marsh is a 165-acre marsh at the mouth of San Pablo Creek on the City of Richmond shoreline in southeastern San Pablo Bay. The West County Landfill and Transfer Station borders the marsh to the southwest, with the Richmond Sanitary District and other recycling operations to the south of the marsh on the east side of San Pablo Creek. There are a series of old, crumbling levees from some defunct commercial enterprise that run along the banks of the creek and also extend out from this southern marsh edge. These berms are being reclaimed by the marsh and are densely vegetated with gumplant (*Grindelia stricta*). San Pablo Marsh is predominantly pickleweed with *S. foliosa* on the bayfront and in the channels. The marsh stretches east to an 11-acre pickleweed, *S. foliosa* and alkali bulrush (*Bolboschoenus maritimus*) cove bordered by levees on either side, located behind the Richmond Rod and Gun Club rifle range. The northern levee serves as a gravel road out to the club's RV park, skeet shooting range, and boat launch. This sub-area extends upstream on both sides of San Pablo Creek to just past the bridge used to access the landfill from Parr Blvd.

Although the acreage of hybrid *Spartina* was less than 3% of the area of San Pablo Marsh before treatment began in 2005, the cordgrass was already distributed over a large portion of the system. Its heaviest concentration was on the bayfront edges of the marsh, the mudflats of the eastern coves, and the banks of San Pablo Creek, but it was rapidly spreading to the inner marsh along the network of second and third order channels.

The first area addressed by imazapyr treatment in 2005 was the westernmost bayfront edge of the marsh that was heavily infested, and this control work was done from a truck-mounted sprayer hauling hose hundreds of meters out into the marsh. The remainder of the marsh west of San Pablo Creek was treated by backpack. All of these sections were retreated in 2006 with follow up applications in 2007 on a greatly reduced area with large patches of stubble where the large clones previously stood. The infestation east of San Pablo Creek was treated with imazapyr for the first time in 2007 using backpack sprayers, with some truck-mounted sprayer work on large clones in the creek channel downstream of the landfill bridge off Parr Blvd. Above the bridge to the landfill, San Pablo Creek is dominated by brackish marsh vegetation that has kept invasive *Spartina* from establishing.

The eastern marsh plain was dotted with small clones, but the small to medium-sized channels contained some continuous linear infestations that had expanded rapidly in the absence of treatment. The mudflats and protected coves of the easternmost portion of this sub-area had also become heavily infested. These tall, dense stands senesced before they could be treated in 2006 and 2007 although the surrounding populations of hybrid *Spartina* were still green and healthy.

In the marsh west of San Pablo Creek, only a handful of scattered patches required treatment in 2007, so this area may be essentially *Spartina*-free in 2008, although there will probably be some clean-up work on the creek banks because of less optimal dry time for the herbicide. Dry time probably also effected the few mudflat *Spartina* plants off the eastern marsh bayfront, and there will inevitably be follow-up in the linear channel infestations. As

described above, the coves by the Richmond Rod & Gun club have not been treated, and contain some very tall, dense stands of hybrid. The total remaining infestation in San Pablo Marsh is approximately one acre, with the majority concentrated in these eastern areas.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Helicopter broadcast (primary for eastern coves)
Truck-mounted sprayer (follow-up for eastern coves and other clones near the levees)
Backpack sprayers (primary for marsh plain and follow up in 2009 and beyond)

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

The most appropriate method for treating the heavily-infested eastern coves of this sub-area is an aerial imazapyr application because of the complex terrain and need for an early application. The helicopter can achieve much more uniform coverage than a ground-based crew working in these large stands of eight foot tall plants in soft mud. Timing is a very important aspect of treatment at this site, and aerial methods allow the earliest access for the control work with the lowest impact to the habitat value. Treatment has already been precluded by early senescence, and it is essential that these plants get controlled early enough to stop seed production and potential dispersal to the surrounding sites.

There may be issues mobilizing a helicopter at this site, namely the cost in time and money since there are no other aerial treatment sites in the North Bay. A truck-mounted sprayer could also be used, but the contractor would need access to the marsh by mid-July to late August at the latest, while the plants are still actively growing. Follow-up applications in 2009 and beyond in these coves should utilize a truck-mounted sprayer, or backpack sprayers when the clones are too far from the levee road. Any imazapyr retreatment on the marsh plain or along San Pablo Creek will be performed with backpack sprayers.

Monitoring Needs

As with other San Pablo Bay ISP sites, identification of hybrid *Spartina* can be a challenge. These marshes have extensive *S. foliosa* meadows, and the native cordgrass of the North Bay can grow taller and with larger flower heads and a higher culm density than the average plant. As infestations are reduced to scattered individuals, some with sub-lethal impacts that alter common diagnostic traits, an expansion of genetic analysis will be required to complete the eradication. ISP monitoring will need to occur earlier than in previous years, to provide detailed maps to the treatment contractors to ensure that all plants are controlled and to reduce the search time over these relatively large marshes with numerous channels. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 22C: RHEEM CREEK MARSH

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of Richmond
Grantee(s): CWF

Sub-Area Description

This 15 acre strip marsh is located at the mouth of Rheem Creek in southeastern San Pablo Bay along the Richmond shoreline, approximately one mile south of the Point Pinole Regional Shoreline. At the northern end of the sub-area, just south of Giant Marsh, is a 300-m long meandering rock jetty that protects a small cove of pickleweed (*Sarcocornia pacifica*) and *S. foliosa,* and separates this marsh pocket from the main strip marsh to the south. Another manmade rock levee borders the site to the south, and serves as a storage lot for large shipping containers. Along the upland to the east is the model plane airstrip for the Bay Area Radio Control Society (BARCS).

Similar to the other sites in the Two Points complex, Rheem Creek Marsh was lightly infested with hybrid *S. alterniflora* when treatment began in 2005, and the majority of the invasive cordgrass was on the bayfront edge of the marsh and had not yet colonized the interior of the site. Because of the late start to the 2005 treatment season due to the Biological Opinion being issued on September 7, the majority of the plants on this site were senescing,

which resulted in poor efficacy from the imazapyr treatment. The site was treated with imazapyr from backpack sprayers under more positive conditions in 2006, with follow-up retreatment in 2007.

Most of the hybrid *Spartina* in this sub-area is scattered among the *S. foliosa* meadow on the bayfront edge of the strip marsh. Many of these plants are cryptic, only being slightly taller than the surrounding native matrix but with bright red stems. The remains of several large clones can be found on the southern edge of Rheem Creek mouth, with just a small percentage of the original footprint still alive. There are also some plants remaining in the small cove protected by the jetty in the northern end of the site. Less than 1000 ft^2 of hybrid *Spartina* remains to focus on at Rheem Creek Marsh in 2008.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and September 1
Annual beginning in 2008 until eradicated

Considering the relatively small size of the remaining infestation, an imazapyr application by backpack sprayer is the most appropriate method for Rheem Creek Marsh in 2008. Any regrowth at this site is most likely either a portion of a previously large clone, plants in the rip-rap of the jetty, or is within a meadow of *S. foliosa*. Digging is not practical in any of these situations. Breaking and not completely removing the rhizome can stimulate vegetative growth, and the effort involved is difficult to do without heavy machinery and a way to efficiently remove the plant material from the site.

Monitoring Needs

As mentioned above, many of the hybrid plants in this marsh are cryptic, and since there are large areas of *S. foliosa* on the site, an expansion of genetic analysis is warranted to inform treatment. The treatment contractor will need detailed maps of the current year infestation to eliminate the potential confusion from these cryptic hybrids, and to enable them to treat only the infestation while preserving the native *S. foliosa* stands. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 22D: STEGE MARSH

Sub-Area Partners

Owner(s): EBRPD
Manager(s): EBRPD
Grantee(s): CWF

Sub-Area Description

The 6-acre Stege Marsh is located on the cove of the Richmond Inner Harbor, bordered by the Richmond Marina on the west and Hoffman Marsh (Sub-area 22e) and the Point Isabel Regional Shoreline to the southeast, with I-580 running along the upland edge approximately 500 meters from the marsh, through the City of Richmond. The site is part of Eastshore State Park, which is jointly managed by California State Parks and East Bay Regional Parks District (EBRPD). Stege Marsh is a remediation site funded by Cherokee Simeon Venture LLC, which involved excavation and removal of sediments contaminated by former chemical and pesticide manufacturing on the site. New habitat features have also be added as part of the overall restoration, including about 3.5 acres of new marsh habitat and a freshwater lagoon. The Watershed Project is actively involved in the stewardship and continued restoration of Stege Marsh, including planting pockets of native *Spartina foliosa* on the mid-elevation mudflats of an inner cove to the north of the Bay Trail that bisects the site.

When treatment began on this site in 2005, there were only scattered clones beginning to infest the site. Imazapyr has been applied by backpack sprayer in all three years, but the control work has been conducted very late in the season because of clapper rail restrictions and the limited number of contractors available to perform aquatic vegetation management in the Estuary. Volunteers from the Watershed Project have also been involved in the eradication, cutting accessible *Spartina* flower heads before treatment to make sure that any remaining plants are at not dispersing the infestation to other parts of the site or out to the Bay.

A handful of scattered hybrid *Spartina* plants remain in Stege Marsh, totaling approximately 250 ft^2. With one small exception, all the remaining plants are on the outboard side of the marsh, south of the Bay Trail that runs through the site. Several of these plants are right at the toe of the levee below the trail, while others protrude noticeably out of the small meadows of *S. foliosa*. Many plants have been genetically tested in this marsh over the years, and the vast majority has come back native.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary in 2008) Manual removal (primary if control is needed in 2009 or beyond)
Equipment:	Backpack sprayer Shovels or similar tools
Timing:	Treatment should occur between July 15 and September 1 Annual beginning in 2008 until eradicated

Despite the relatively small size of the remaining infestation, an imazapyr application by backpack sprayer is still the most appropriate method for Stege Marsh in 2008. Any regrowth at this site is most likely either a portion of a previously large clone or is within a meadow of *S. foliosa.* Both of these would have a large rhizome structure that makes digging impractical in either situation. Breaking and not completely removing the rhizome can stimulate vegetative growth, and the effort involved is difficult to do without heavy machinery and a way to efficiently remove the plant material from the site. EBRPD, or the volunteers of the Watershed Project, may choose to complete the eradication by digging in 2009 or beyond after another imazapyr treatment in 2008 reduces the infestation to an acceptable level for this laborious exercise.

Monitoring Needs

Treatment of the remaining hybrid *Spartina* in this marsh may result in a small proportion of regrowth, and these plants often show sub-lethal impacts making them hard to differentiate from *S. foliosa*. Although the current infestation is composed of obvious hybrids that stand out clearly, there may be questionable traits on these plants where some percentage survived. In addition, since the size of the overall site is large enough, and includes remote areas that are hard to access from the ground, detailed maps of the current *Spartina* infestation must be provided to the treatment contractor. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 22E: HOFFMAN MARSH

Sub-Area Partners

Owner(s):	EBRPD
Manager(s):	EBRPD
Grantee(s):	CWF

Sub-Area Description

The 35-acre Hoffman Marsh is set back several hundred meters from the Richmond Inner Harbor in the City of Richmond, and is bordered by Rydin Road and commercial development on the west, Point Isabel Regional Shoreline to the south, and I-580 running along the eastern edge just 50 meters from the marsh. Hoffman Marsh was recently restored to muted tidal exchange, and some new channels were excavated in the process. There is a straight 600m-long channel that connects Hoffman to the tidal influence of the Bay. The interior channels in the southern half of the site are lined with thick stands of gumplant (*Grindelia stricta*), while the northern half has very little. This site contains extensive patches of *S. foliosa* surrounded by a matrix of pickleweed (*Sarcocornia pacifica*).

In 2005, the infestation at Hoffman Marsh consisted of just one pioneering clone of hybrid *S. alterniflora* in the far northern portion of the site on the banks of one of the second order channels. This clone was treated very late in the 2005 season with imazapyr from a backpack sprayer, and required follow-up in 2006 using the same method. During ISP monitoring in 2007, there was a small plant with hybrid traits found in the same location, and it was removed manually after being recorded by GPS.

At this point there is no confirmed hybrid *Spartina* remaining in Hoffman Marsh. One suspect plant near the previous hybrid clone was sampled and submitted for genetic analysis. However the reactions failed during the processing of the sample at the lab, so this plant is still in question.

Treatment Strategy, Methods, and Timing

Method: Manual removal (primary)

Equipment: Hand pulling, shovels or similar tools

Timing: Treatment should occur between August 1 and September 15

If any hybrid plants are discovered in Hoffman Marsh, they should be small pioneering individuals and can be manually removed during a survey by either the ISP or the landowner.

Monitoring Needs

Since one suspect plant was found in 2007 and the genetic testing failed, this plant should be resampled in 2008 and sent in for genetic analysis. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 22F: ALBANY/SOUTH RICHMOND SHORELINE

Sub-Area Partners

Owner(s): EBRPD and multiple private landowners
Manager(s): EBRPD
Grantee(s): CWF

Sub-Area Description

This site stretches from Golden Gate Fields and the Albany Bulb in the southeast, along the shoreline of the Albany mudflats, Point Isabel Regional Shoreline, and the highly developed waterfront of South Richmond, out to Point San Pablo in the northwest. Much of the southern section is part of Eastshore State Park, which is jointly managed by California State Parks and East Bay Regional Parks District (EBRPD). The Albany/South Richmond Shoreline site includes over 25 km of shoreline, much of it adjacent to residential, commercial or light industrial development. Long stretches are composed of armored shoreline with rip-rap or concrete to counteract erosion. There are some thin strip marsh areas composed mainly of pickleweed *(Sarcocornia pacifica)*, with saltgrass (*Distichlis spicata*) along the upper edge. Some shallow coves can be found on the southern shoreline on either side of Point Molate, and they contain vulnerable mudflat habitat. Brooks Island Bird Sanctuary lies approximately 500 meters off the mainland in the center of the site. There are a number of oil tanker piers jutting out into the Bay along the shoreline from Point Richmond to Point San Pablo.

This site has been added to the 2008-2010 Site-Specific Plans after ISP monitoring found several widely-scattered individual patches of hybrid *Spartina* in 2007. No treatment has yet occurred on this site.

There are currently five small areas of concern at this site. The largest is one expanding clone of hybrid *Spartina* along the Albany cove mudflats just south of the outlet of a small ditched historic creek. The patch is at the transition between the pickleweed strip marsh below I-580 and the mudflat, and is expanding rapidly in the unvegetated mud. Next is an individual plant approximately 3m in diameter on the east shore of the Harbor Channel where this large manmade waterway bends to the northwest becoming the Santa Fe Channel, just below the small Parr-Richmond Canal. A single small plant was found in the little cove north of Sanderling Island, adjacent to the Richmond Yacht Club at Point Richmond, between Mallard Drive and Pelican Way south of Brickyard Cove Road. The final individual hybrid *Spartina* patch was identified on the north side of Castro Point approximately 500 m north of the Richmond-San Rafael Bridge. This plant covers 15 m in diameter but at a low cover class. Finally, on the west side of the Albany bulb there are some suspected hybrid *Spartina* plants that have not yet been confirmed by genetic testing.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

These small pioneering *Spartina* infestations will be treated for the first time in 2008, using imazapyr and a back-pack sprayer. The main issue at this site is mobilization, since all of the clones are quite small and easy to treat, but to access them the treatment contractor will need to drive between points, and sometimes walk long distances from the truck to reach the infestation.

Monitoring Needs

The suspected hybrid plants on the Albany bulb will need to be verified by genetic testing to determine whether that area will need to be included in the planning for treatment. The entire shoreline of this site needs to be surveyed annually to ensure that no other pioneering *Spartina* patches colonize.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Two Points Complex, Contra Costa County, TSN: ISP-2005-22, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original five sub-areas remain as defined in that plan, and one new sub-area has been added. The new sub-area is in the immediate vicinity of the existing sub-areas, and is extremely similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 23: MARIN OUTLIERS, MARIN COUNTY

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Marin Outliers, Marin County, TSN: ISP-2005-23, 2005-2007 Control Seasons) dated May 2005. The original 11 sub-areas remain as defined in that plan, and four new sub-areas have been added. There have been no new species or other significant environmental factors identified. The work described in this plan will continue and potentially complete the work initiated in 2004.

Site Partners

The sites in the Marin Outliers complex have numerous landowners, ISP partners, and engaged stakeholders. The State Coastal Conservancy grant recipient that will contract all of the treatment work is:

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Steve Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* Control Plans on all sub-areas in the Marin Outliers complex.

Site Description

Map Site 23: Marin Outliers includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

23a	Brickyard Cove	Map	23h	Strawberry Point	Map
23b	Beach Drive	Map	23i	Strawberry Cove	Map
23c	Loch Lomond Marina	Map	23j	Bothin Marsh	Map
23d	San Rafael Canal Mouth North	Map	23k	Sausalito	Map
23e	Muzzi & Martas Marsh	Map	23l*	Starkweather Park	Map
23f	Paradise Cay	Map	23m*	Novato	Map
23g	Greenwood Beach Road/Harbor	Map	23n*	Triangle Marsh	Map
			23o*	Marin Island	

* Sub-area added since the 2005-2007 *Spartina* control plan

The Marin Outliers is a site complex composed of smaller, disparate sites scattered throughout the shoreline and marshes of eastern Marin County. This complex stretches some 12 miles from the southernmost site in Sausalito that consists of some remnant marsh patches adjacent to the marinas, to the northernmost in Novato that is a large, intact marsh just south of Hamilton Field. The Marin Outliers sites are highly diverse, ranging from coves of native *Spartina foliosa* adjacent to residential properties, to the rip-rap shoreline adjacent to light industry or marinas, to restored and intact remnant marshes. There are three other separate Site-Specific Plans for tidal areas of Marin not included here: the large Corte Madera Creek complex (Site 4), and the individual sites Blackie's Pasture (Site 3) and Pickleweed Park (Site 9).

The 13 infestation sites of the Marin Outliers include an even mix between *Spartina densiflora* and hybrid *Spartina alterniflora*, with both species present on several of the sites. Hybrid *S. alterniflora* has not spread extensively from the Central and South Bay to the North Bay, so these infestations represent new loci of dispersal for this aggressive species and are an extremely high priority to control. Similarly, *S. densiflora* has not spread extensively out of the Corte Madera Creek watershed where it was introduced at Creekside Park, and the infestations within the Marin Outliers consist of the majority of these pioneering areas in the entire Estuary.

Prior to the initiation of control efforts in 2004, the entire infestation of this complex totaled less than three acres scattered over miles of shoreline and over 130 acres of marsh. An Integrated Pest Management (IPM) strategy has been implemented in these areas, with a combination of manual and chemical control methods utilized. This has produced a significant reduction in the invasive *Spartina* at most of the Marin Outliers. However, two new sites were discovered by ISP Baywide monitoring in 2006 and added to the complex, Starkweather Pond (23l) and Novato (23m). The total area of invasive *Spartina* in this complex is approximately 0.2-0.4 acres in 2008.

Several of the sub-areas are relatively large restored or remnant marshes dominated by pickleweed (*Sarcocornia pacifica*) with a full native marsh plant assemblage and well developed channels. These sites may still contain some medium to large individual clones of hybrid *Spartina*, but do not have any coalesced meadows or cordgrass prograding the marsh out onto mudflat, and imazapyr has reduced the footprint of many clones to a small fraction of their original area and height. Where *Spartina densiflora* is present at these sites, it has been reduced by treatment to pockets of scattered plants or seedlings. Two sites consist of moderately infested coves of native *Spartina foliosa* that received their first comprehensive imazapyr treatment in 2007. The remainder of the sites contains only a thin band of appropriate habitat for *Spartina* invasion, and the spot treatment of these sites has eliminated the large mature plants and reduced the infestation to scattered individuals with a lower cover class.

Treatment Approach

The treatment approach for all sub-areas is described below.

SUB-AREA 23A: BRICKYARD COVE

Sub-Area Partners

Owner(s): McNear Brick and Block (adjacent lands)
Grantee(s): CWF

Sub-Area Description

Brickyard Cove is a shoreline area to the east of Point San Pedro Road in eastern San Rafael adjacent to McNear Brick & Block, one of the oldest brickyards in the Bay Area, which has been in operation since 1868. At first glance the shoreline appears to be composed of rocky substrate, but in fact most of it is old brick embedded in the sandy mudflats. There is a thin band of marshland that contains scattered clumps of pickleweed (*Sarcocornia pacifica*), alkali heath (*Frankenia salina*), and stands of *Spartina foliosa*.

The infestation of *S. densiflora* at this site has been treated with imazapyr by backpack sprayer for three seasons beginning in 2005. The original infestation contained less than 0.1 acre of invasive cordgrass concentrated in several clusters, rooted in the brick and rocky substrate of this large cove.

The infestation at this site has been reduced to a handful of plants covering less than 100 ft^2 of shoreline. Many of these are seedlings or second year plants, but a few are resprouting mature plants. Treatment has occurred fairly late in the growing season for this species, and consequently seed has often been produced and the infestation has not been completely eliminated. In addition, late-season applications normally have lower efficacy than those conducted when the plants are growing vigorously.

Treatment Strategy, Methods, and Timing

Method: Manual removal (digging and/or pulling)

Equipment: Shovels or similar tools appropriate for the site

Timing: No later than mid-June 2008
Annual beginning in 2008 until eradicated

Imazapyr has worked well on most of the mature *S. densiflora* on this site, but ISP experience has been that efficacy is much lower on seedlings or smaller, second year plants. This is probably due to a lower ratio of leaf surface area to root biomass in these small plants, which results in an insufficient amount of herbicide translocating to the below-ground portion of the plant. For this reason, coupled with the small scale of the infestation that is approaching eradication, and the ease of access to the site, manual removal methods will be used to complete the control work at this sub-area beginning in 2008. Small plants can be pulled from the sandy substrate, while any resprouting larger plants will need to be dug out. Work can begin early in the growing season at a time when most if not all of the *Spartina* has grown to a sufficient size to be found and removed. If the manual treatment is completed too early, late-sprouting plants may be missed. However, the removal should occur no later than mid-June in a given year, which is normally when *S. densiflora* begins to flower. It is essential that no more seed is ever produced on this site, and it may take multiple seasons until any seed bank that is currently in the sediment is eliminated.

Monitoring Needs

Early season control work means that an additional survey will need to be conducted at the end of the growing season to verify that no additional seedlings have emerged, and that no small plants were overlooked on the site during control efforts. This monitoring may be conducted by either arm of the ISP, the Monitoring Program or the Control Program. With the small size of the Brickyard Cove sub-area, any plants discovered during a survey can be immediately removed to improve efficiency.

It is suspected that some of the remaining infestation consists of hybrids of *S. densiflora* and *S. foliosa*, so further sampling will be conducted to confirm or deny this identification. The results of this genetic testing will not impact the control efforts unless these hybrids have a *S. foliosa* phenotype, in which case those plants will be removed from the surrounding native stands. Plants that look like the *S. densiflora* parent would be sampled for genetic testing as they were removed. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23B: BEACH DRIVE

Sub-Area Partners

Owner(s): Multiple private landowners, represented by the Bayside Acres Homeowners Association
Manager(s): Bayside Acres Homeowners Association
Grantee(s): CWF

Sub-Area Description

This sub-area actually consists of two very different marsh systems on either side of Beach Drive, which is a small residential street to the south of Point San Pedro Road in eastern San Rafael. To the west is a narrow, 100 m-wide cove which extends about 450 m to the northwest behind a row of residential properties on Beach Drive and Point San Pedro Road. This cove has a significant and expanding presence of native *Spartina foliosa* with the associated increase in the accretion of sediment in recent years. Across the road to the east is a 3-acre muted tidal marsh composed of pickleweed (*Sarcocornia pacifica*), gumplant (*Grindelia stricta*) and native *Spartina* in some of the small channels.

The cove contained approximately 10-15 large clones of hybrid *Spartina* when treatment began in 2005. Applications in 2005 and 2006 were conducted later in the season than planned due to weather delays, and the incoming tide appeared to impact the efficacy significantly from the 2006 work since this site is of low, almost mudflat elevation. A few of the big clones along Beach Drive were reduced, but others thrived including those in the north of the cove along Point San Pedro Road. Imazapyr treatment was conducted much earlier in 2007, on August 28 on an optimal low tide from truck-mounted sprayer, and is expected to improve the trajectory of control of this site.

The muted marsh on the east side of the road was also treated for three seasons from 2005 to 2007. The hybrid *Spartina* infestation here was clogging the small channels that run through this marsh, and clones were expanding across the marsh plain and on the higher marsh transition zone on the perimeter. Efficacy here was much higher from the 2006 treatment because the tide didn't play as much of a factor. Imazapyr treatment by backpack sprayer in 2007 consisted of retreating some small remaining patches down in the channels, as well as individual plants scattered widely throughout the marsh and the edges of previously treated clones that resprouted.

The cove along Beach Drive had some fairly substantial hybrid clones amongst the meadow of *Spartina foliosa*. These tall, robust plants have been reduced, but because efficacy was lower than expected in previous years, a portion of the original infestation footprint is still present. Some clones that were not fully killed by treatment sent out runners and have expanded slightly by vegetative growth. In the muted tidal marsh across the road, only a handful of hybrid *Spartina* plants still exist. These are all small, individual plants including both regrowth and some new plants or seedlings. The total area of invasive *Spartina* in both sections of the Beach Drive sub-area is under 1000 ft^2.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary);
Manual removal in muted marsh (where appropriate)

Equipment: Truck-mounted sprayer or backpack sprayer; Shovels or similar tools

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

The hybrid *Spartina* population in the cove section of this sub-area will still need an imazapyr application in 2008. The mud of this site is extremely soft, making access very difficult. As a result, treatment has been conducted using long wand attachments to extend the nozzle reach of the truck-mounted sprayer. Both this soft substrate as well as the large root mass of these clones makes manual control impossible. Earlier treatment of the site in the height of the growing season could potentially eliminate this population after one more treatment in 2008, since the imazapyr can stop seed production. The application should occur by mid-July when the hybrid can be more easily differentiated from the native.

The muted tidal marsh section of the sub-area across Beach Drive should be down to just a handful of *Spartina* plants in 2008, possibly even fully eliminated. If the remaining infestation consists of only scattered seedlings or young plants, they could be manually removed. Any regrowth from previously established clones would best be treated with imazapyr by backpack sprayer because of the difficulty of removing the root mass from within the channels.

Monitoring Needs

The treatment crew would benefit greatly from a detailed mapping of the tidal marsh section of the sub-area. The monitoring crew should comb the entire site very carefully since it is very close to eradication. Genetic samples may have to be taken to differentiate any *S. foliosa* from stunted hybrid *Spartina* that has returned. This genetic evaluation will also be required in the cove section of the site when the stunted regrowth is not clearly part of the footprint of a previously-treated hybrid clone. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23C: LOCH LOMOND MARINA

Sub-Area Partners

Owner(s): Loch Lomond Marina (adjacent lands)
Manager(s): Pat Lopez – Harbormaster
Grantee(s): CWF

Sub-Area Description

The Loch Lomond Marina is located off Point San Pedro Road in San Rafael, with Beach Drive (Sub-area 23b) immediately to the east. This site consists of a narrow fringe of marsh vegetation along the shoreline of a cove to the west of the marina, and the rip-rap along the inside of the protective marina levee on the western, southern and eastern edges.

This sub-area consists of less than an acre of viable habitat for invasive *Spartina*. The small, pioneering infestation of hybrid *Spartina alterniflora* here has been almost eliminated by three seasons of imazapyr treatment. The majority of remaining plants are located amongst the pickleweed (*Sarcocornia pacifica*) and salt grass (*Distichlis spicata*) of the cove to the west. Previously there was also invasive cordgrass clogging the channel that runs from Point San Pedro Road down into this cove, but these had been eliminated by 2007. Several widely-scattered individual *Spartina* plants were treated in 2007 on the inside of the marina levees, and because this control work was conducted during the height of the growing season in August, it is expected to be highly effective.

Successful imazapyr treatment has reduced the hybrid *Spartina* infestation at this sub-area to just a handful of plants covering a total area of less than 100ft^2. All cordgrass plants are small individuals from regrowth or new recruitment because the established clones have been eliminated or significantly reduced in size.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary in rip-rap);
Manual removal along western cove shoreline

Equipment: Backpack sprayer;
Shovels or similar tools

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

Any invasive *Spartina* plants that return along the shoreline of the cove could be manually removed to complete the eradication on this site. Access is easy and will not hinder the hauling of the removed plant material out of the marsh. However, the plants anchored in rip-rap cannot be effectively removed in this way, and should continue to receive imazapyr treatment from a backpack sprayer. Presumably this would only need to be applied in 2008 because the infestation is down to just a few plants.

Monitoring Needs

The few remaining plants scattered over this sub-area have tended to be cryptic, requiring genetic lab confirmation that they were indeed hybrid. This may continue because any regrowth from the treatments will tend to present as *S. foliosa* (short, widely-spaced, with thinner stems and smaller flower heads). This is not a significant issue around the marina itself since there is only invasive *Spartina* growing in the rip-rap, but this may become an issue in the cove shoreline and up into the channel from Point San Pedro Road.

The small size of this site would allow it to be monitored after the treatment season by either the Control or Monitoring arm of the ISP. If any plants had emerged since the treatment season, they could be easily removed on the same day, which would serve to get ahead of the infestation rather than waiting an additional year to follow-up. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23D: SAN RAFAEL CANAL MOUTH NORTH

Sub-Area Partners

Owner(s): City of San Rafael (adjacent lands)
Manager(s): City of San Rafael
Grantee(s): CWF

Sub-Area Description

This sub-area consists of two separate sections, the northern shoreline of the San Rafael Canal to the east of Sea Way, and a *Spartina foliosa* cove west of Summit Avenue adjacent to the Marin Yacht Club that is to the west. The shoreline section begins at a small marsh at the end of Sea Way where it meets the canal, and runs for approximately one kilometer along the rocky shoreline at the base of the steep cliffs to Loch Lomond Marina to the east. Perched atop these cliffs are the enormous personal estates on Bay Way in San Rafael, but these properties do not have access to or ownership of the public shoreline. The second section is a cove dominated by *S. foliosa* that extends inland about 200 m to the north, and has a 50 m-wide mouth along the canal. A deep channel runs down the center of this marsh, denying access from the eastern side along Summit Ave. to the western half.

The cove section of this sub-area contained 5-7 large established clones of hybrid *Spartina alterniflora* within a surrounding matrix of densely packed native *Spartina foliosa*. This infestation poses a serious threat to the entire cove because these giant plants swamp the native cordgrass with hybrid pollen, creating hybrid seed that can convert the marsh and further disperse the invasive to new sites. This cove was treated with imazapyr for the first time in 2007, utilizing backpack sprayers and access from the Marin Yacht Club side of the marsh to the west.

The canal shoreline section of the infestation is composed of patches of *Spartina densiflora* scattered along approximately 650 m of rocky shoreline. The western half of the infestation was treated with imazapyr in 2005 & 2006 using backpack sprayers and had been eliminated by 2007, but the eastern half was discovered more recently and was only treated for the first time in 2007. There were 4-5 clusters of *S. densiflora* along this stretch, mostly containing young plants but also including some very large individuals that have been developing for several years.

The cove section has a very deep, steep-sided channel adjacent to the hybrid *Spartina* that made treatment difficult on the east side of the clones. Therefore, only a portion of the infestation was treated on this site in 2007; although the majority of the hybrid *Spartina* was controlled, there will be approximately 1000 ft^2 that will need control work in 2008. The canal shoreline section should be down to the final few plants by treatment season 2008. However, some of these large *S. densiflora* plants were at a fairly low elevation that can translate into lower efficacy, and it is normal for the first year of treatment on large plants to require follow-up.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary in cove section and in rocky shoreline substrate);
Manual removal of seedlings along the shoreline where possible

Equipment: Backpack sprayer;
Wooden boards to cross NE channel
Shovels or similar tools

Timing: Treatment should occur between May 15 and July 15
Annual beginning in 2008 until eradicated

Since the established hybrid clones along the channel in the cove section were so tall and dense, they obstructed the imazapyr application to their eastern sides that were overhanging the channel. These clones will require additional applications to methodically reduce them from the one side that can be accessed safely and completely. As the treated portion of the clone dies, it will expose a new edge that the imazapyr can be applied to directly. In addition, any sub-lethal impacts from previous treatment will serve to expose more of the plant because the tall, overhanging channel edge *Spartina* won't return as strong. There were also several plants in the northeast corner of the site that could not be reached for 2007 treatment because of timing and tidal inundation. It is important to plan treatment of this sub-area on the optimal low or receding tide to improve access and maximize dry time.

Along the shoreline of the canal, only minimal treatment is expected for 2008. Any large plants returning from 2007 will probably require an imazapyr application because the rocky substrate makes digging very difficult, and it is a very long distance to haul the plants out of the marsh. Seedlings or other young plants can just be pulled since small *S. densiflora* are often less impacted by herbicide than those plants with a greater leaf surface area to root ratio. Treatment over the whole site can begin by mid-June to address the *S. densiflora* before it flowers and contributes more to the seed bank.

Monitoring Needs

An expansion of genetic testing of plants in the *S. foliosa* cove may be required to inform treatment in future years. As the infestation in the cove is reduced by imazapyr application, some of the regrowth may begin to appear cryptic since the surrounding site matrix is so dominated by dense, robust native *Spartina*. Since treatment will occur early in the summer on this site, ISP monitoring will need to occur with enough time to allow the Control Program to receive the genetic results to inform treatment. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23E: MUZZI & MARTA'S MARSHES

Sub-Area Partners

Owner(s): CDFG, State Lands Commission
Manager(s): CDFG
Grantee(s): CWF

Sub-Area Description

Muzzi Marsh was once part of a historic marsh plain that extended several miles along Corte Madera Creek upstream to Ross Valley. A local developer (Muzzi) diked 200 acres in the 1950's, which subsequently subsided as it dried out and killed the salt marsh vegetation. When the Larkspur Ferry Terminal was constructed in the early 1970's, the Golden Gate Bridge, Highway and Transportation District (GGBHTD) used the site for both mitigation (eastern 130 acres) and the disposal of dredge spoils (western 70-acre portion). In 1976, the eastern dike was breached in four places to restore tidal action to Muzzi, and an extensive meander system has developed, extending off the relict tidal drainage. The site began to establish marsh vegetation within one year of the breaching, but the plant community remains fairly homogeneous today, dominated by a large pickleweed (*Sarcocornia pacifica*) plain and extensive areas of native *Spartina foliosa*.

Muzzi Marsh actually includes two separated marshes to the north and south with the broad channel of Marsh Creek running east-west between them and breached dikes around both perimeters. Included in this sub-area is also a small, 15-acre fragment of muted tidal marsh known as Marta's Marsh that borders Muzzi to the south. Much of the interior of Marta's is still unvegetated mudflat, but the higher elevation edges of the site within the dikes contain pickleweed and some other native marsh plant species.

The two marshes of this sub-area are bordered by San Clemente Creek to the south, with the residential properties of Corte Madera beyond. To the north is an undiked remnant of ancient marsh known as the Corte Madera Ecological Reserve (formerly Heerdt Marsh) that stretches up to the mouth of Corte Madera Creek. This marsh is addressed separately in the ISP's Site-Specific Plans for the Corte Madera Creek Watershed (Site 4). A large up-

land area created by the 750,000 cubic meters of Ferry Terminal dredge spoils borders Muzzi to the west and this has been heavily infested with pampas grass (*Cortaderia selloana*). Beyond are some permanently ponded areas, and the commercial development of Corte Madera along Hwy. 101.

Both marshes have infestations of both *S. densiflora* and hybrid *S. alterniflora* that have been treated since 2005 with imazapyr. Due to the time constraints governing ground-based treatment in California clapper rail habitat, and the small size of this site relative to the overall ISP work, the 2005 & 2006 applications were conducted at the end of the treatment season. This resulted in much lower efficacy and inevitably some seed production and dispersal, especially from *S. densiflora* that normally flowers in June or July. In addition, Muzzi is a very difficult marsh to move across on the ground because of its complex of large channels that cannot be crossed. Access is only by boat, which requires precise timing to allow enough water to cross the mudflats to the marsh scarp, but also requires an appropriate tide to allow for sufficient dry time for the imazapyr application. These factors came together for the 2007 application and the entire infestation found by the ISP monitoring crew was treated using backpack sprayers. With the complexity of these sites, some small hybrid *Spartina* plants had been overlooked in previous years, and were now more substantial, particularly clones that were hidden down in the deep channels. The treatment contractors and ISP Control Program Supervisor on site used the boat to navigate through some wider channels, and then carried the backpack sprayers over the marsh plain to other patches identified on the GIS maps. The one large hybrid clone in the center of Marta's was the only part of the infestation in that marsh that needed to be accessed on the incoming tide by boat. The small *S. densiflora* plants on the edges of Marta's were accessed using the paved trails off Channel Drive and walking down into the pickleweed fringe where the infestation was scattered.

The bulk of the original infestation has been controlled, with several nodes of hybrid *Spartina* reduced to stubble on the footprint of the previous clone, with a small percentage returning as stunted plants. There are several large, low elevation hybrid clones in Muzzi that were first treated in 2007 and will inevitably need retreatment in 2008. The *S. densiflora* is concentrated in nodes, with one area along the sandy bayfront berm of the northern marsh edge, and a couple patches on the marsh plain in the center of the southern marsh near some channels. Marta's has just one large clone of hybrid *S. alterniflora* in the center of the eastern half of its interior mudflat, and the *S. densiflora* has most likely been eradicated from this site. The total infestation of both *Spartina* species at Muzzi and Marta's Marshes is now less than 1000 ft^2, and Marta's should be eradicated by 2009.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary); Manual removal of seedlings
Equipment:	Backpack sprayer and boat
Timing:	Treatment should occur between May 15 and July 15 Annual beginning in 2008 until eradicated

Access to the site is only by small boat, launched from the Marin Rowing Association on lower Corte Madera Creek by the Hwy 101 bridge. All the herbicide to be used during the application must be pre-mixed with the aquatic surfactant and water and transported out to the site in one trip. Space is very limited on the small boat with the crew and equipment, and would not accommodate the transport of any substantial amount of manually removed *Spartina*. Since herbicide applications are less effective on *S. densiflora* seedlings, they should be pulled and bagged to help complete the eradication. Any regrowth from the established clones of either *Spartina* species should be treated with imazapyr until eradicated. Treatment should be conducted much earlier than in the past to ensure that there is no seed produced from the *S. densiflora*.

Monitoring Needs

ISP field-based monitoring of this site needs to precede treatment due to the large size of the site and difficult terrain. Treatment contractors require detailed maps of the infestation to plan for the appropriate amount of premixed herbicide to bring along on the boat, and to pinpoint precise *Spartina* locations to limit the amount of hunting that needs to occur in this highly channelized and complex site. There is also a significant presence of native *Spartina foliosa* in this area, which will necessitate an expansion of genetic testing to determine if any cryptic hybrids are present. The previous year's treatment can often complicate this issue, with regrowth of the hybrids showing some traits of the native *Spartina* such as reduced height and culm density. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23F: PARADISE CAY

Sub-Area Partners

Owner(s): 17-20 adjacent residential landowners
Grantee(s): CWF

Sub-Area Description

Paradise Cay is a housing development on the eastern Tiburon Peninsula constructed with the backyard of most residential parcels facing docks on manmade canals. The northern end of the complex is home to the Tiburon Yacht Club. There is a very thin band of marsh vegetation (mostly pickleweed) along these canals at the toe of the rip-rap on which the houses were built. In the southwest corner is a small, narrow cove about 100 meters long and 20 meters wide between the development to the east and the base of the steep mainland slope below Paradise Drive.

Paradise Cay contains infestations of both *S. densiflora* and hybrid *S. alterniflora*, and was treated with imazapyr for the first time in 2007 utilizing backpack sprayers. The southwestern cove contained the majority of the *Spartina* on the site, with three large hybrid clones each 10-15 meters in diameter. These clones were rapidly expanding vegetatively in the soft mud of the cove and beginning to coalesce into a continuous rectangular meadow. The adjacent homeowners have witnessed several impacts as a result, including the loss of resident and migratory waterfowl use of the cove, and an increase in mosquitoes and flooding. Within the canals, there are very small scattered infestations of both *S. densiflora* and hybrid *S. alterniflora* on private properties adjacent to docks and in the rip-rap below MHW. In 2007, treatment was conducted on parcels from which the ISP received back signed permission slips permitting the contractor access to perform the application. This occurred on approximately 50% of the infested properties within the canals, and 100% of the southwestern cove.

The first treatment on very tall, dense clones (such as those of the cove) is never 100% effective, especially from ground-based applications. The amount of above-ground biomass obstructs direct contact with some percentage of the leaf surface area, reducing the coverage of the herbicide application. In addition, the below-ground biomass is so substantial that it is difficult to get enough herbicide translocating through the plant to kill it completely on the first application. If efficacy from 2007 is 75-80% in the cove, approximately 1500 ft^2 will remain. Within the canals portion of the sub-area, about half of the small residential infestations were not treated. Combined with any regrowth or new plants, there will be a few hundred square feet remaining in 2008 in this portion of the site.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary);
Manual removal (where appropriate in the canal subsection)

Equipment: Backpack sprayer
Shovels and other digging equipment

Timing: Treatment should occur between June 1 and July 15
Annual beginning in 2008 until eradicated

A follow-up imazapyr treatment in 2008 will be required to continue the control work at this site. In the canal area, the *Spartina* is often rooted in docks, rip-rap, or other hard substrate that makes manual removal of the roots impossible. Imazapyr is the appropriate tool for controlling these plants, but where possible manual methods will be utilized since many of these plants are very small. This small size makes them easy to pull or dig, but also tends to result in poor efficacy from the herbicide application, making manual methods more appropriate and effective. Treatment must be implemented much earlier than in the past to ensure that viable *S. densiflora* seed is not created to expand the infestation.

Monitoring Needs

The genetics of the plants identified as hybrid *Spartina* within the canals needs to be verified as soon as possible in the 2008 growing season. Many of these plants are so small and widely-spaced that they appear more like *S. foliosa* than hybrid *S. alterniflora*. The ISP Control Program will be contacting landowners for access permission for treatment, and the scope of the infestation at Paradise Cay must be identified before these letters are mailed. Due to the constraints of how many samples the genetics lab can process, few of these patches have been analyzed genetically, but their cryptic appearance now makes it a necessity. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23G: GREENWOOD COVE

Sub-Area Partners

Owner(s): Strawberry Point Elementary School, Strawberry Recreational District, multiple other private landowners (adjacent lands)
Grantee(s): CWF

Sub-Area Description

Greenwood Cove is located in north-central Richardson Bay, east of Strawberry Point. This area has extensive mudflats with a thin band of marsh vegetation including pickleweed (*Sarcocornia pacifica*), alkali bulrush (*Bolboschoenus maritimus*), and native *Spartina foliosa*. The surrounding land use is high-density residential, with condominiums and apartments lining the shoreline of the cove. There is also a small, 2.5-acre restoration marsh adjacent to Strawberry Point Elementary to the west of the main cove.

The majority of the infestation at Greenwood Cove was a dense band of mature *S. densiflora* along the northern shoreline. The heaviest strip is actually up against the condominium complex on Greenwood Cove Drive under some overhanging decks, with the rest of the infestation scattered on the shoreline of the adjacent Greenery Apartments to the east and the marsh cove to the west. This site was treated for the first time in 2007 using imazapyr applied from backpack sprayers. There are also two small areas of hybrid *S. alterniflora* that have been genetically verified in the area. One is a linear infestation of low cover class in a ditch to the north of the small marsh by Strawberry Point Elementary. This area was an active construction site in 2007, with a cyclone fence and earthmoving equipment; hence, it has not yet been treated. There was also one individual hybrid *Spartina* plant near the outlet of this marsh, but since it was confirmed by the lab in autumn 2007, it has not yet been treated.

The current infestation consists of any scattered regrowth of *S. densiflora* from the 2007 treatment, and the two patches of hybrid *S. alterniflora*. The total area of invasive *Spartina* at Greenwood Cove is only a couple hundred square feet.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary);
Manual removal (any seedlings)

Equipment: Backpack sprayer

Timing: Treatment should occur between May 1 and July 15
Annual beginning in 2008 until eradicated

Due to the high percent cover of the original *S. densiflora* infestation, and the large size of those established plants, an imazapyr application is still the most appropriate treatment method for follow up in 2008. Digging to remove this infestation would erode the bank and change the integrity of the shoreline adjacent to the condominiums. Retreatment should be conducted with a backpack sprayer, and should be scheduled in June or early July to avoid seed set. The two areas of hybrid *Spartina* could be treated at the same time. Any *S. densiflora* seedlings or small young plants could be manually removed to expedite the eradication at this site.

Monitoring Needs

Early season control work means that an additional survey will need to be conducted at the end of the growing season to verify that no additional seedlings have emerged, and that no small plants were overlooked on the site during control efforts. This monitoring may be conducted by either arm of the ISP, the Monitoring Program or the Control Program. With the small size of the Greenwood Cove sub-area, any plants discovered during a survey can be immediately removed to improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23H: STRAWBERRY POINT

Sub-Area Partners

Owner(s): County of Marin, Strawberry Point Association, multiple adjacent residential landowners
Manager(s): County of Marin
Grantee(s): CWF

Sub-Area Description

Strawberry Point is a narrow peninsula protruding south into the center of Richardson Bay. There is a narrow finger of land along the eastern side that runs almost the entire length of the peninsula and creates a narrow embayment between it and the mainland. This finger has an excavated channel at its midpoint, with large residential estate properties on the southern half and a marshy, hook-shaped island to the north. There are extensive mudflats offshore where this peninsula joins the mainland west of Greenwood Cove (Sub-area 23g).

The invasive *Spartina* for this sub-area is entirely located on the eastern shoreline of the Strawberry Point landmass. The infestation contains scattered individual points of both *S. densiflora* and hybrid *S. alterniflora*. There were nine points of *S. densiflora*, most of them associated with the northern island and mudflats, but also a few on the mainland shoreline adjacent to residential parcels. These are either individual plants or low density clusters of plants. There were also four points of hybrid *Spartina*, most in the southern end of the site along Egret Way or Heron Drive. Only one was a large established clone, located in an unvegetated area in the rip-rap along Heron Drive. Due to time constraints and unfavorable tides, as well as the prioritization of larger sites around the Bay, only a few of these *Spartina* points were treated in 2007, using a backpack sprayer and imazapyr. No treatment has occurred on the island due to incomplete permissions and the access issues.

The combined area of *Spartina* on this sub-area needing either a first treatment or a follow up application is less than 500 ft^2. Most of the *S. densiflora* points are under a meter in diameter, and larger clusters are low percent cover. The large hybrid *Spartina* clone in the south portion of the site was largely eliminated by treatment in 2007, and the other patches of this species are relatively new pioneers that are still small.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary); Manual removal (any seedlings or small plants in soft substrate)
Equipment:	Backpack sprayer and boat for access; Shovels or similar tools
Timing:	Treatment should occur between May 1 and July 15 Annual beginning in 2008 until eradicated

All known invasive *Spartina* plants in this sub-area will be treated in 2008. Treatment will be conducted much earlier than the previous year to ensure that *S. densiflora* does not disperse seed. A boat will be required to access the patches on the island, and conveniently there is a boat ramp on the mainland directly adjacent to this northern portion of the infestation. Imazapyr will be applied by backpack sprayer, and any seedlings or small plants in soft substrate will be pulled and bagged to expedite eradication at this site.

Monitoring Needs

Early season control work means that an additional survey will need to be conducted at the end of the growing season to verify that no additional seedlings have emerged, and that no small plants were overlooked on the site during control efforts. This monitoring may be conducted by either arm of the ISP, the Monitoring Program or the Control Program. With the small size of the infestation at Strawberry Point, any plants discovered during a survey can be immediately removed to improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23I: STRAWBERRY COVE

Sub-Area Partners

Owner(s):	Multiple private residential landowners, represented by DeSilva Island Homeowners Association
Manager(s):	DeSilva Island Homeowners Association
Grantee(s):	CWF

Sub-Area Description

Strawberry Cove, also referred to as Seminary Cove, is a 10.5-acre tidal marsh at the base of DeSilva Island, nestled between Strawberry Point to the east and Hwy. 101 to the west. The marsh drains to a large mudflat area in northwestern Richardson Bay. West of the marsh are commercial properties along Hwy. 101. This pickleweed and *S. foliosa* marsh is owned by the DeSilva Island Homeowners Association, and the road up to these hilltop condominiums runs along the southern edge of the marsh.

There is just one large clone of hybrid *S. alterniflora* in the southern half of this marsh. The clone was approximately 30 m in diameter when it was first treated with imazapyr in 2007. Backpack sprayers were used to conduct the application.

It is anticipated that this large hybrid clone will have been significantly reduced by the first imazapyr application, but probably not eliminated. It is estimated that less than 500 ft^2 will need retreatment in 2008, with possible limited follow up in 2009 to eliminate this infestation.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

It is expected that the first treatment on very tall, dense clones (such as those at this site) is never 100% effective, especially from ground-based applications. The amount of above-ground biomass obstructs direct contact with some percentage of the leaf surface area, reducing the coverage of the herbicide application. In addition, the below-ground biomass is so substantial that it is difficult to get enough herbicide translocating through the plant to kill it completely on the first application. Up to 1000 ft^2 will require retreatment in 2008 depending on the efficacy from 2007.

Monitoring Needs

The ISP Monitoring Program will need to thoroughly survey the entirety of this marsh to ensure that any progeny from this clone are discovered and treated before they can establish a significant presence. This may require an expansion of genetic testing on the site because Seminary Marsh has extensive areas of native *S. foliosa* that will need to be differentiated from any new individuals. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23J: BOTHIN MARSH

Sub-Area Partners

Owner(s): County of Marin
Manager(s): County of Marin
Grantee(s): CWF

Sub-Area Description

Bothin Marsh Open Space Preserve is a large, multi-use park within the Marin County Open Space District located in the northwestern corner of Richardson Bay west of Hwy 101 in Mill Valley. The park has a large tidal marsh component, including tidal channels and expansive mudflats in the southern portion, thin strip marshes of pickleweed and *Spartina foliosa* along the paved trails, and other small fragmented pickleweed and alkali bulrush (*Bolboschoenus maritimus*) marshes.

Prior to treatment, there were several large stands of hybrid *S. alterniflora* beginning to dominate the thin strip marshes along the park trails. These marshes are in an area referred to as Bayfront Park adjacent to the water treatment plant several hundred meters south of Sycamore Avenue and the Mill Valley Middle School. Genetic testing was needed to confirm that these plants were indeed the target invader because the stands were all of uniform short height and senesced early in the season, traits more characteristic of the pure *S. foliosa* parent than of these hybrids. This early senescence precluded treatment in 2006 when the treatment contractor arrived on site to find that the plants were not actively growing; consequently the application was cancelled because the plants would not have translocated the herbicide. In 2007, treatment was scheduled for earlier in September, but again most of the above-ground biomass was red-brown. Fortunately, there was a carpet of short green regrowth over the majority of the infestation footprint. That vegetation was treated with imazapyr using backpack sprayers.

It is uncertain what the level of efficacy will be from treatment in 2007 because of the unusual state of the plants at this sub-area. The limited green leaf surface area may have reduced the efficacy of the herbicide application. The previous footprint of the hybrid *Spartina* was approximately 2500 ft^2, with an additional cryptic hybrid outlier

identified along the trail at the south end of the park that has not yet been treated because it was only recently confirmed through testing.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and August 1
Annual beginning in 2008 until eradicated

The key to successful treatment of this sub-area is timing, to ensure that the plants are green and healthy so that the imazapyr will be taken up by the plant and translocated. These stands are still far too large for manual removal, which would destroy the habitat value of the site. Pickleweed is normally not impacted by imazapyr, so this understory is much better preserved by an herbicide application than by excavation or covering.

Monitoring Needs

The cryptic nature of the hybrid *Spartina* at this site will probably require additional genetic sampling to confirm presence/absence as the infestation is reduced by treatment. The continuous stands will give way to scattered individual plants with *S. foliosa* traits that could be very hard to pick out for control work. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23K: SAUSALITO

Sub-Area Partners

Owner(s): City of Sausalito and one private landowner
Manager(s): City of Sausalito
Grantee(s): CWF

Sub-Area Description

Sausalito is home to world famous marinas, and its shoreline has been largely developed to accommodate recreation and other commercial interests. The remnant tidal marshes and mudflats are scattered in small, fragmented pockets between docks, light industry, office buildings, and small upland parks.

Although there seems to be numerous little crannies that invasive *Spartina* could colonize amongst all the infrastructure of Sausalito, only two infestations have been located. The first is located in the largest remaining tidal marsh patch on this shoreline, off Marinship Way to the northwest of Testa Street, a few blocks from the US Army Corps of Engineers Bay Model. It is a tiny pickleweed area less than an acre in size with some small channels, and it has become heavily infested with cryptic hybrids that have been genetically verified. The second infestation consists of a couple hybrid *Spartina* plants in a tiny mudflat cove adjacent to a City of Sausalito park along Bridgeway. Similar to the problems encountered at Bothin Marsh (Sub-area 23j) described above, the plants at both of these Sausalito infestations were largely senescent when the treatment contractor arrived at the site in 2007. Any green growth was treated with imazapyr by backpack sprayer.

It is uncertain what the level of efficacy will be from treatment in 2007 because of the unusual state of the plants at this sub-area. The limited green leaf surface area may have reduced the efficacy of the herbicide application. The previous footprint of the hybrid *Spartina* at both parts of this sub-area was approximately 1000 ft^2.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer

Timing: Treatment should occur between July 15 and August 1
Annual beginning in 2008 until eradicated

The key to successful treatment of this sub-area is timing, to ensure that the plants are green and healthy so that the imazapyr will be taken up by the plant and translocated. This infestation is still too large for manual removal, which would destroy any habitat value of the northern site. Pickleweed is normally not impacted by imazapyr, so this understory is much better preserved by an herbicide application than by excavation or covering.

Monitoring Needs

The cryptic nature of the hybrid *Spartina* at this site will probably require additional genetic sampling to confirm presence/absence as the infestation is reduced by treatment. The stands will become scattered individual plants with *S. foliosa* traits that could be very hard to pick out for control work. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23L: STARKWEATHER PARK

Sub-Area Partners

Owner(s): City of San Rafael
Manager(s): City of San Rafael
Grantee(s): CWF

Sub-Area Description

Formerly known as Shoreline Park, this City of San Rafael open space area was renamed the Jean and John Starkweather Shoreline Park in 2003 to honor these conservation activists. Located in southeastern San Rafael, the park consists of several restored tidal marshes, two permanent ponds, and a trail atop the rip-rap of the heavily fortified shoreline. For the purposes of this ISP Site-Specific Control Plan, Starkweather Park is the 8.5-acre restored tidal marsh located approximately one kilometer from the western landfall of the Richmond-San Rafael Bridge north of San Quentin. This marsh wraps around the eastern side of the office park at Pelican Way and Glacier Point. It contains a developing perimeter of pickleweed (*Sarcocornia pacifica*) and a meadow of *S. foliosa*, with a lower elevation center of mudflat.

The infestation of *S. densiflora* on this site was discovered in late summer 2006, and was already well distributed around the entire inner perimeter of this marsh. It was still a relatively young population, but was beginning to form a continuous linear infestation around the marsh at a specific favorable elevation on the edge of the pickleweed just below the toe of the adjacent levee. Although the *Spartina* on this site was treated very late in the season in 2006 (in mid-October, the last site of the year), efficacy from the backpack imazapyr application was remarkably high. In 2007, only five small plants required retreatment, all showing obvious impacts from the 2006 work.

The 2007 imazapyr application may have eliminated *Spartina densiflora* from this marsh. If any plants remain, they will cover a total of less than 10 ft^2. Since seeds of this species may be viable for several years, there may be seedling recruitment to remove.

Treatment Strategy, Methods, and Timing

Method: Manual removal

Equipment: Shovel or similar tool

Timing: Treatment should occur between May 1 and July 1
Annual beginning in 2008 until eradicated

Any *S. densiflora* found on this site will be manually removed to complete the eradication. Regrowth from mature treated plants will be dug out, and any seedlings will be pulled and disposed off site.

Monitoring Needs

Early season control work means that an additional survey will need to be conducted at the end of the growing season to verify that no additional seedlings have emerged, and that no small plants were overlooked on the site during control efforts. This monitoring may be conducted by either arm of the ISP, the Monitoring Program or the Control Program. With the small size of the Starkweather Park sub-area, any plants discovered during a survey can be immediately removed to improve efficiency. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23M: NOVATO

Sub-Area Partners

Owner(s): State Lands Commission
Manager(s): City of Novato
Grantee(s): CWF

Sub-Area Description

This sub-area is comprised of a 180-acre remnant marsh in southwestern San Pablo Bay bordered to the north by the Hamilton Wetland Restoration Project at the decommissioned Hamilton Air Force Base in the City of Novato. This marsh is part of an intact tidal marsh complex that continues south 1.6 km to Gallinas Creek and the northern edge of the ancient, relatively-unaltered China Camp Marsh. It is a broad 300 m-wide pickleweed (*Sarcocornia pacifica*) marsh with well-developed channels and a wide fringe of *S. foliosa* meadow along the bayfront below the marsh plain scarp. A manmade channel runs parallel to the north-south levee on the western edge of the marsh.

The infestation on this site consists of two large, expanding clones of hybrid *S. alterniflora* near the bayfront on the eastern side of the marsh, surrounded by pioneering small clones and individual plants scattered across several acres of the marsh plain. The first imazapyr application was conducted in 2007 utilizing backpack sprayers, covering approximately 3000 ft^2.

Treatment was conducted at the optimal time in 2007, when the plants were healthy and green and still in flower. If efficacy is high, the first application could have reduced the infestation by 75-80% or more. It is expected that less than 500 ft^2 will need retreatment in 2008, and that any necessary follow up in 2009 or beyond should be minimal.

Treatment Strategy, Methods, and Timing

Method: Imazapyr treatment (primary)

Equipment: Backpack sprayer; Large wooden boards to cross the western channel
Airboat (possible for access from the water at low tide)

Timing: Treatment should occur between July 15 and September 15
Annual beginning in 2008 until eradicated

The major issue at this site is accessing the infestation area for treatment. Despite access from the water being the easiest, the marsh must be approached on the ground on an appropriate low tide, which would preclude an approach over the mudflats by a standard boat. Access by ground involves crossing the 10 m-wide channel that runs along the north-south levee to reach the western marsh plain. Fortunately, this endeavor is possible using wooden boards brought to the site by the contractor and positioned strategically to allow the crew to cross the soft mud of this deep manmade channel. A pre-loaded backpack sprayer(s) will be carried across to conduct the imazapyr application on the remaining hybrid *Spartina*. The restoration work at Hamilton Field began over the winter of 2007-2008, and the road used to access this site has been altered. If the treatment crew cannot access the site by land as they did in 2007, an airboat should be used to access from the bay at low tide (to provide the necessary dry time).

Monitoring Needs

Detailed monitoring maps of the site need to be created prior to treatment to use for planning the scope of the application and to limit the surveying required of the treatment crew. Since all of the treatment materials must be transported across the channel described above, the treatment contractor must have an accurate accounting of the application area to bring the appropriate amount of materials. In addition, a comprehensive survey of the marshes south of the site down to China Camp needs to be conducted since these systems are contiguous to this infestation that has been expanding for several years and presumably dispersing seed.

An expansion of genetic testing is needed at this site because of some suspect plants discovered during treatment in 2007. The upper elevation plants of the bayfront *S. foliosa* meadows are noticeably taller than the adjacent plants, and have a very similar appearance to the confirmed hybrid *Spartina* treated at the site. These taller plants could be cryptic hybrids, which would greatly expand the known infestation at this site and require a much larger treatment effort. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

SUB-AREA 23N: TRIANGLE MARSH & SHORELINE

Sub-Area Partners

Owner(s): State Lands Commission, Marin Audubon Society, Marin Country Day School and Marin Montessori School (adjacent landowners/stakeholders)
Manager(s): Marin Audubon Society, Marin Country Day School, and Marin Montessori

Grantee(s): CWF

Sub-Area Description

Triangle Marsh is a 13-acre slice of remnant tidal marsh north of Paradise Drive in the Town of Corte Madera. The site was purchased by Marin Audubon Society in 2000 and has undergone ecological restoration with funding from Caltrans to remove fill, grade and contour areas to the appropriate marsh elevations, and planting the upland areas with natives. The salt marsh was quickly colonized by native plants such as pickleweed (*Sarcocornia pacifica*), gumplant (*Grindelia stricta*), and *Spartina foliosa*, but is still very vulnerable to invasion. This site extends 400 meters along the shoreline to the east to include the thin fringe marsh adjacent to Marin Country Day School and a small, one acre block of marsh at Marin Montessori School.

This site has several pioneering clones that have recently colonized three nodes within the area. Only one cryptic hybrid *Spartina* clone has been identified and confirmed within Triangle Marsh itself, and it is located on the eastern corner where the marsh narrows to a thin shoreline strip. The second area of infestation is adjacent to the Marin Country Day playfield, where several hybrid clones were located on the shoreline approximately 100 meters west of the dock and parking lot. Finally, there were two species of invasive cordgrass in the Marin Montessori marsh, one plant of *S. densiflora* and two larger clones of hybrid *S. alterniflora*. The Triangle Marsh plant was just confirmed as a hybrid in winter 2007, and has not yet been treated. The rest of the non-native *Spartina* on the site was treated with imazapyr for the first time in 2007, using a backpack sprayer.

The plants treated in 2007 may have some regrowth, but should be significantly reduced in size if not eliminated. Including the untreated plant in Triangle Marsh, there is less than 500 ft^2 of invasive *Spartina* within this site.

Treatment Strategy, Methods, and Timing

Method:	Imazapyr treatment (primary) Manual removal (follow-up in appropriate substrate)
Equipment:	Backpack sprayer Shovels or similar tools
Timing:	Treatment should occur between July 15 and September 15 Annual beginning in 2008 until eradicated

An applicator will return to this site in 2008 and treat the invasive *Spartina* on this site with imazapyr using a backpack sprayer. If the *S. densiflora* has regrowth from 2007 treatment, or there are seedlings of this species found, they may be removed manually to expedite the process. Manual means may be used to complete the eradication on this site once the plants have been reduced to an appropriate size to make this effort feasible. Any plants removed manually will be disposed off site.

Monitoring Needs

In light of the discovery of a cryptic hybrid on the site in 2007, Triangle Marsh needs to be surveyed more comprehensively accompanied by an expansion in the genetic testing of the *Spartina* on the site. Monitoring will continue until a minimum of three years of no non-native *Spartina* is reached.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Marin Outliers, Marin County, TSN: ISP-2005-23, 2005-2007 Control Seasons, May 2005), and are incorporated by reference into this update plan.

The original 11 sub-areas remain as defined in that plan, and four new sub-areas have been added. The new sub-areas are in the vicinity of the existing sub-areas, and are similar in physical and ecological character. There have been no new species or other significant environmental factors identified at the existing or new sub-areas.

Even with the addition of the new sub-areas, the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007. As a result, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 24: PETALUMA RIVER, MARIN AND SONOMA COUNTIES

This plan updates and appends the original site specific control plan for this site (Invasive *Spartina* Control Plan for Petaluma River, Marin and Sonoma Counties, TSN: ISP-2007-24, 2007 Control Season) dated May 2007. All four sub-areas are the same as defined in that plan, and no new species or other factors have been identified. The work described in this plan will continue and potentially complete the work initiated in 2007.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the State Coastal Conservancy directly to one or more project partner. The grant recipient for this site is:

Friends of Petaluma River, PO Box 4928, Petaluma, Ca. 94955, *David Yearsley, Executive Director, (707) 763-7756.* Friends of the Petaluma River is a non-profit organization dedicated to celebrating and conserving the Petaluma River, its wetlands, and wildlife. Friends' mission is to promote stewardship of the Petaluma River with work throughout its watershed; providing access opportunities, educational materials, and conservation programs. Friends also provides a voice for the River's inhabitants and resources in public affairs. Friends has developed extensive contacts with user groups and private and public landowners throughout the watershed.

Site Description

Map Site 24: Petaluma River includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

24a Upper Petaluma River- Upstream of Grey's Field Map

24b Grey's Field Map

24c Petaluma Marsh Map

24d Lower Petaluma River-Downstream of San Antonio Cr Map

The area encompassed by this Site-Specific Plan includes approximately 4,500 acres of marshland and riparian habitat within the Petaluma River Watershed. The City of Petaluma, at the confluence of the Petaluma River and Lynch Creek, forms the northern boundary of this plan, with San Pablo Bay forming the southern boundary at the mouth.

This site consists of a complex mosaic of historic tidal marsh habitat, developed shoreline, brackish tidal riparian edge zones, maintained pastureland, restoration sites, light industrial facilities and urban development. The largest component of this site is the 3,900-acre Petaluma Marsh, one of the largest historic tidal marshes in the entire Estuary.

The pioneering infestation of *Spartina alterniflora* hybrids in the Petaluma River complex is still very limited in its distribution. The majority of the infestation is located adjacent to a dredging and barge dock facility just downstream of Highway 101 south of Petaluma, with scattered infestations located upstream and downstream this central core. In sum, these infestations cover approximately 0.2 acres scattered over this very large marshland complex, which is equal to less than 0.01% of the area.

Treatment Approach

The treatment approach for all sub-areas is described below. Sub-areas with significant similarities have been grouped together.

SUB-AREA 24A: PETALUMA RIVER - LYNCH CREEK CONFLUENCE TO GREY'S FIELD

Sub-Area Partners

Owner(s): State Lands Commission, City of Petaluma
Manager (s): State Lands Commission, City of Petaluma
Grantee(s): Friends of the Petaluma River

Sub-Area Description

This sub-area of the Petaluma River Complex is centered around the City of Petaluma, and much of this area is heavily developed shoreline with rip-rapped or filled riverside. There is heavy and light industry in the area, as

well as commercial districts, docks and marinas, and an overpass for Hwy 101. The northern portion of the property is defined by the confluence of the main river system and Lynch Creek, and the southern boundary is at the northwestern end of the restoration marsh known as Grey's Field. A portion of this area includes Schollenberger Park, a newly restored wetland within the City of Petaluma.

Treatment in 2007 involved the use of an airboat to access the clones along the shoreline of the river. Applicators used the onboard spray equipment to apply imazapyr herbicide to the target plants. This was the first season of treatment on the river, and efficacy estimates of the treatment will be done in the late spring of 2008.

As of winter 2007, the infestation in this marsh has not changed since the original site plan for this site was written. The riverside habitats contained in this sub-area are very lightly infested, with only scattered *Spartina alterniflora* hybrid clones dispersed at specific spots along shoreline. Clones have been identified at the docks in Petaluma near the Shamrock and Pomeroy facilities, near the Petaluma Marina, and along both banks of the river in the Schollenberger Park area near Haystack. There is an estimated 0.1 acre of *Spartina alterniflora* hybrids within Sub-Area 24a, or less than 0.01% of the marsh.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Boat
Backpack sprayers

Timing: June-July start time for ground-based treatments

Early season treatment of actively growing plants is the optimal timing scenario to insure proper uptake of the herbicide into the plant tissue. Therefore, a June-July start time is preferred. Treatment will utilize boats to access the clones scattered along the edges of the river, and applicators will target non-native *Spartina* clones where they are identified using either backpack sprayers or onboard spray equipment.

Monitoring Needs

Monitoring throughout the Petaluma River site should involve extensive ground-based surveys using GPS units to map the locations of the plants in this area. As this infestation was only discovered in 2007, there is a need to collect genetic samples throughout the site for analysis. Genetic and GPS sampling results will determine the extent to which control work at the site will occur in future control seasons.

SUB-AREA 24C: PETALUMA MARSH

Sub-Area Partners

Owner(s): California State Lands Commission
Manager (s): California State Lands Commission
Grantee(s): Friends of the Petaluma River

Sub-Area Description

For the purposes of this plan, the Petaluma Marsh sub-area encompasses the roughly 4000 acres of marshland located from the southern end of the restoration marsh called Grey's Field in the north to the outlet of San Antonio Creek in the south. This area includes all marshlands on both sides of the Petaluma River. The largest portion of this sub-area is the Petaluma Marsh proper, the largest intact marsh system in the San Francisco Bay Estuary. This marsh contains numerous sloughs, pans, small channels, mid-marsh vegetation and other habitats.

Treatment of the few clonal patches within Petaluma Marsh was completed in late September of 2007. All clones were accessed via airboat, and treated using imazapyr herbicide applied via the spray equipment mounted on the airboat. Treatment occurred too late in the season for efficacy estimates to be made in 2007. Efficacy assessments for the treatments in this marsh will be completed in late spring 2008.

As of winter 2007, the infestation in this marsh has not changed since the original site plan for this site was written. This area of marsh contains roughly 0.1 acre of *Spartina alterniflora* hybrids along the main river channel, representing less than 0.01% of Sub-Area 24c. The infestation is scattered in only a few locations, in discrete clonal clumps.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Boat
Backpack sprayer

Timing: June-July start time for ground-based treatments

Early season treatment of actively growing plants is the optimal timing scenario to insure proper uptake of the herbicide into the plant tissue. Therefore, a June-July start time is preferred. Treatments will use boats to access the clones scattered along the edges of the river, and applicators will target non-native *Spartina* clones where they are identified using either backpack sprayers or onboard spray equipment.

Monitoring Needs

Monitoring throughout the Petaluma River site should involve extensive ground-based surveys using GPS units to map the locations of the plants in this area. As this infestation was only discovered in 2006, there is a need to collect genetic samples throughout the site for analysis. Genetic and GPS sampling results will determine the extent to which control work at the site will occur in future control seasons.

SUB-AREA 24B AND 24D: GREY'S FIELD, LOWER PETALUMA RIVER: SAN ANTONIO CREEK TO RIVER MOUTH

Sub-Area Partners

Owner(s): California State Lands Commission
Manager (s): California State Lands Commission
Grantee(s): Friends of Petaluma River

Sub-Area Description

Sub-Area 24b is located downstream of Shollenberger Park on the east side of the Petaluma River and includes the area on the east side of the river known as Grey's Field. This marsh area is a newly restored brackish tidal wetland, with wide, shallow, unvegetated mudflats encompassing some 150 acres. The majority of vegetation establishment at this site is still confined to the edges of the marsh.

Lower Petaluma River (Sub-area 24d) is a 225-acre stretch of riverside salt marsh habitat from the confluence of the Petaluma River and San Antonio Creek to the mouth of the river. Within this area are large sloughs such as Black John Slough and wide marsh areas extending back from the river's edge to the cultivated farmland beyond.

No treatment has occurred on either Gray's Field or along the Lower Petaluma River since there are no known infestations of non-native *Spartina* in these sites.

Current field survey results and genetic analysis of samples taken from Grey's Field indicate no non-native *Spartina* within this marsh area, or within the Lower Petaluma River. The description of treatment options and strategy within this section are provided in the event that non-native *Spartina* is identified in this marsh during the 2008 treatment season.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application

Equipment: Boat
Backpack sprayers

Timing: June-July start time

Should any non-native *Spartina* plants be identified in these two sub-areas of the Petaluma River site, they will likely be small and scattered populations even smaller than those found in the other two sections of the site. Treatment work will follow the strategy outlined for those sites, namely boats used to access the clones, where either on-board spray equipment or backpack sprayers will be used by applicators to apply imazapyr herbicide to the target plants. Work will have optimal efficacy if done during the active growing phase of the plant's life history, starting in June or July of each year.

Monitoring Needs

Careful monitoring by boat or via accessible pathways contiguous to these marsh areas will be necessary each year through 2010 to catch the appearance of any new clones that seek to colonize these otherwise uninfested marsh areas. To the extent that hybrid *S. alterniflora* plants are found, these marshes should be sampled for genetic analysis to determine the extent of the infestation, and where to look for additional hybrid plants in the marsh.

Environmental Compliance

Complete environmental compliance information, analyses, and mitigations were presented in the original control plan for this site (Invasive *Spartina* Control Plan for Petaluma River, Marin and Sonoma Counties, TSN: ISP-2007-24, 2007 Control Season), and are incorporated by reference into this update plan.

All sub-areas are the same as defined in that plan, and no new species or other significant environmental factors have been identified. Because the area of invasive *Spartina* slated for treatment in 2008-2010 is significantly less than the area treated in 2005-2007, any potential environmental impacts resulting from treatment are expected to also be less, and thus there are no new or increased impacts.

Updated Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists have been provided in Attachment 2.

SITE 26: NORTH SAN PABLO BAY, NAPA AND SOLANO COUNTIES

This is the first control plan created for this newly-discovered *Spartina*-invaded site. This site is very similar in nature to some other ISP sites (e.g., Site 24 – Petaluma River and Site 23 – Marin Outliers), and there are no new species of concern or other significant environmental factors that were not previously evaluated in site-specific control plans. The work described in this plan will initiate and potentially complete control at the indicated locations.

Background

In 2001, the California State Coastal Conservancy (Conservancy) established the San Francisco Estuary Invasive *Spartina* Project (ISP) to coordinate San Francisco Bay Estuary-wide control of non-native, invasive *Spartina* (cordgrass) species. Regional *Spartina* control efforts prior to the inception of the ISP were scattered, with limited communication between affected landowners. As part of the ISP's Bay-wide approach, a Programmatic Environmental Impact Report/Environmental Impact Statement (PEIR/S) was developed, which was finalized in October of 2003.

This Invasive *Spartina* Control Plan ("Site-Specific Plan" or SSP) for the North San Pablo Bay Complex, Solano and Napa Counties, 'tiers' off of the PEIR/S, and includes background and site information, site-specific goals, treatment strategy, and a description of potential impacts of treatment. The SSP was prepared by consultants of the ISP, in collaboration with the project partners listed below. The SSP also specifies actions or practices ("mitigations") necessary to implement the plan with the least possible adverse environmental impact, in compliance with the ISP's PEIR/S and all applicable regulatory requirements. The SSP will be implemented by the project partners, with assistance from the ISP, beginning in the summer of 2008.

Consistent with the ISP's regional strategy, the SSP was developed based on the concepts of Integrated Vegetation Management (IVM), whereby a broad range of site-specific factors were considered to determine the optimal combination of treatment methods (manual, mechanical, and chemical) and strategies for use at the site. The SSP may be modified over time as new scientific information becomes available, and based on site-specific conditions.

Site Partners

Part or all of the work planned at this site will be implemented with grant funding provided by the Conservancy directly to the project partner. The grant recipient for this site is:

California Department of Transportation (CalTrans), District 4, 111 Grand Ave, Oakland, CA 94612, *510-286-4444*. CalTrans was responsible for the use of White Slough for mitigation, and coordinated the planting within the marsh. The ISP will work with CalTrans to determine the origin of the non-native *Spartina* in the slough, and to gain access to the site for treatment activity.

US Fish and Wildlife Service, San Pablo Bay National Wildlife Refuge, 7715 Lakeville Hwy, Petaluma, A 94954 , *Christy Smith (707) 769-4200, christy_smith@fws.gov*. The Fish and Wildlife Service owns much of the shoreline of San Pablo Bay. The ISP will work with the USFWS to coordinate control work, monitoring and access to the shoreline areas infested with non-native *Spartina*.

California Wildlife Foundation, 1212 Broadway, Suite 840, Oakland, CA 94612; *Steve Dunn, Administrator, (510) 268-1828, sdunn@californiawildlifefoundation.org.* The California Wildlife Foundation (CWF) is an independent 501(c)3 nonprofit organization founded in 1990 to support the programs of the California Department of Fish & Game and the Wildlife Conservation Board, with the mission of protecting the state's wildlife species and ensuring sustainable habitat as a public trust resource. CWF will receive and manage grant funds to implement *Spartina* Control Plans on all sub-areas in the Marin Outliers complex.

Site Description

Map Site 26: North San Pablo Bay Complex includes the following sub-areas, which are shown in Attachment 3, "*Spartina* Control Site Maps":

26a* White Slough/Napa River **Map**
26b* San Pablo Bay NWR & Mare Island **Map**

* Sub-area added since the 2005-2007 *Spartina* control plans

The complex includes approximately 5,500 acres of historic marshland, restored marshland, riparian habitat and developed shoreline within the Napa River Watershed and along the northern shoreline of San Pablo Bay (see Attachment 3, "*Spartina* Control Site Maps"). The Cities of Vallejo and American Canyon have tidal marsh property within this complex, as does the US Fish and Wildlife Service within the San Pablo Bay National Wildlife Refuge and the US Navy at Mare Island.

The pioneering infestation of *Spartina alterniflora* hybrids in the North San Pablo Bay complex is still very limited in its distribution. The infestations within this part of the Bay are limited to the shoreline of Mare Island and within the new marsh at White Slough. The combined total cover of these two infestations is less than 0.2 acre, which represents much less than 0.01% of the overall marsh habitat within the North San Pablo Bay. Individual Sub-Area descriptions of the infestation in the Petaluma River Complex are provided in Section 6 of this document.

Treatment Approach

The following sections provide details for each sub-area, including a description of the site and infestation and treatment plans for 2008-2010.

SUB-AREA 26A: WHITE SLOUGH AND THE NAPA RIVER

Sub-Area Partners

Owner(s): CalTrans
Manager (s): CalTrans
Grantee(s): CWF

Sub-Area Description

There are two main portions of this sub area: the restoration site on the east side of the Napa River called White Slough, in Vallejo, and the marshes along the shorelines of the Napa River to its mouth in the Bay. The White Slough area is the only known area where non-native *Spartina* grows within this sub-area.

White Slough marsh is a roughly 135-acre restored tidal marsh that lies to the east of Highway 37 and west of Sonoma Boulevard in the city of Vallejo. The marsh is a sparsely vegetated tidal marsh in the initial stages of colonization. The majority of the area is open mudflat with tidally inundated low sections. The periphery of the marsh is composed of scattered pickleweed (*Sarcocornia pacifica*), non-native *Spartina*, and alkali bulrush (*Bolboschoenus maritimus*).

The other marsh areas included in this sub-area are those within the large section of the Napa River area downstream of Highway 12 and extending to the Carquinez Straits. This large area of restored and historic tidal marsh, developed shoreline, industrial and military facilities is currently uninfested with non-native *Spartina*. However, ongoing monitoring in the area may result in the discovery of new stands requiring control.

The infestation in this marsh is in the very early stages of colonization, and is located only in the western, northern and eastern edges of the marsh in scattered small patches. The clonal individuals have not coalesced to any real extent, and there is very little marsh vegetation otherwise in the marsh.

Treatment Strategy, Methods, and Timing

Method: Imazapyr herbicide application
Digging
Covering

Equipment: Truck-mounted sprayers
Backpack sprayers
Shovels and other digging equipment
Geotextile fabric

Timing: Annual treatment until eradicated
June start time

The objective for the 2008-2010 treatment plan is to treat and eradicate all *S. alterniflora* hybrid plants within the White Slough marsh area. After initial treatment in 2008, these areas and all other areas within the Napa River

area will be monitored for treatment efficacy and additional *Spartina* locations by the ISP's Mapping and Monitoring Program.

The ISP determined the appropriate treatment methods for the site based on evaluation of site conditions and other factors such as treatment method efficacy, impacts to sensitive marsh habitat, cost of treatment, hazards to personnel, and required follow-up. The proximity of most of the *Spartina* plants to sensitive marshland and endangered species habitat, and the scattered distribution of the infestation, indicate that the most appropriate treatment method is via the application of an aquatic herbicide formulation (either imazapyr or glyphosate). At some locations, digging of small, individual clones may be undertaken. Covering strategies may also be employed where the structure of the infested area will enable long-term placement of covering fabric without the threat of wave energy displacing the material.

Treatment of all known locations of *S. alterniflora* hybrids will begin in June 2008, when the plants are actively growing and most susceptible to herbicide treatment. Truck-mounted sprayers will be used where access to the infestation is possible along levees or maintenance roads. The remaining scattered *Spartina* patches that are accessible on foot will be treated using backpack sprayers, with the applicator walking the marsh to apply the herbicide. Details of application methods are as described in the final programmatic EIS/EIR.

All herbicide applications will be done during low tide to allow adequate coverage and dry time. A detailed treatment schedule will be completed prior to the initiation of work.

All personnel in the marsh for treatment operations will be trained in endangered species recognition and in general marsh safety. All herbicide applications will follow the herbicide label and Material Safety Data Sheets (MSDS) for the product(s) used. All ISP partners and contractors must prepare and implement a suitable Spill Prevention and Response Plan prior to and during treatment.

SUB-AREA 26B: SAN PABLO BAY NATIONAL WILDLIFE REFUGE AND MARE ISLAND

Sub-Area Partners

Owner(s): USFWS
Manager (s): USFWS
Grantee(s): USFWS

Sub-Area Description

The San Pablo Bay National Wildlife Refuge lies along the north shore of San Pablo Bay in Sonoma, Solano, and Napa Counties. The refuge includes open bay/tidal marsh, mud flats, and seasonal and managed wetland habitats.

The Napa-Sonoma marshes in San Pablo Bay have been greatly impacted by human activities such as hydraulic mining, salt production, water diversions, and diking, draining, and filling for agricultural and industrial uses. About 85 percent of the historic tidal marshes of San Pablo Bay have been altered, negatively affecting the ability of the remaining tidal marshes to accept winter rainfall and purify water in the bay.

The refuge provides critical migratory and wintering habitat for shorebirds and waterfowl, particularly diving ducks, and provides year-round habitat for endangered, threatened, and sensitive species like the California clapper rail, salt marsh harvest mouse, California black rail, San Pablo song sparrow, and Suisun shrew.

Mare Island is the site of the Mare Island Naval Shipyard, located to the west of the City of Vallejo. The areas under consideration in this plan are those around the tidally-influenced periphery of the island, where tidal marsh vegetation is able to grow. A main area of focus is the southwestern edge of the island (or peninsula) where a broad band of mixed pickleweed and *Spartina* marsh extends westward toward the Sonoma River mouth from the mouth of the Carquinez Straits. This broad area is roughly four miles long and 1-1.5 miles wide in spots, and blends into the San Pablo Bay National Wildlife Refuge to the east.

The infestations of non-native *Spartina* within the Refuge are thus far limited in distribution. However, there are two separate species of non-native *Spartina* in the marshes along the southern shoreline of Mare Island. *Spartina densiflora* has formed a small colony on the bayfront edge of the marsh roughly due west of the USGS facility on Mare Island. The *Spartina alterniflora* hybrids are located along the western portion of the Mare Island shoreline roughly 1.6 miles to the northwest of the *S. densiflora* infestation, and consist of a few clonal patches in an otherwise native marsh system.

Treatment Strategy

Method:	Imazapyr herbicide application
Equipment:	Shallow-bottomed boat Backpack sprayers
Timing:	Annual treatment until eradicated June start time

The objective for the 2008-2010 treatment plan is to treat and eradicate all non-native *Spartina* stands along the shoreline of the North San Pablo Bay. Inventory and efficacy monitoring of all of the marshlands of the area will be done on a yearly basis to assure that the current infestations have been controlled and that no new infestations develop in other areas of the North San Pablo Bay area.

The ISP determined the appropriate treatment methods for the site based on evaluation of site conditions and other factors such as treatment method efficacy, impacts to sensitive marsh habitat, cost of treatment, hazards to personnel, and required follow-up. The non-native *Spartina* distribution within this marsh is of very limited distribution and size. The locations of these infestations (in sensitive marshland and potential endangered species habitat), and the small size of the infestation, indicate that the most appropriate method for controlling the *Spartina* infestation on this site is via the application of an aquatic herbicide formulation (either imazapyr or glyphosate). This herbicide will be applied using a shallow-bottomed boat equipped with spray apparatus in areas accessible from the shoreline, or by crews fitted with backpack sprayers and walking through the marsh. All herbicide applications will be done during low tide to allow adequate coverage and dry time. A detailed treatment schedule will be completed prior to the initiation of work.

All personnel in the marsh for treatment operations will be trained in endangered species recognition and in general marsh safety. All herbicide applications will follow the herbicide label and Material Safety Data Sheets (MSDS) for the product(s) used. All ISP partners and contractors must prepare and implement a suitable Spill Prevention and Response Plan prior to and during treatment.

Environmental Compliance

In addition to outlining the proposed approach for controlling *Spartina* at the subject site, this Site-Specific Plan also provides documentation and analysis in compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), tiering off of the ISP's Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR; 2003) and Addendum (2005). The PEIS/EIR assessed the overall need of the *Spartina* control project and analyzed the potential effects of implementing treatment methods for the regional program and identified the mitigation measures that would be applied to each action to reduce or eliminate impacts at treatment locations. The 2005 Addendum evaluated a new herbicide, imazapyr, and determined that it posed no additional or increased risks to the environment above what had been evaluated in the PEIS/EIR. This document considers the need for the work in light of the regional program and potential cumulative effects, and specifies the treatment methods to be used and the required site-specific mitigations. This material is provided to assist the State Coastal Conservancy and local responsible agencies to reach their own conclusions on whether and how to approve a project within their jurisdiction.

Additional environmental assessment necessary for compliance with Section 7 of the Endangered Species Act is provided as a separate document.

DETERMINATION OF ECOLOGICAL THREAT /PURPOSE AND NEED FOR PROJECT

The North San Pablo Bay Complex currently has a very sparse population of *S. alterniflora* hybrids and S. densiflora plants. The plants are located in a loosely centralized hub within a large, intact marsh system composed of native *S. foliosa* and associated brackish tidal marsh flora. Many of the marshes within this complex are home to healthy breeding populations of endangered California clapper rail. Control of *S. alterniflora* and *S. densiflora* within this complex will avoid increased hybridization between the *S. alterniflora* and *S. foliosa* species, eliminate the potential degradation of the habitat for the clapper rail, and remove a potential source of propagules from the still lightly-infested San Pablo Bay.

The loss of approximately 85 to 90 percent of the tidal marsh in the San Francisco Estuary as a whole has led to dramatic losses of fish and wildlife in tidal marsh habitat, decreased water quality and increased turbidity in the

Bay. As part of the region-wide effort to restore habitat lost in the Estuary, restoration efforts are being undertaken by various groups within the Napa River watershed and within San Pablo Bay. The many marshes near the mouth of the Napa River are just such an effort to restore habitat value to the San Francisco Estuary, and these sites are directly threatened by the presence of non-native *Spartina* along the Mare Island Shoreline and at adjacent sites. Since many of these restoration sites are currently lightly vegetated, they are highly vulnerable to invasion by non-native *Spartina* due to a lack of biotic resistance. It is essential to reduce this invasion potential by eradicating all of the small populations of invasive *Spartina* within the North San Pablo Bay Complex.

The two parent species of the hybrid (the native *S. foliosa* and non-native *S. alterniflora*) have little pollination timing overlap, so first generation crosses are infrequent. However, since the hybrids have a much wider range of flowering times, seeds produced by native plants that are in the vicinity of *S. alterniflora* hybrids are often hybrid themselves. These hybrid plants produce up to 21 times more pollen than the native *S. foliosa*, and with higher fertility. This superior hybrid pollen production serves to overwhelm the native *S. foliosa* in a process referred to as 'pollen swamping', resulting in native stands producing mostly hybrid back-cross seed. New stands of hybrid *Spartina* in proximity to *S. foliosa* can thereby act as a reproductive bridge between the species, quickly spreading the invasion around the Bay, and eventually converting any native *S. foliosa* stands to a range of hybrid forms. This hybrid assimilation could eventually lead to the extinction of the genetically pure native *S. foliosa* and the unique habitat values it produces. There are significant stands of currently intact native *S. foliosa* throughout North San Pablo Bay that could be assimilated into an untreated hybrid swarm.

These highly aggressive, invasive *Spartina* hybrids readily expand into new areas including tidal mudflats, recently restored marsh, and even into established *S. foliosa*/ pickleweed (*Sarcocornia pacifica*) stands in remnant native marsh. These invasions can have significant consequences for the plant communities of the marsh as well as the wildlife habitat they provide. *S. alterniflora* and its hybrids are able to survive in a much broader range of conditions than the native *S. foliosa*, including areas of the marsh below which other vascular plants are absent due to submergence intolerance, high wind and wave energy environments, and other environmental factors. The result is the conversion of tidal mud flats into invasive cordgrass meadows and the elimination of critical foraging habitat for migratory shorebirds on the Pacific Flyway, as well as residents such as the endangered California clapper rail (*Rallus longirostris obsoletus*). The permanent alterations to the existing native plant communities of the salt marsh may also serve to preclude the recovery of other threatened and endangered species in the Bay.

Tidal sloughs and channels can become choked with invasive cordgrass and the associated excess trapped sediment can have significant consequences both ecologically and in regards to drainage and flood control management. Invasive *Spartina* will impede the movement of fish and wildlife using these marsh corridors, and increase the need for regular dredging and vegetation management to prevent upstream flooding due to the impediments to efficient stream discharge. In addition, the substantial plant biomass produced by invasive *Spartina* becomes floating debris (wrack) in the winter. Massive deposits of this material can clog tidegates and other water control structures (thereby increasing annual maintenance costs), and can also smother areas of the high salt marsh.

PROJECT ALTERNATIVES AND POTENTIAL IMPACTS

No Action Alternative

The No Action Alternative (NAA) would not implement coordinated treatment in an effort to control non-native *Spartina* on the Sub-Areas included within this Site-Specific Plan. The property owners of each of the sites would manage the infestation when personnel availability, political will, and funding allowed. The scope, extent and persistence of these measures are not known.

ISP monitoring of the pre-treatment populations of *S. alterniflora* around the Bay over the period from 2001-2003 showed significantly increasing rates of expansion within the three-year scope of the monitoring project. For *S. alterniflora* hybrids, the Bay-wide mean expansion rate was found to be 317% over that period. Given the vigorous expansion of the hybrid population of *S. alterniflora* in the Estuary, it is likely that the current infestation, left uncontrolled, could grow and come to dominate areas of the North San Pablo Bay Complex within the next 10 years, resulting in losses to wetland functions and values over many acres of marsh. Such a rapid change in the structure and function of these marshland areas will almost certainly result in decreased habitat value, increased sedimentation, clogged channels and other significant impacts.

Proposed Action (Treatment Plan)

The proposed action for this 5,500-acre site is to treat the 0.1-acre area of non-native *Spartina* with land and boat applications of aquatic herbicide and by digging and/or covering. Applying estimated treatment efficacy and *Spartina* expansion rates, this will comprise treating the entire 0.1 acre the first year, and any remaining or newly discovered stands in the following year. It is anticipated that in 2009, very little non-native *Spartina* will remain in this area requiring control. The proposed action for each sub-area is presented in the "Treatment Approach" section above.

In compliance with the ISP's Final PEIS/EIR Mitigation, Monitoring, and Reporting Plan, each sub-area of this site was evaluated to determine potential site-specific impacts and necessary mitigation and conservation measures[3]. This evaluation is attached as Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists (Attachment 2).

Additional, detailed assessments of potential impacts to special status species, cultural resources, visual resources, adjacent land uses, and water quality follow:

Special Status Species: The ISP PEIS/EIR identified a number of species that might be found within areas where invasive *Spartina* treatment sites are located. Site-specific evaluation determined that the following 12 species are present or potentially present within both sub-areas: salt marsh harvest mice, Suisun shrew, California clapper rail, California black rail, Suisun song sparrow, salt marsh common yellowthroat, winter or spring-run Chinook salmon, steelhead, delta smelt, Sacramento splittail, soft bird's beak, and Suisun thistle. San Pablo song sparrow is expected to be present only at sub-area 26b.

Because of the extremely small area requiring treatment within the site, it was readily determined that potential impacts to these species were less than significant (i.e., the project is not likely to cause adverse affects) after implementation of mitigations specified in Attachment 3.

Special status species not expected to be present at either site include salt marsh wandering shrew, harbor seal, western snowy plover, California least tern, Alameda song sparrow, Coho salmon, California red-legged frog, San Francisco garter snake, and California sea blite.

Cultural Resources: The North San Pablo Bay site will be submitted to the US Department of the Interior, Fish & Wildlife Service Cultural Resources Team (CRT), Sherwood, Oregon in 2007, as appropriate, for Section 106 review. It is expected that CRT will apply "Appendix B" determination to the North San Pablo Bay site, after conducting field surveys on the site.

The appearance of cultural resource properties can seldom be predicted with certainty. There is the potential for subsurface deposits in this project location. Should any cultural deposits be encountered during any phase of the project, work shall halt and the CRT office will be notified. The Regional Archaeologist, or other similarly qualified individual, will be asked to make an assessment of the deposits before work may resume in the area of discovery.

Visual Resources: The potential impacts to visual resources were found to be insignificant at all of the Sub-Areas of the North San Pablo Bay complex. A small fraction of the areas of marsh vegetation (a maximum of 0.01%) will be treated; it is unlikely that members of the public will be concerned about this amount of dead vegetation, especially since it will coincide with the natural autumn senescence of the marsh plants. Although ISP signage has been developed to educate the public about *Spartina* invasion and control in the San Francisco Estuary, permanent/long-term signs will probably not be utilized, due to the lack of a central infestation and the scattered nature of the many treatment areas. Individual sub-area mitigations are included in Section 6 of this document.

Adjacent Land Uses: Sub-Area 26a is bordered by residential development and a public-use bike path while Sub-Area 26b is not open to public access and former military housing and facilities are located approximately 0.5 mile to the east of the infestations. Therefore, there will be very little opportunity for the *Spartina* control work in these salt marshes to come into contact with the public, with the main source being incidental viewing from boats on the Bay.

[3] The evaluation addressed 12 general categories including geomorphology and hydrology, water quality, biological resources, air quality, noise, human health and safety, visual resources, land use, cultural resources, socioeconomics, and environmental justice, and also considered potential cumulative effects of this project when combined with other projects in the project area.

At both areas, the *Spartina* control methods to be implemented are very targeted, greatly reducing or eliminating the possibility of producing a negative environmental impact on adjacent lands as a result of the *Spartina* control work. Applicators following the proper protocols to mitigate impacts to the treatment site will simultaneously be reducing/eliminating impacts to adjacent lands. The following mitigations for potential adjacent land use impacts will be employed on-site as per the PEIS/R and the USFWS Programmatic Biological Opinion Conservation Measures (Attachment 3):

- Minimize drift according to ISP drift management plan (HS-3; CM-3, 4)
- Post appropriate signage a minimum of 24 hours pre-treatment (HS-3)
- Avoid scheduling herbicide application near high public use areas during weekends or holidays, or close public access to area 24 hours before and after treatment (HS-3)
- Maintain ISP or approved equivalent Site Safety and Spill Prevention plan on site (HS-4; CM-3, 4, 17)

Water Quality: Since aquatic areas such as the Bay allow for movement of water between sites, water quality issues in one area may translate into water quality issues at adjacent sites. Mitigations related to the actual application of aquatic herbicide formulations will be sufficient to avoid water quality impacts to adjacent areas because of herbicide breakdown or adsorption, as well as dilution from the large volume of the Bay. The other major water quality concern, related to spills, will be mitigated in the same manner for adjacent areas as on the treatment area itself. For both herbicide or petroleum spills, ISP has provided or approved a Spill and Containment Plan to mitigate the degradation of water quality from such an event.

The following possible water quality related impacts and their applicable mitigations have been identified for the site:

- Apply herbicide directly to plant at low tide and according to label (WQ-1; CM-3, 4)
- Apply under supervision of trained applicator (WQ-2; CM-3)
- Implement spill and containment plan provided or approved by ISP (WQ-2, 3; CM-17)

Conclusions: All treatment methods and approaches proposed for the site are consistent with those anticipated in the PEIS/R. All impacts caused by the treatment were identified for each sub-area in the Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists (Attachment 2), and in this document, and all appropriate mitigations have been identified. Any unavoidable impacts were among the significant and unavoidable impacts previously identified and approved in adoption of the ISP's PEIS/R (September 25, 2003).

REQUIRED PERMITS AND AUTHORIZATIONS

A number of state, regional, and local authorizations are needed to complete the proposed control work. Any permit requirements have been incorporated into the Site-Specific Impact Mitigation Matrix.

MITIGATION AND CONSERVATION MEASURES

Pursuant to the ISP PEIS/R, the project has been evaluated to determine potential site-specific impacts and necessary mitigation and conservation measures. The evaluation addressed 12 general categories including geomorphology and hydrology, water quality, biological resources, human health and safety, land use, and cultural resources, as well as other important environmental resources and values. This evaluation is attached as Site-Specific Project Impact Evaluation and Site-Specific Project Mitigation checklists (Attachment 2). All mitigations identified in the Site- Specific Project Mitigation checklist will be implemented and verified by the ISP Field Supervisor.

RESTORATION

The plan for controlling the non-native *Spartina* infestation on this site is targeted for selective control within the overall native marsh habitat. Adjacent stands of native pickleweed (*Sarcocornia pacifica*), gumplant (*Grindelia stricta*) Pacific cordgrass (*Spartina foliosa*), as well as other native tidal marsh plant species (*Bolboschoenus maritimus, Jaumea carnosa, Frankenia salina, Distichlis spicata, Limonium* spp., *Triglochin* spp., and others) will be avoided whenever possible. Subsequent to successful control, areas where non-native *Spartina* has been removed will offer patches of open marsh habitat for colonization by plant propagules present in the substrate and in the water column. The surrounding native tidal marsh plant population at this site as well as in this region of the Bay will serve to supply sufficient native propagules for natural vegetative recolonization of the site. It is not

anticipated that revegetation or other direct restoration efforts beyond the removal of non-native *Spartina* will be necessary to allow native marsh conditions to begin to re-establish here.

Replanting of native *S. foliosa* plugs or other methods within this area is not advised. A characteristic of *S. alterniflora* hybrids is their ability to produce copious amounts of hybrid pollen as well as overlap the flowering period of the native *S. foliosa*. If *S. foliosa* is planted in proximity to stands of hybrid *Spartina*, there is a significant potential for 'pollen swamping' of the *S. foliosa*, resulting in hybrid seed production by the native. Therefore, until such time as the non-native *Spartina* hybrids are eradicated or significantly reduced in distribution on this site, no *S. foliosa* plantings will be undertaken.

COMPLIANCE MONITORING AND REPORTING

The Project will comply with all applicable regulations and permits and will submit reports according to the requirements of the agencies. Monitoring for compliance with the statewide National Pollutant Discharge Elimination System (NPDES) permit will be completed according to the Water Quality Monitoring Plan (WQMP) developed by the ISP.

All data collected from this project will be reviewed by the ISP Monitoring and Data Assessment Team, and data and reports will be available on the ISP website (www.*Spartina*.org), and upon request.

A Quality Assurance and Control (QA/QC) protocol is incorporated into each site-specific plan to ensure that impacts to the marsh and surrounding environment are mitigated, and that the control work proceeds as planned and achieves its goals. The QA/QC protocol requires each ISP grant recipient and implementing partner to incorporate the Site-Specific Impact Mitigation Checklist directly into its treatment work plans. To assure proper implementation of the applicable mitigation and conservation measures, the ISP Field Operations staff will conduct frequent field visits during the *Spartina* control work.

By incorporating the Impact Mitigation Checklist into its work plan, the responsible ISP partner acknowledges the time, funding, and training of field staff that will be required to properly conduct the *Spartina* control work at its site. This advance preparation will help the partner to avoid and/or suitably mitigate potential impacts to the environment, and will provide a systematic checklist that field staff can follow as part of their project planning. Since the ISP partner must sign off on each mitigation and conservation measure as part of the development of their work plan and while implementing treatment activities, the ISP has the opportunity to assure that the mitigation requirements, and the reasoning behind them, are fully understood and that the partner is capable of implementing them on each site. ISP Field Operations staff will be on site or immediately available during each *Spartina* control event to provide technical assistance and oversight to the partner and contractors. The ISP Field Operations staff will intervene if an ISP partner or contractor fails to properly implement a mitigation and conservation measure, and will halt activities until the problem can be resolved.

Any failure to properly implement a mitigation or conservation measure will be reported to the ISP and to the Conservancy, who will initiate a consultation with the relevant regulatory agency (e.g., U.S. Fish and Wildlife Service or the Regional Water Quality Control Board) to determine an appropriate course of action. Actions in response to a failed mitigation or conservation measure may include implementation of additional mitigation measures by the implementing partner, and/or the issuance of a notice of violation to the implementing partner by one or more agencies. In addition, the Conservancy may choose to withhold payment of grant funding for work done in violation of a mitigation or conservation measure, whether or not the grantee was directly overseeing the work.