REPORT

Western Stege Marsh Restoration Project Monitoring Plan

University of California, Berkeley
Richmond Field Station
Richmond, California

August, 2004

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

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Executive Summary

Blasland, Bouck & Lee, Inc. (BBL) has prepared this Wetland Restoration Monitoring Plan (Monitoring Plan) on behalf of the University of California, Berkeley (UC Berkeley), in compliance with requirements to develop a monitoring plan to document post-remediation conditions in portions of the Richmond Field Station (RFS) Western Stege Marsh. The RFS is currently owned by the UC Regents for use by the UC Berkeley campus and is located at 1301 South 46th Street in Richmond, California. The Western Stege Marsh Restoration Project (WSMRP) site consists of areas remediated during Phases 1 and 2 of the RFS remediation. Monitoring of the WSMRP will commence following completion of final grading in disturbed areas. Monitoring is proposed to continue for 5 years, with monitoring efforts occurring in the late spring and early fall of each year. At the end of each monitoring year, UC Berkeley will submit a compliance monitoring report to pertinent regulatory agencies (i.e., U.S. Army Corps of Engineers [USACE], San Francisco District; U.S. Fish and Wildlife Service [USFWS]; Regional Water Quality Control Board [RWQCB], San Francisco Bay Region; and San Francisco Bay Conservation and Development Commission [BCDC]).

Decades of industrial use along the Richmond shoreline, dating back to the 1870s, resulted in impacted sediments in Western Stege Marsh. Remediation and restoration activities on the RFS are being conducted in compliance with the requirements of the RWQCB, Order Number 01-102. On September 4, 2003, USACE issued a Nationwide Permit 38 (NWP 38) to UC Berkeley to perform a portion of remediation activities ordered under RWQCB Order Number 01-102. Remediation activities in Western Stege Marsh are being conducted in phases and include 1) removal of soft sediments; 2) treatment of excavated sediment and soil, as necessary; 3) disposal of excavated materials; 4) backfilling the WSMRP with clean Bay Mud; 5) restoration of low-functioning/low-quality habitat at a ratio of 1.5 to 1 and of medium functioning/medium quality habitat at a ratio of 2 to 1; and 6) monitoring and management.

This Monitoring Plan is structured around standard field measurement techniques to enable UC Berkeley to measure various aspects of the WSMRP, identified as Project Standards, and document progress toward attainment of articulated Project Targets representative of Project Standards. Assessing progress of monitoring protocols developed herein also will allow UC Berkeley to adapt management strategies and institute Contingency Measures to continue advancement toward Project Targets. Meeting restoration goals will allow the project to meet requirements presented in NWP 38 conditions.

1. Introduction

1.1 Overview of Compliance Monitoring

Blasland, Bouck & Lee, Inc. (BBL) has prepared this Wetland Restoration Monitoring Plan (Monitoring Plan) on behalf of the University of California, Berkeley (UC Berkeley), in compliance with requirements to develop a monitoring plan to document post-remediation conditions in portions of the Richmond Field Station (RFS) Western Stege Marsh. Figure 1-1 is a site location map of the RFS. The Western Stege Marsh Restoration Project (WSMRP) site consists of areas remediated during Phases 1 and 2 of the RFS remediation. Figure 1-2 presents the approximate location of the WSMRP. Monitoring of the WSMRP will commence following completion of final grading in the disturbed areas. Monitoring is proposed to continue for 5 years, with monitoring efforts occurring in the late spring and early fall of each year, and baseline conditions being defined as those present in the WSMRP at Year 0. At the end of each monitoring year, UC Berkeley will submit a compliance monitoring report to pertinent regulatory agencies (i.e., U.S. Army Corps of Engineers [USACE], San Francisco District; U.S. Fish and Wildlife Service [USFWS]; Regional Water Quality Control Board [RWQCB], San Francisco Bay Region; and San Francisco Bay Conservation and Development Commission [BCDC]).

Remediation and restoration activities on the RFS are being conducted in compliance with the requirements of the RWQCB, Order Number 01-102 (RWQCB, 2001). On September 4, 2003 USACE issued a Nationwide Permit 38 (NWP 38) to UC Berkeley to perform a portion of remediation activities ordered under RWQCB Order Number 01-102 (RWQCB, 2001). Remediation activities in Western Stege Marsh are being conducted in phases and include 1) removal of soft sediments; 2) treatment of excavated sediment and soil, as necessary; 3) disposal of excavated materials; 4) backfilling the WSMRP with clean Bay Mud; 5) restoration of low-functioning/low-quality habitat at a ratio of 1.5 to 1 and of medium functioning/medium quality habitat at a ratio of 2 to 1; and 6) monitoring and management.

Use of protocols recommended in this Monitoring Plan will enable UC Berkeley to assess the relative success of the WSMRP and identify Contingency Measures, as necessary, that should be implemented to increase the likelihood of project success. Meeting restoration goals will allow the WSMRP to meet requirements presented in NWP 38 conditions.

1.2 Project Objectives

Objectives of the Monitoring Plan for the WSMRP are as follows:

- Quantitatively assess jurisdictional waters of the United States, including wetlands (waters/wetlands) functions within the WSMRP using a hydrogeomorphic (HGM) approach.

- Illustrate progress toward, or deviation from, proposed Project Targets as articulated by this Monitoring Plan.

- Provide appropriate agencies with information regarding restoration efforts.

- Initiate/trigger Contingency Measures, as necessary, to continue progress toward proposed Project Targets and Project Standards as articulated by this Monitoring Plan.

1.3 Project Location

1.3.1 Landscape Setting

The City of Richmond (Richmond) is located on the San Francisco Bay in western Contra Costa County, California, 11 miles north of the City of Oakland (Figure 1-1). Richmond is bordered by the City of San Pablo to the north, the City of El Cerrito to the south, central San Francisco Bay to the west, and the Berkeley Hills to the east.

Richmond is predominantly a mix of urban commercial, industrial, and residential land. Adjacent to Central San Francisco Bay, the shore is a mix of marsh, tidal mudflats, open slough channels, and coastal scrub and grasslands uplands.

1.3.2 Western Stege Marsh Project Location

1.3.2.1 Richmond Field Station

The RFS is owned currently by the UC Regents and operated by UC Berkeley, and is located at 1301 South 46th Street in Richmond, California (Figures 1-1 and 1-2). The RFS is bounded by Meade Street off Interstate 580 to the north, by Meeker Slough/Regatta Boulevard to the west, and by South 46th Street to the east. Stege Marsh comprises the tidal marsh areas that extend across the southern portion of the RFS and adjacent properties. The western portion of Stege Marsh (Western Stege Marsh) is located on the RFS. The East Bay Regional Park District (EBRPD) Bay Trail transverses the southern portion of Stege Marsh to create an inner and outer portion. Currently, Cherokee Simeon Ventures (CSV) owns the property to the east of the RFS and is in the process of redeveloping the property. This adjacent property was owned formerly by Zeneca, Inc. (Zeneca) and is referred to as the Zeneca Property (Figure 1-2).

Areal extent of the RFS is approximately 162 acres, of which approximately 90 acres are uplands, zoned industrial, and used primarily for research and education. Approximately 72 acres of marsh and tidal mudflats also exist in the southern portion of the RFS. Of these 72 offshore acres, approximately 9.4 acres are located within the inner portion of Western Stege Marsh.

The RFS and the adjacent Zeneca Property are identified in RWQCB, Order Number 01-102 as the Meade Street Operable Unit (MSOU) (RWQCB, 2001). The MSOU is divided into two operable units, Subunits 1 and 2 (Figure 1-2). Subunit 1 encompasses the Zeneca Property and the eastern portion of Stege Marsh (Eastern Stege Marsh). Subunit 2 encompasses the RFS and Western Stege Marsh. Subunit 2 has been subdivided further into Subunits 2A and 2B. Subunit 2A includes the southeastern portion of the RFS uplands and the eastern portion of Western Stege Marsh. Subunit 2B includes the remaining uplands and the western portion of Western Stege Marsh, including a portion of Meeker Slough belonging to the Richmond Redevelopment Agency (Figure 1-2).

1.3.2.2 Western Stege Marsh Restoration Project Area

The WSMRP is located in the marsh and ecotone portions of Subunit 2A and marsh and ecotone portions in M1a and M3 of Subunit 2B (Figure 1-3). The WSMRP is bounded on the north by the developed portion of RFS, on the east by Subunit 1, and on the south by the EBRPD Bay Trail. The western boundary is depicted on Figure 1-3 and is identified as the western edge of remediation activities conducted in Phases 1 and 2. Note that the western boundary of waters/wetlands in Western Stege Marsh is at 5 feet National Geodetic Vertical Datum (NGVD) west of Meeker Slough. Remediation and restoration activities in the remaining marsh and ecotone

portions of Western Stege Marsh will be conducted in a future phase (i.e., Phase 5 of the RFS remediation plan). Monitoring of this area will be addressed once the remediation and restoration plan for Phase 5 has been finalized.

The main hydrologic feature of the WSMRP is Meeker Slough, which is approximately 40 to 50 feet wide. Meeker Slough provides the large majority of hydrologic input for Western Stege Marsh. The bottom elevation of Meeker Slough in Western Stege Marsh ranges from approximately 0 to -1.0 foot NGVD (URS Corporation [URS], 2003).

Major habitat types in the WSMRP consist of coastal scrub (California Natural Diversity Database [CNDDB] vegetation classification 32.000.00) (Department of Fish and Game, 2003) and marsh habitats (i.e., muted tidal marsh [CNDDB vegetation classification 52.000.00], tidal mudflats, and open slough channels). Figure 1-4 presents the location of existing plant community types in Western Stege Marsh prior to implementation of remedial activities authorized under NWP 38. Detailed descriptions of each habitat can be found in Sections 2.3.1 through 2.3.4.

1.4 Project Background

Decades of industrial use along the Richmond shoreline, dating back to the 1870s, resulted in impacted sediments in Western Stege Marsh. Unavoidable impacts to waters/wetlands through the mandated cleanup of impacted sediments (RWQCB Order #01-102) (RWQCB, 2001) are being mitigated through restoration activities. On September 4, 2003, the USACE issued a NWP 38 (File #28135S) to UC Berkeley for remediation and restoration of waters/wetlands within Western Stege Marsh. The NWP 38 permits activities in waters/wetlands, below 5 feet NGVD in Western Stege Marsh.

Phase 1 of the multiphase remediation program for RFS included work in marsh and upland areas of Subunit 2A and the upland portion of Subunit 1 (Figures 1-2 and 1-3). In preparation for Phase 1 work, Levine Fricke (LFR) delineated the geographic extent of waters/wetlands. On September 11, 2001 and on behalf of Zeneca, LFR submitted a Joint Aquatic Resource Permit Application (JARPA) for Subunits 1 and 2A. Subsequently, UC Berkeley performed additional characterization of the marsh and established a modified excavation boundary. As a result of the new excavation boundary, UC Berkeley submitted a supplementary report to the USACE and USFWS requesting a revision to the limit of work and addition of UC Berkeley as a co-permittee (URS, 2002).

In February 2002, LFR conducted California clapper rail ([CCR] *Rallus longirostris obsoletus*) (Federal Register, 1970) surveys in Stege Marsh. In 2002, two meetings were held with Mr. David Wooten of the USFWS to discuss results of the CCR surveys and discuss potential impacts of the remediation and restoration program on CCR. Following agreements reached to limit impacts to CCR (i.e., work restricted to areas outside CCR habitat and a 150-foot buffer zone surrounding CCR habitat during breeding season), USACE issued a NWP 38 on September 17, 2002 for work within Subunit 2A (File #26417S).

Phase 1 of the multiphase remediation program for RFS was performed from September through December 2002 and included excavation in marsh and upland areas of Subunit 2A. Zeneca conducted remediation activities for the upland portion of Subunit 1 from June through December 2002. Both Zeneca and UC Berkeley used Zeneca's contractor (Geocon) to perform the Phase 1 excavation and remediation activities. However, due to the limited duration of the work schedule, it was not possible to complete the full extent of permitted work in 2002 under NWP 38 File #26417S. The eastern portion of Stege Marsh (Eastern Stege Marsh) and Western Stege Marsh are now independent projects (RWQCB, 2001).

Phase 2 of the multiphase remediation program for RFS included work in the remaining authorized area not completed under NWP 38 File #26417S in 2002 and in two additional areas within Western Stege Marsh (Figures 1-2 and 1-3). Phase 2 work was planned and performed in 2003. In preparation for Phase 2, URS performed additional CCR surveys on behalf of UC Berkeley in February 2003. On behalf of UC Berkeley, BBL submitted a request for modification to the NWP 38 #26417S (BBL, 2003a) in July 2003. Modifications included a permit extension to allow completion of remediation activities in the remaining authorized area and remediation activities in two additional areas within Western Stege Marsh. The request was submitted to USACE and copies were sent to USFWS. Under the Endangered Species Act of 1973, as amended (ESA), proposed activities invoked a Section 7 consult, requiring an evaluation of the effects of the proposed project on species of conservation concern. Thus, UC Berkeley submitted a Biological Assessment (BA) (BBL, 2003b) that detailed the WSMRP and surrounding area and discussed remedial alternatives, potential impacts to CCR, and a proposed mitigation plan. Following USACE and USFWS review of the BA, USFWS issued a Biological Opinion (BO) on September 3, 2003 (USFWS, 2003).

On September 4, 2003, USACE issued NWP 38 File #28135S to UC Berkeley for remediation and restoration of waters/wetland areas within Western Stege Marsh. Conditions of NWP 38 File #28134S stated that remediation and restoration activities must be implemented as described in the request for modification to the previous NWP 38 (BBL, 2003a) and the BA (BBL, 2003b). Additionally, the USFWS BO imposed terms and conditions that stated UC Berkeley must develop a management plan for feral animals in the vicinity of Western Stege Marsh and a management plan for non-native plant species within the area of Stege Marsh under UC Berkeley's jurisdiction. Phase 2 remediation activities in Western Stege Marsh were performed from September 2003 through January 2004. The current conditions of Western Stege Marsh, following completion of Phase 2 activities, are presented on Figure 1-3.

This Monitoring Plan covers the marsh and ecotone portions of Subunit 2A and marsh and ecotone portions in M1a and M3 of Subunit 2B (Figure 1-3). Remediation and restoration activities in the remaining marsh and ecotone portions of Western Stege Marsh will be conducted in future phases. Monitoring of future remediation areas will be addressed once the restoration plan for Phase 5 has been finalized. UC Berkeley is developing remedial action alternatives and negotiating the extent of excavation for Phase 5 with the RWQCB. Remedial alternatives may result in a total impact to waters/wetlands in Western Stege Marsh ranging from 5.2 acres to 3.7 acres.

In addition to this Monitoring Plan, UC Berkeley submitted a Feral Animal Management Program (BBL, 2004a) and an Invasive/Exotic Vegetation Management Program (BBL, 2004b) to the USACE in January 2004 to comply with terms and conditions imposed by the USFWS BO. These management plans are currently being implemented; complete details and complete implementation schedules are provided in the referenced documents (BBL, 2004a, 2004b). Relevant details are discussed in this Monitoring Plan.

RWQCB has requested additional remediation monitoring plans, including a Surface-Water Monitoring Program in Western Stege Marsh and a Groundwater Monitoring Program along the upland boundary of Western Stege Marsh. These programs currently are being finalized, and monitoring will commence in winter 2004/2005.

2. Remediation and Restoration

2.1 Overview

In the 9.4 acres of Western Stege Marsh, pre-construction habitats ranged from highly disturbed areas heavily contaminated with chemicals of concern (COCs) (i.e., low-functioning/low-quality habitat areas) to areas moderately degraded due to elevated concentrations of COCs and/or physical disturbance (i.e., medium-functioning/medium-quality habitat areas). Areas designated as low-functioning/low-quality and medium-functioning/medium-quality are presented on Figure 2-1. As mitigation for the disturbance, low-functioning/low-quality habitat will be replaced at a ratio of 1.5 to 1, and medium-functioning/medium-quality habitat at a ratio of 2 to 1 (Figure 2-2). It should be noted that all impacts associated with proposed remedial activities are temporary in nature. There will be a net gain in marsh habitat, and no permanent loss of marsh habitat will occur.

Following remediation, disturbed waters/wetlands will be restored according to the grading plan presented on Figure 1-3. In general, the marsh plain was restored to a slightly lower elevation, with areas of former high marsh converted primarily to low marsh to provide additional high-functioning/high-quality habitat for CCR. Slough channels were restored to their approximate pre-remediation configuration, and additional channels were extended into the eastern area of the marsh. The mitigation strategy is two-fold: 1) restore/enhance disturbed areas; and 2) lower elevation of adjacent upland to create new waters/wetlands and ecotone areas. Created waters/wetlands will be located in former upland areas on the eastern and northern perimeter of Western Stege Marsh. The main components of the restoration plan include:

- removing the walking path on the eastern side of the marsh to create a contiguous marsh area;
- removing pampas grass (*Cortaderia jubata*) and invasive/exotic upland species on the island and along the northwestern and western side of the marsh;
- removing fill in uplands areas adjacent to the marsh to create new waters/wetlands and ecotone and to enhance wildlife habitat for marsh species;
- grading restored areas and a biological interface to form an ecotone and provide a continuous marsh system;
- sizing new channels to replicate and enhance existing sloughs;
- constructing additional channels to facilitate tidal action in the eastern portion of the marsh;
- reconnecting existing side channels to new channels; and
- promoting revegetation of native wetland species in marsh areas impacted by proposed activities through monitoring, actively managing invasive/exotic species, and employing adaptive management practices to meet Project Standards.

2.2 WSMRP Restoration Goals

The Western Stege Marsh restoration is designed to improve hydrologic, biogeochemical, plant community maintenance, and faunal support/habitat functioning within the WSMRP. UC Berkeley has defined biological and hydrologic goals for the mitigation project.

The biological goal for the mitigation project is to enhance and increase marsh habitat in Western Stege Marsh. Specific objectives include:

- increasing areas of low and middle marsh;

- creating an ecotone transition from high marsh to upland, to improve CCR upland refugial access;
- removing invasive/exotic plant species from coastal scrub habitat; and
- restoring disturbed areas of Western Stege Marsh to habitat suitable for use by CCR.

The hydrologic goal for the mitigation project is to restore and improve the tidal channel network. Specific objectives include:

- increasing the area and cross-section of tidal channels commensurate with the tidal prism of the restored area in the eastern portion of the marsh;
- extending tidal channels to the eastern portion of the marsh to support pickleweed (*Salicornia virginica*) and Pacific cordgrass (*Spartina foliosa*) habitat;
- providing tidal flow to Western Stege Marsh, including the eastern half where the previously unvegetated area was located; and
- improving water quality through reducing COC concentrations and neutralizing low pH conditions.

These biologic and hydrologic goals are used to develop a set of Project Targets for monitoring that are based on improving hydrologic, biogeochemical, plant community, and faunal support/habitat functions.

2.3 Ecosystem Descriptions

2.3.1 Marsh

The marsh ecosystem in the WSMRP is composed of high marsh, middle marsh, low marsh, and tidal mudflat. Prior to remediation, high marsh areas were dominated by emergent vegetation consisting primarily of salt grass (*Distichlis spicata*), with some alkali bulrush (*Scirpus robustus*), marsh gum plant (*Grindelia stricta* var. *angustifolia*), and fleshy jaumea (*Jaumea carnosa*). Middle marsh areas are currently dominated by pickleweed. Low marsh areas are currently dominated by Pacific cordgrass, which has been confirmed by genetic testing. Tidal mudflat generally lacks vegetation and is associated with slough channels that run through the WSMRP.

2.3.1.1 Proposed Restoration

Following restoration, the marsh plain will be graded to a slightly lower elevation, with areas of former high marsh converted primarily to low marsh to provide additional high-functioning/high-quality habitat for the CCR. Restored marsh ecosystems in the WSMRP are designed to consist of high marsh, low marsh, tidal mudflat, and open-water sloughs. In its current state, the total area of marsh ecosystem within the WSMRP is approximately 2.4 acres. Following completion of restoration activities, disturbed marsh ecosystem will be restored, and 2.6 acres of additional marsh ecosystem will be created, for a total of 5.0 acres.

Under current conditions in Western Stege Marsh, Pacific cordgrass grows from above the mean tide line (0.43 NGVD) to slightly above the mean hightide line (2.6 NGVD). As such, this will be the target range for elevation of Pacific cordgrass in the restored and created marsh areas. Under current conditions in the Western Stege Marsh, pickleweed grows between the mean hightide line (2.6 NGVD) and the mean high-high-tide line (3.2 NGVD). As such, this will be the target range for elevation of pickleweed in the restored and created marsh areas. Target acreage for Pacific cordgrass is 2.6 acres; target acreage for pickleweed is 1.7 acres.

2.3.2 Ecotone (Transition Zone)

Currently, the marsh ecosystem is separated from the coastal scrub ecosystem by a narrow transition zone (i.e., ecotone). The abrupt transition zone between marsh and upland is heavily vegetated with a mixture of native and non-native vegetation. On the outboard side of the EBRPD Bay Trail, which forms the southern boundary of the WSMRP, marsh ecosystem transitions from pickleweed and Pacific cordgrass communities to tidal mudflats and open water.

2.3.2.1 Proposed Restoration

Following restoration, a 10- to 30-foot-wide ecotone on the east and north sides, respectively, will form a gradual transition zone to the upland area. Total areal coverage for the created transition zone will be 0.4 acres.

2.3.3 Coastal Scrub ("Bulb" and "Island")

The coastal scrub ecosystem is located on the northern portion of Western Stege Marsh known as the "bulb," and along a small berm in the southern portion of Western Stege Marsh known as the "island" (Figure 1-4). In these habitats, native vegetation is composed primarily of coyote brush (*Baccharis pilularis*), with some meadow barley (*Hordeum brachyantherum*), toyon (*Heteromeles arbutifolia*), and Poison oak (*Toxicodendron diversiloba*). However, costal scrub habitat in and around Western Stege Marsh is dominated by invasive/exotic species such as fennel (*Foeniculum vulgare*) and several invasive/exotic grasses such as Harding grass (*Phalaris aquatica*), pampas grass, scotch broom (*Cytisus scoparius*), wild oats (*Avena* sp.), and ripgut (*Bromus diandrus*), with some wild radish (*Raphanus sativus*), Italian thistle (*Carduus pycnocephalus*), and various contoneaster species (URS, 2003). As the dominant vegetation in coastal scrub areas in and around Western Stege Marsh was dominated by non-native species, these habitats are also referred to as ruderal scrub.

2.3.3.1 Proposed Restoration

Restoration of coastal scrub ecosystems is being conducted under activities presented in the Invasive/Exotic Vegetation Management Plan (BBL, 2004b). Some areas of coastal scrub habitat present on the bulb may be regraded to create marsh habitat during Phase 5, dependent on the remedial action selected.

2.3.4 Slough Channels

The main hydrologic feature of the WSMRP is Meeker Slough, which is approximately 40 to 50 feet wide. Meeker Slough provides the large majority of hydrologic input for Western Stege Marsh. The bottom elevation of Meeker Slough in Western Stege Marsh ranges from approximately 0 to -1.0 foot NGVD (URS, 2003).

2.3.4.1 Proposed Restoration

Some areas of Meeker Slough and smaller sloughs that extend into the WSMRP will be temporarily disturbed by proposed remediation and restoration activities. Slough channels will be restored to their approximate pre-remediation configuration, and additional channels will be extended into the eastern portion of Western Stege Marsh. Restoration and enhancement of sloughs are designed to provide adequate tidal flushing and hydrology to support proposed ecosystems.

3. Project Targets and Project Standards

This Monitoring Plan will be initiated subsequent to completion of final grading of the WSMRP. Use of protocols recommended in this Monitoring Plan will enable UC Berkeley to assess relative success of the WSMRP and identify any Contingency Measures, as necessary, that should be implemented to increase the likelihood of project success. Standard definitions of terminology used throughout this Monitoring Plan are presented in Table 1. The WSMRP will be monitored and actively managed to promote reestablishment of native wetland species and provide CCR habitat. Monitoring will include data collection during scheduled monitoring events twice each year: once in spring (i.e., April/May) and once in fall (i.e., September/October). Monitoring is proposed for a period of 5 years following completion of final grading.

Table 1. Standard Definitions for Monitoring Plan Terminology

Reference Term	Definitions
Project Target	The level of functioning identified or negotiated for a restoration project. This target should be based on reference standards and/or site potential and be consistent with restoration or creation goals. Project Targets are used to evaluate progress of the project toward reference standards and/or site potential.
Project Standard	Performance criteria and/or specifications used to guide restoration activities toward Project Targets. Project Standards should include and specify reasonable Contingency Measures if the Project Target is not being achieved.
Field Indicator/ Measurement	Observable and/or measurable characteristics of waters/wetlands that correspond or correlate to articulated Project Standards.
Function	Processes that are necessary for the maintenance of an ecosystem, such as primary production, nutrient cycling, decomposition.
Quality	A qualitative description based on the relative concentration of COCs in sediment. Low: areas possessing relatively high concentrations of COCs. Medium: areas possessing relatively lower concentrations of COCs.
Contingency Measure	Allowances or measures set aside to respond to events or occurrences that may occur but are not determinable at the present time.

3.1 Project Targets

Based on hydrologic, biogeochemical, plant community, and faunal support/habitat functioning goals of the restoration project, the following Project Targets are selected for data collection:

- Restore hydrologic complexity to the WSMRP.
- Improve water quality by increasing water residence time of water within the WSMRP.
- Restore low salt mash (Pacific cordgrass), middle salt marsh (pickleweed), emergent, and coastal scrub native plant communities within the WSMRP.
- Encourage the establishment of a compositionally and structurally complex ecosystem within the WSMRP with attributes important to wildlife, specifically focused on increasing habitat functioning for the California clapper rail.

3.2 Project Standards and Field Indicators/Measurements

Project Standards are criteria and/or specifications used to guide the restoration and/or monitoring activities toward Project Targets. Project Standards and associated Field Indicators/Measurements are presented in Table 2 and detailed in Sections 3.2.1 through 3.2.4. Unless otherwise stated, Field Indicators/Measurements are values toward which Project Targets should show progress by Year 5 of the monitoring program. Following annual evaluation of Project Targets, regarding their progress toward attaining Project Standards, specific Contingency Measures may be recommended and implemented, as necessary. Such mid-course evaluation and management is the basis of the adaptive management plan presented in Section 5. An annual monitoring report detailing data collection and analysis, assessing progress of the WSMRP toward attaining Project Standards, and recommending any necessary management activities, will be submitted to the RWQCB, USACE, USFWS, and BCDC. A detailed schedule of events for the Monitoring Plan is presented in Section 4.7 and Table 5.

3.2.1 Project Target #1:

Restore hydrologic complexity to the WSMRP.

Project Standards associated with restoration of hydrologic complexity within the WSMRP include:

- tidal inundation (i.e., water depth during low- and high-tide events);
- marsh elevation in relation to mean high tide;
- bankfull width;
- bankfull depth; and
- bankfull width to depth ratio.

Hydrology is the most important factor in waters/wetland restoration and creation, and tidal waters/wetlands hydrology is dependant upon tidal inundation. Marsh elevation in relation to mean high tide is critical for creation of tidal waters/wetlands, as it determines hydrology of the waters/wetland. Associated Field Indicators/Measurements for these Project Standards are provided in Table 2.

3.2.2 Project Target #2:

Improve water quality by increasing water residence time of water within the WSMRP.

Project Standards associated with improvement of water quality within the WSMRP include pH, conductivity, dissolved oxygen, and turbidity, among others. Water quality will be addressed in the Surface-Water Monitoring Program in Western Stege Marsh and the Groundwater Monitoring Program along the upland boundary of Western Stege Marsh. As stated in Section 1.4, these programs currently are being finalized, and monitoring will commence in winter 2004/2005.

3.2.3 Project Target #3:

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

To assess the establishment and development of a mature plant community, four Project Standards are proposed. These include:

- percent cover of native vegetation (excluding areas of tidal mudflat);
- total acreage of Pacific cordgrass;
- total acreage of pickleweed; and

- vigor of planted stock.

Associated Field Indicators/Measurements for each of the Project Standards are provided in Table 2.

3.2.4 Project Target #4:

Establish a compositionally and structurally complex ecosystem within the WSMRP with attributes important to wildlife, specifically focused on increasing habitat functions for the California clapper rail.

The restoration of faunal support/habitat functions will be monitored primarily through two Project Standards:

- percent litter/detrital matter; and
- annual CCR surveys.

Associated Field Indicators/Measurements for each of the Project Standards are provided in Table 2. The restoration of some faunal support/habitat functions within the WSMRP includes creating low salt mash (i.e., Pacific cordgrass), middle salt marsh (i.e., pickleweed), emergent, and coastal scrub native plant communities. Therefore, additional factors related to faunal support/habitat functions, such as establishment of horizontal and vertical structural complexity, will be monitored through Project Target #3.

Table 2. Project Standards for the Richmond Field Station Western Stege Marsh Restoration Project, Richmond, California

Project Target #1: *Restore hydrologic complexity to the WSMRP.*

Project Standard	Field Indicator/Measurement
Tidal Inundation: Water depth during low- and high-tide events	Slough channels, tidal mudflats, and Pacific cordgrass areas exhibit an adequate tidal range based on best professional judgment and values available in current literature.
Marsh elevation in relation to mean high tide	Adequate elevations based on best professional judgment and values available in current literature.
Bankfull Width	Between 4.0 and 12.0 feet
Bankfull Depth	Between 0.25 and 1.25 feet at thalweg
Bankfull Width:Depth Ratio	Between 9.6 and 16 at thalweg

Project Target #2: *Improve water quality by increasing water residence time of water within the WSMRP.*

Project Standard	Field Indicator/Measurement
pH	See Surface-Water Monitoring Program and Groundwater Monitoring Program (to be submitted)
Conductivity	See Surface-Water Monitoring Program and Groundwater Monitoring Program (to be submitted)
Dissolved oxygen	See Surface-Water Monitoring Program and Groundwater Monitoring Program (to be submitted)
Turbidity	See Surface-Water Monitoring Program and Groundwater Monitoring Program (to be submitted)

Table 2. Project Standards for the Richmond Field Station Western Stege Marsh Remediation and Restoration Project, Richmond, California (continued)

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

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

Project Target #4: *Establish a compositionally and structurally complex ecosystem within the WSMRP with attributes important to wildlife, specifically focused on increasing habitat functioning for the California clapper rail.*

Project Standard	Field Indicator/Measurement
Percent litter/detrital matter	Based on best professional judgment and values available in current literature.
Annual California clapper rail survey	Restoration sites continue to provide suitable habitat to support CCR based on best professional judgement.

4. Methodology

Data for Project Targets, with the exception of CCR use and tidal range, will be collected using a transect and quadrat system and/or slough cross-section locations established within the WSMRP. The transect and quadrat system and slough cross-section locations will be established in summer 2004, following completion of final grading in the marsh. A pressure transducer, used to extrapolate tidal range in the WSMRP, will be installed in summer 2004. Proposed locations of transects, quadrats, slough cross-section locations, and photodocumentation locations are presented on Figure 4-1. Transects will be established running from east to west across the WSMRP in areas that were disturbed by remediation. Some transect and quadrat locations (i.e., all of Transect G and quadrats E5 through E10) will be placed in undisturbed areas, and will serve to help monitor the effectiveness of invasive/exotic species control. Transects will be separated north to south by approximately 100 feet, except where specific habitats will be targeted for monitoring (i.e., transects A', E, F, and G). Transects will be marked using rebar with identification information. In addition, field teams will record the Universal Transverse Mercator (UTM) coordinates with a global positioning system (GPS) unit using North American Datum [NAD] 83 and a compass bearing for the start point of each transect. One-meter by 1-meter quadrats will be placed on transects starting from the east side of Western Stege Marsh and progressing westward. The southwest corner of each quadrat will be marked using rebar displaying quadrat identification information. Each quadrat will be separated by approximately 75 feet along the transect, with the exception of transect G, where quadrats were randomly selected to monitor the effectiveness of invasive/exotic species control on the slope along the EBRPD Bay Trail.

Data regarding percent cover by native vegetation and establishment of Pacific cordgrass and pickleweed marsh habitat will be collected at each quadrat. Data regarding tidal range will be collected using a pressure transducer installed near the WSMRP. Data regarding marsh elevation will be collected at each quadrat and slough cross-section location. Data for each of these parameters will be collected during scheduled times to occur during the semi-annual monitoring events (i.e., spring [April/May] and fall [September/October]), and as specified in the schedule presented in Section 4.7 and Table 5. Data regarding CCR use of Western Stege Marsh will be collected between January and April each year during the breeding season (Table 5).

4.1 Project Target #1

Restore hydrologic complexity to the WSMRP.

Tidal inundation of the WSMRP will be extrapolated from data collected from a pressure transducer installed near the WSMRP and topography of the WSMRP. The pressure transducer will record tidal elevation at a specified location every 15 minutes. Data will be downloaded from the pressure transducer on a regular basis and will be used to extrapolate tidal range throughout the WSMRP based on topographic information. The pressure transducer will be installed either on the EBRPD Bay Trail bridge that crosses over Meeker Slough or on a platform installed at the confluence of Meeker Slough and the Main Western Stege Marsh slough channel. Final location of the pressure transducer location will be based on access, accessibility, and security considerations. Potential installation locations are presented on Figure 4-1.

To assess bankfull width, bankfull depth, and the bankfull width to depth ratio, field teams will survey the longitudinal profile of each slough channel using land-based survey techniques. Field teams will also survey several cross-sections in each channel. Proposed cross-section survey locations are presented on Figure 4-1.

Marsh elevation will be monitored during each fall (i.e., September/October) monitoring event through land-based survey techniques. Baseline data regarding marsh elevation will be collected following establishment of the transect and quadrat system and slough cross-section locations. For years 1 through 4, surveys will be

performed at the southwest corner of each quadrat established for vegetation monitoring, longitudinally along the sloughs, and at slough cross-section locations. During the final monitoring event in the fifth year, an aerial survey of the mitigation area should be performed to collect elevation data for the entire marsh.

4.2 Project Target #2

Improve water quality by increasing water residence time of water within the WSMRP.

To monitor changes in water quality, survey points and monitoring wells will be established as part of the Surface-Water Monitoring Program and Groundwater Monitoring Program. At the monitoring locations, water-quality parameters will be measured on a schedule identified in reports detailing these programs. Data collected will include parameters such as pH, conductivity, temperature, and turbidity, among others. Data generated during these programs will assist in assessing the overall water quality in the WSMRP.

4.3 Project Target #3

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

To monitor the development of restored vegetative communities, percent cover by native vegetation will be estimated using two techniques:

1) Quadrat surveys – Quadrats will be established along transects that extend through the WSMRP. Vegetation present in established quadrats will be speciated, and aerial coverage will be estimated for species identified. Proposed transect and quadrat locations are presented on Figure 4-1. Quadrat surveys will be conducted in all quadrat locations during each fall (i.e., September/October) monitoring event. During each spring (i.e., April/May) monitoring event, quadrat surveys will be conducted only in quadrat locations in ecotone areas (i.e., between 5 and 6 feet NGVD).

2) Vegetative Mapping – Maps indicating areas of vegetation dominance throughout the WSMRP will be created during each fall (i.e., September/October) monitoring event. Percent vegetative cover and percent cover by dominant vegetation groups will be calculated using automated computer-assisted (CAD) drawings.

Within each quadrat, field teams will measure two Project Standards:

- percent cover of native vegetation; and
- vigor of planted stock.

In addition, field teams will record species present in each quadrat.

Project Standards related to acreage of Pacific cordgrass and pickleweed habitat will be evaluated during the fall (i.e., September/October) monitoring event through use of vegetative mapping and through data collected from quadrats. Total acreages of Pacific cordgrass and pickleweed habitat proposed in the mitigation plan are approximately 2.6 acres and 1.7 acres, respectively. Ecotone edge composes the remaining acreage of created marsh habitat.

Associated Field Indicators/Measurements are included in Table 2. All cover class measurements will be recorded using cover class midpoints (Table 3). Vigor of planted stock will be assessed using the qualitative guidelines outlined in Table 4. All plant nomenclature will follow that presented in the *Jepson Manual of Higher Plants of California* (Hickman, 1993).

Table 3. Cover Class Midpoints

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

Table 4. Qualitative Score for Assessing the Vigor of Planted Stock

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

4.4 Project Target #4

Establish a compositionally and structurally complex ecosystem within the WSMRP with attributes important to wildlife, specifically focused on increasing habitat functions for the California clapper rail.

Non-invasive, protocol surveys, similar to those performed for Stege Marsh in 2003, will be performed yearly during the CCR breeding season to assess CCR use of the mitigation area (Evens, 2003). Protocol survey will be conducted between January and April each year.

As previously discussed, the restoration of some faunal support/habitat functions within the WSMRP includes creating low salt mash (i.e., Pacific cordgrass), middle salt marsh (i.e., pickleweed), emergent, and coastal scrub native plant communities. The establishment of horizontal and vertical structural complexity will be monitored through Project Target #3.

4.5 Photodocumentation

Several photodocumentation locations will be established in and adjacent to the WSMRP. During each monitoring event (i.e., spring and fall), photographs will be taken in a specified direction from each photodocumentation location, as shown on Figure 4-1. Photodocumentation will provide a visual record of the progress of the restoration efforts and will be included in the annual report.

4.6 Reporting

Data regarding Project Standards will be collected, analyzed, and submitted in a report to the RWQCB, USACE, USFWS, and BCDC on an annual basis in the first quarter of the year following completion of the previous year's monitoring. Reports will address progress of the WSMRP based on Project Standards, address progress toward achieving Project Targets, and will recommend Contingency Measures, as necessary. If Project Standards are not met after 5 years, additional monitoring will be recommended, as described in Section 5. If Project Standards are met prior to completion of the 5-year program, a reduction in monitoring, maintenance,

and/or reporting may be recommended. The annual report will also document activities conducted as part of the active ecotone revegetation, Feral Animal Management Program (BBL, 2004a), and Invasive/Exotic Vegetation Management Program (BBL, 2004b).

4.7 Schedule of Events

Initial baseline data for marsh elevation will be collected following establishment of the transect and quadrat system, as described in Section 4.1. Data regarding percent cover by native vegetation, establishment of Pacific cordgrass and pickleweed marsh habitat, and marsh elevation will be collected during specified monitoring events, as specified in Table 5. Tidal inundation will collected continuously at 15-minute intervals following installation of the pressure transducer. Tidal data will be downloaded from the pressure transducer on a regular basis. Protocol surveys of CCR use of Western Stege Marsh will be conducted once each year during the breeding season (i.e., January – April). An annual monitoring report will be submitted to the RWQCB, USACE, USFWS, and BCDC in the first quarter of the year following completion of the previous year's monitoring. Table 5 indicates the schedule of events for the Monitoring Plan over the anticipated 5-year duration.

Table 5. Frequency of Monitoring Efforts over the 5-Year Monitoring Interval, Richmond Field Station Western Stege Marsh Remediation and Restoration Project, Richmond, California.

Monitoring Activity	Spring 2004	Fall 2004	Spring 2005	Fall 2005	Spring 2006	Fall 2006	Spring 2007	Fall 2007	Spring 2008	Fall 2008
Establishment of Transects, Quadrats, Cross-section Locations, and Pressure Transducer	a									
Project Target #1										
Tidal Inundation	b	b	b	b	b	b	b	b	b	b
Marsh Elevation (Land Survey)	c	•		•		•		•		•
Marsh Elevation (Aerial Survey)										•
Project Target #2										
Tidal Inundation	b	•	•	•	•	•	•	•	•	•
Marsh Elevation (Land Survey)	c	•		•		•		•		•
Marsh Elevation (Aerial Survey)										•
Project Target #3										
Vegetation Quadrat Surveys (Ecotone Quadrats Only)			•		•		•		•	
Vegetation Quadrat Surveys (All Quadrats)		•		•		•		•		•
Vegetation Dominance Mapping		•		•		•		•		•
Project Target #4										
Vegetation Quadrat Surveys (Ecotone Quadrats Only)			•		•		•		•	
Vegetation Quadrat Surveys (All Quadrats)		•		•		•		•		•
Vegetation Dominance Mapping		•		•		•		•		•
California Clapper Rail Use			d		d		d		d	
Photodocumentation		•	•	•	•	•	•	•	•	•
Annual Monitoring Report			e		e		e		e	

a – Transects, quadrats, slough cross-section locations, and the pressure transducer will be established in summer 2004.
b –Data regarding tidal inundation will be collected continuously at 15-minute intervals using the pressure transducer.
c – Baseline data regarding marsh elevation will be collected following establishment of the transects, quadrats, and slough cross-section locations.
d – Protocol surveys of CCR use of Western Stege Marsh will occur between January and April each year.
e – An annual report will be submitted to the appropriate agencies during the first quarter of the year following completion of the previous year's monitoring activities (the annual report for the fifth year of the program will be submitted in the first quarter of 2009).

5. Contingency Measures/Adaptive Management

If progress toward meeting Project Targets is not evident following any complete year of monitoring, potential for success of the mitigation area will be evaluated, and Contingency Measures will be proposed in the annual monitoring report. Potential Contingency Measures and adaptive management protocols are summarized in this Monitoring Plan. Identification of Contingency Measures should include the following steps:

1) Conduct an analysis to assess whether the state of the WSMRP is progressing toward Project Targets. Ecosystems are dynamic, and it may be that the Project Targets articulated in the baseline report do not apply to conditions in Year 5.

2) Analyze potential causes of the change in state. It is important that the monitoring team directly treat the cause of the problem and not an indirect side effect.

3) If the new state is a departure from Project Targets, a plan should be developed and implemented to increase likelihood of success of the restoration area.

The ability to react to the dynamic nature of restored systems, in order to increase the likelihood of restoration success, is the basis for adaptive management. Through analysis of data collected during monitoring events, management recommendations will be made and implemented. Data collected regarding the Project Targets will be evaluated against the Project Standards to gauge whether satisfactory progress is being made toward hydrologic, biogeochemical, plant community maintenance, and faunal support/habitat functioning goals given the current management activities. Baseline management activities are presented in Section 5.1 through 5.4. If progression toward attainment of Project Targets is not observed, management actions will be recommended and implemented to increase the likelihood of attaining Project Targets. Each of the steps in the adaptive management program (i.e., monitoring, assessment, evaluation, recommendation, and implementation) will interact with the preceding step to create a continuous process that builds upon originally stated goals and lessons learned from past experiences.

5.1 Project Target #1

Restore hydrologic complexity to the WSMRP.

Adequacy of tidal range (i.e., inundation) will be assessed through professional judgment, based on values presented in available literature and vegetation and marsh elevation data collected during monitoring events. Inadequate tidal inundation in the mitigation area would likely be the result of incorrect elevations or inadequate flow through slough channels. Therefore, Contingency Measures that may be taken to correct inadequate inundation include regrading areas that possess inadequate tidal range or regrading slough channels to increase hydrologic flow.

Correct marsh elevation will be assessed through professional judgment, based on vegetation and tidal innundation data collected during monitoring events and values presented in available literature. Incorrect marsh elevations may be addressed through regrading.

5.2 Project Target #2

Improve water quality by increasing water residence time of water within the WSMRP.

Because water-quality measurements have high temporal variability in both time and space, Project Standards and associated Field Indicators/Measurements focus on spatial trends in water quality within the WSMRP area.

Water quality standards to be evaluated during the Surface-Water Monitoring Program and the Groundwater Monitoring Program, which are currently being developed, will be addressed in these documents.

5.3 Project Target #3

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

Restoration of native plant communities is proposed through natural recruitment of vegetation through available seed stock in marsh areas, active revegetation of the ecotone areas (e.g., seeding and planting of propagules), and active invasive/exotic species control in the marsh and ecotone areas. If progress toward meeting this Project Target is not evident following any complete year of monitoring, potential for success of the mitigation area will be evaluated, and Contingency Measures will be proposed in the annual monitoring report. Contingency Measures may include seeding or planting the mitigation area with local plant stock.

Areas of Pacific cordgrass and pickleweed habitat may be intermixed, exhibiting no obvious dominance, during the first few years monitoring. As such, total acreages of Pacific cordgrass and pickleweed habitat may be difficult to assess. Therefore, during initial monitoring years, the proposed Field Indicators/Measurements may require modification based on professional judgment. If progress toward meeting this Project Standard is not evident following any complete year of monitoring, potential for success of the mitigation area will be evaluated, and corrective actions will be proposed in the annual monitoring report. Potential causes of failure to meet this Project Standard may include incorrect marsh elevation, inadequate tidal flushing, or inadequate seed stock. Therefore, monitoring data should be evaluated to determine the potential cause in order to institute the appropriate Contingency Measure. Contingency Measures may include active seeding or planting or regrading the marsh plain or slough channels.

The problems that invasive/exotic vegetation can create during the development of the restored plant communities are substantial. Invasive exotic species typically are pioneer species and colonizers of open habitats, particularly where human activities have resulted in disturbance on the landscape (Taylor, 1990). Weed problems are exacerbated at sites where weed propagules are abundant, such as in urban environments and along stream channels and/or major roadways. As these conditions exist at the WSMRP, implementation of the Invasive/Exotic Vegetation Management Program (BBL, 2004b) is a critical portion of the restoration plan.

Management of invasive/exotic species in the WSMRP will include assessing and controlling establishment and distribution of smooth cordgrass (*Spartina alterniflora*), hybrid crosses between Pacific cordgrass and smooth cordgrass, fennel, pampas grass, yellow star thistle (*Centaurea solstitialis*), five-hook bassia (*Bassia hyssopifolia*), and perennial pepperweed (*Lepidium latifolium*). Hand pulling, covering with black plastic, and/or applying herbicide will be used as control methods. Mechanical control can be augmented by the application of Rodeo®, or a similar glyphosate herbicide approved for use in aquatic environments by the United States Environmental Protection Agency, to young plants. Herbicides will be applied by experienced personnel in compliance with current local, state, and federal standards to minimize over-spraying that could result in water pollution or excess collateral damage to beneficial wetland species. Management of non-native and hybrid cordgrass will be coordinated with California Coastal Conservancy Invasive Spartina Project staff. The Spartina Project is a non-profit research organization researching and mapping species of cordgrass within the San Francisco Bay estuary. Management of invasive/exotic species will occur in conjunction with monitoring. A detailed description of these activities is presented in the Invasive/Exotic Species Management Program report (BBL, 2004b) submitted to the USACE, USFWS, RWQCB, and BCDC in January 2004. A summary of invasive/exotic management activities conducted each year will be included in the annual report.

5.4 Project Target #4

Establish a compositionally and structurally complex ecosystem within the WSMRP with attributes important to wildlife, specifically focused on increasing habitat functions for the California clapper rail.

CCR typically uses emergent salt and brackish tidal marshes in the San Francisco Bay area for foraging, shelter, and nesting. Its preferred habitat is characterized by areas of emergent vegetation dominated by pickleweed, cordgrass, or bulrush. CCR prefers areas with abundant high marsh habitats for refuge during high tide and networks of tidal sloughs that provide abundant invertebrate prey and escape routes from predators (Goals Project, 2000). Some physical characteristics of marshes that affect CCR use are size, location relative to other marshes, buffer area between marsh and upland, elevation, and hydrology. Elements influencing marsh habitat functioning and quality for CCR use include food resources, cover from predators, nesting habitat, and habitat availability during high tide. CCR prefers areas of dense emergent high marsh vegetation for nesting sites (Albertson, 1998). Primary threats to CCR include loss of habitat and predators such as the feral and domestic cat (*Felix domesticus*), red fox (*Vulpes vulpes*), and Norway rat (*Rattus norvegicus*). The CCR is particularly susceptible to predation during winter high tide, when high marsh and upland areas tend to provide less cover than other times of the year (Bumgardner Biological Consulting, 2001).

Based on results of the CCR surveys completed in 2003, it is estimated that 1.5 CCR pairs are resident in the Meeker Slough marsh habitat, which includes the project area and the marsh habitat south of the project area (Evens, 2003). Based on survey results and habitat requirements, CCR is not expected to use the coastal scrub habitat in the project area. No specific numerical values will be used to evaluate this Project Target. Success will be assessed through professional judgment based on survey results. CCR is unlikely to use the WSMRP until after marsh vegetation has established itself in restored and created marsh habitats.

Lack of progress toward this Project Target would likely be the result of inadequate habitat (i.e., cordgrass, pickleweed, and tidal mudflat habitats) available for CCR. Increased access to the WSMRP by predators may also affect this Project Target. Contingency Measures that may be implemented to increase CCR use of the WSMRP include improving seed stock, tidal flushing, and adjusting marsh elevations to improve habitat function, and/or controlling predators, including feral and domestic cats. UC Berkeley is currently implementing a Feral Animal Management Program (BBL, 2004a) to address potential feral predators in the WSMRP.

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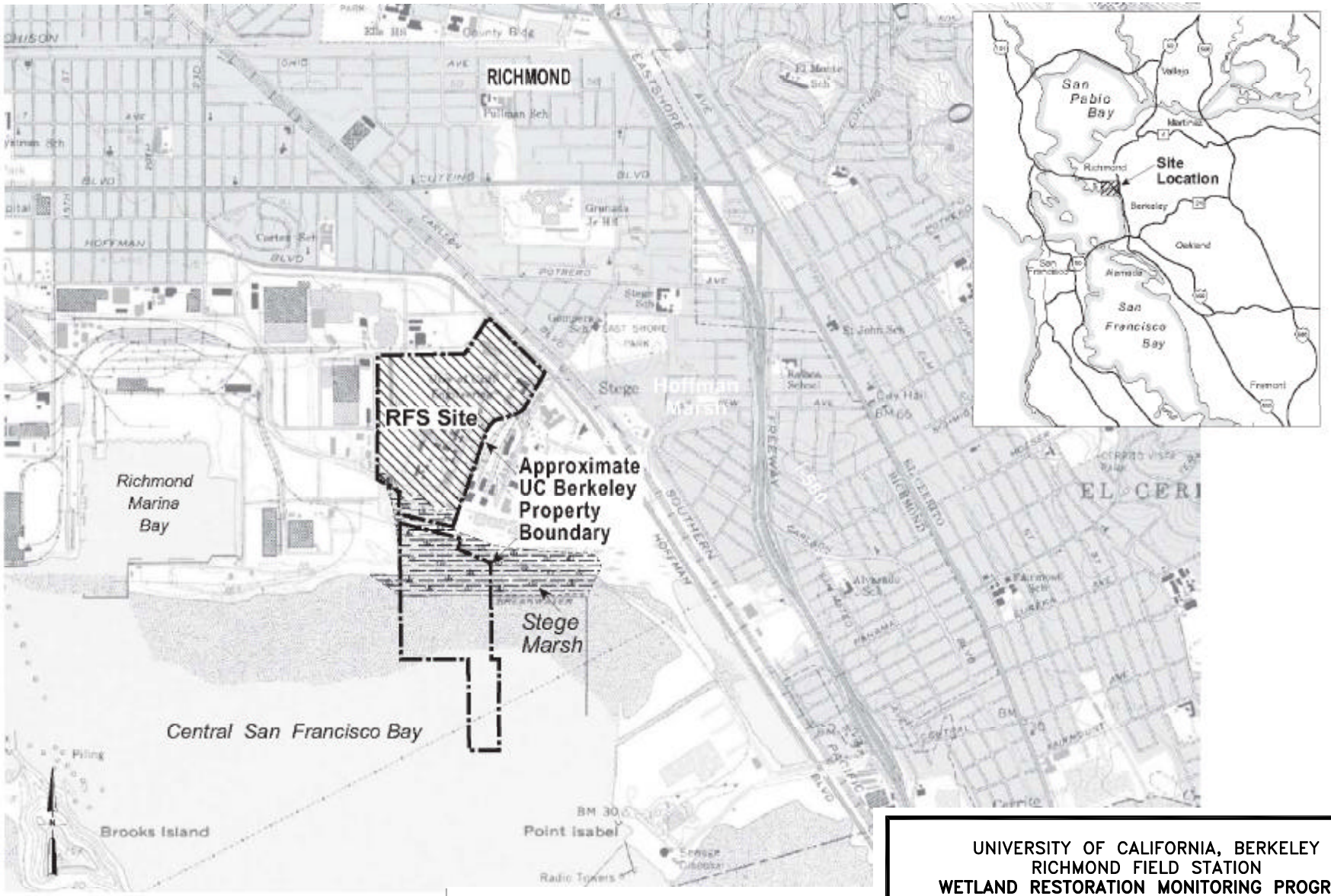
Figures



Map Source: USGS, 7.5 min. Quadrangle map, Richmond, California, 1980 revised

NOTE:
MAP WAS PREPARED FROM A USGS TOPOGRAPHIC 7.5 MIN QUADRANGLE PROVIDED BY URS ON 7/8/03

X: FIGURE 1 SITE LOC MAP.TIFF
L: OFF=REF
P: PAGESET/PLT-AL
7/28/04 IRV-85-JMS
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UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

SITE LOCATION MAP

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1-1

LEGEND:

- ZENECA PROPERTY (SUBUNIT 1)
- RICHMOND FIELD STATION PROPERTY (SUBUNIT 2 & OFFSHORE PROPERTY)
- APPROXIMATE WESTERN STEGE MARSH RESTORATION PROJECT AREA ADDRESSED IN THIS MONITORING PLAN)

NOTES:

1. FIGURE PROVIDED BY URS CORPORATION.
2. NOT TO SCALE.

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

PROPERTY, SUBUNIT, AND PROJECT AREA LOCATIONS AND BOUNDARIES

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1-2

L: OFF=REF
P: PAGESET/PLT-BL
8/6/04 IRV-85-JMS
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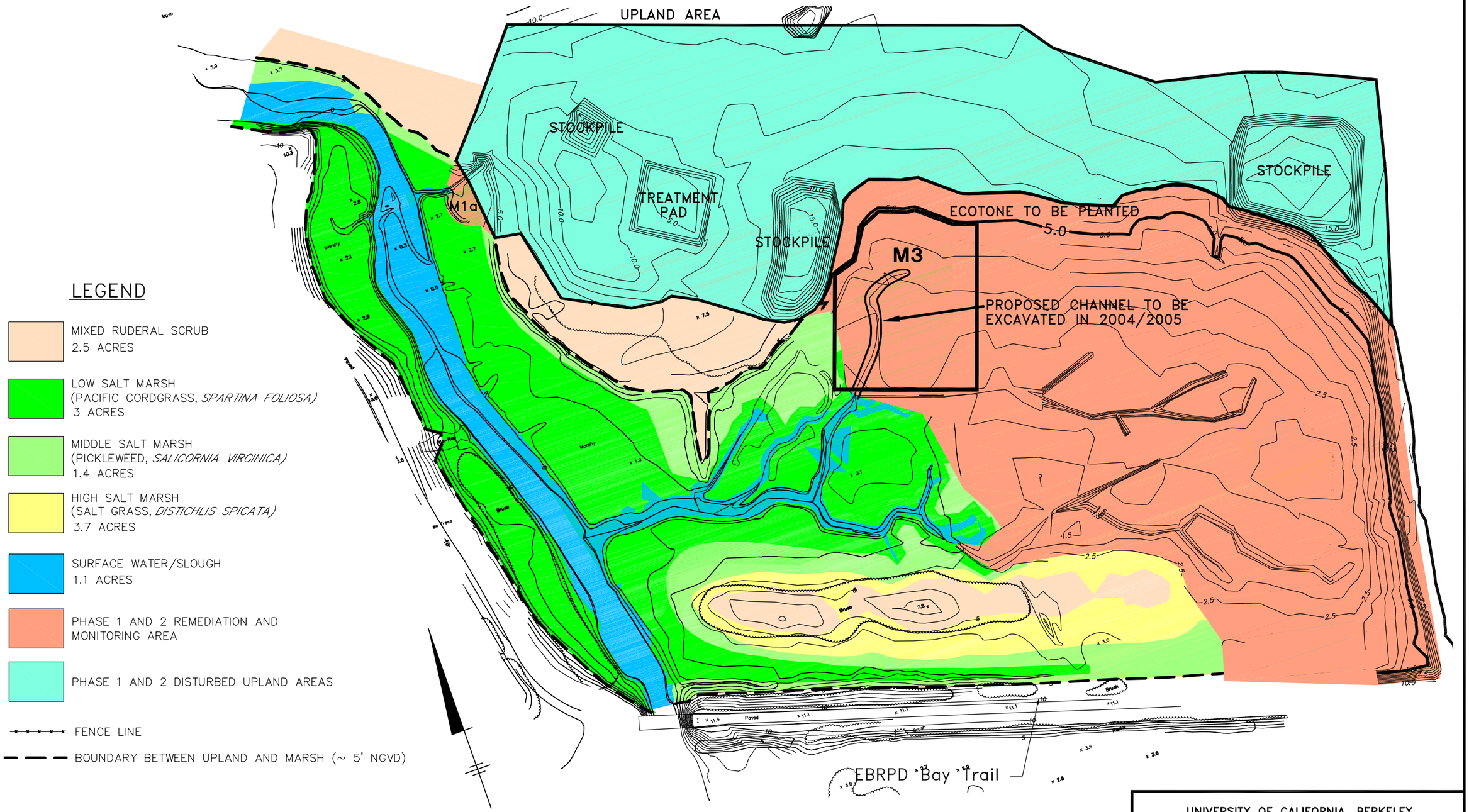

NOTES:

1) SOME PORTIONS OF THE HIGH SALT MARSH (SALT GRASS) AREAS ALONG THE EBRPD BAY TRAIL ALSO CONTAIN INTERMITTENT PATCHES OF PICKLEWEED.

2) BASE MAP SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.

3) STOCKPILES AND TREATMENT AREAS WILL BE REMOVED DURING SUBSEQUENT PHASES.

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UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

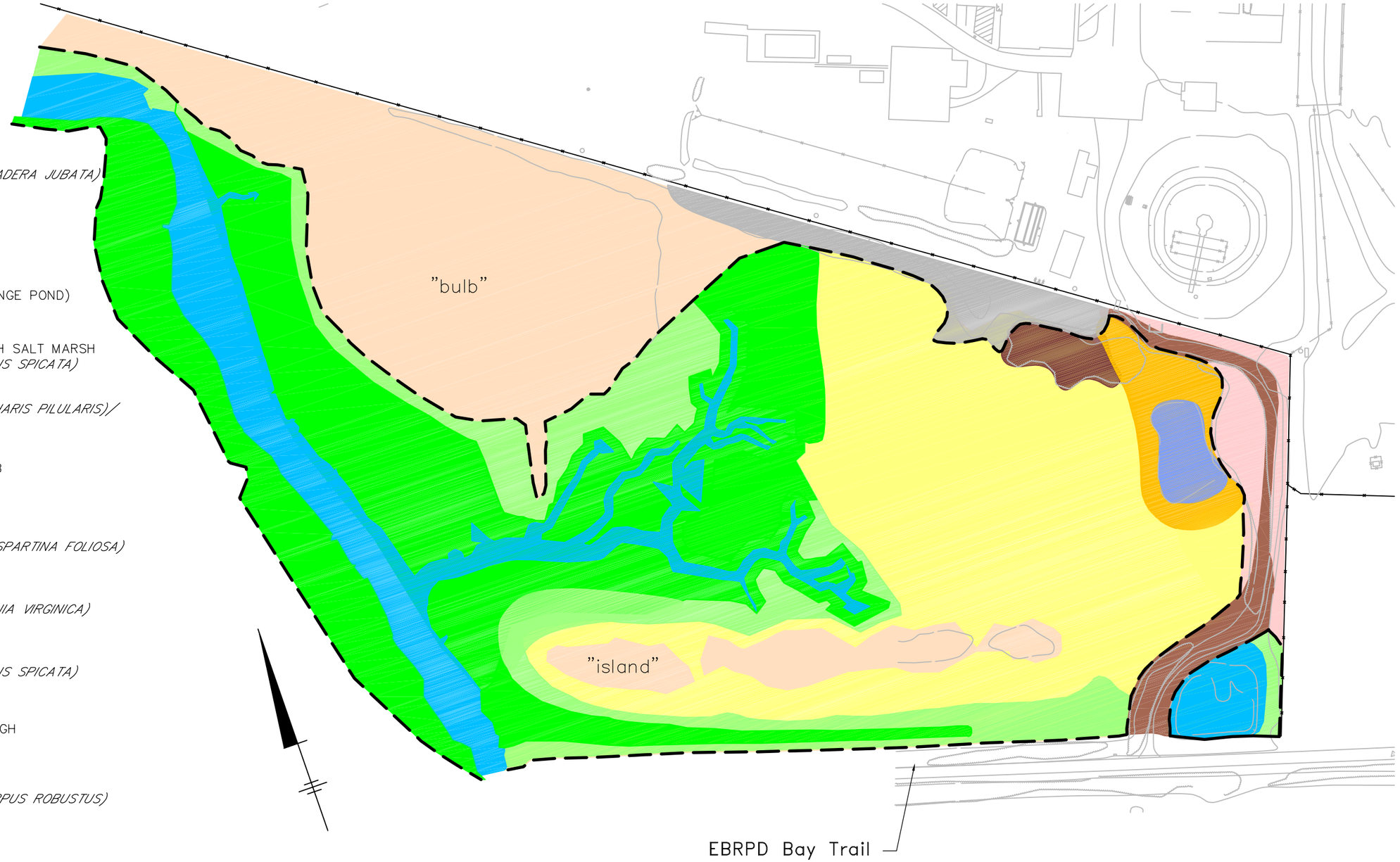
EXISTING CONDITIONS 2003/2004
WESTERN STEGE MARSH

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1-3

LEGEND

- PAMPAS GRASS *(CORTADERA JUBATA)* 0.2 ACRES
- WALKING PATH 0.25 ACRES
- SURFACE WATER (ORANGE POND) 0.1 ACRES
- DISTRESSED/DEAD HIGH SALT MARSH (SALT GRASS, *DISTICHLIS SPICATA)* 0.2 ACRES
- COYOTE BRUSH *(BACCHARIS PILULARIS)*/ CONCRETE RUBBLE 0.3 ACRES
- MIXED RUDERAL SCRUB 2.5 ACRES
- LOW SALT MARSH (PACIFIC CORDGRASS, *SPARTINA FOLIOSA)* 3 ACRES
- MIDDLE SALT MARSH (PICKLEWEED, *SALICORNIA VIRGINICA)* 1.4 ACRES
- HIGH SALT MARSH (SALT GRASS, *DISTICHLIS SPICATA)* 3.7 ACRES
- SURFACE WATER/SLOUGH 1.1 ACRES
- ALKALI BULRUSH *(SCIRPUS ROBUSTUS)* 0.1 ACRES
- FENCE LINE
- BOUNDARY BETWEEN UPLAND AND MARSH (~ 5' NGVD)



0 100' 200'
GRAPHIC SCALE

NOTES:
1) SOME PORTIONS OF THE HIGH SALT MARSH (SALT GRASS) AREAS ALONG THE EBRPD BAY TRAIL ALSO CONTAIN INTERMITTENT PATCHES OF PICKLEWEED.

2) BASE MAP SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

WESTERN STEGE MARSH
PRE-CONSTRUCTION PLANT COMMUNITIES

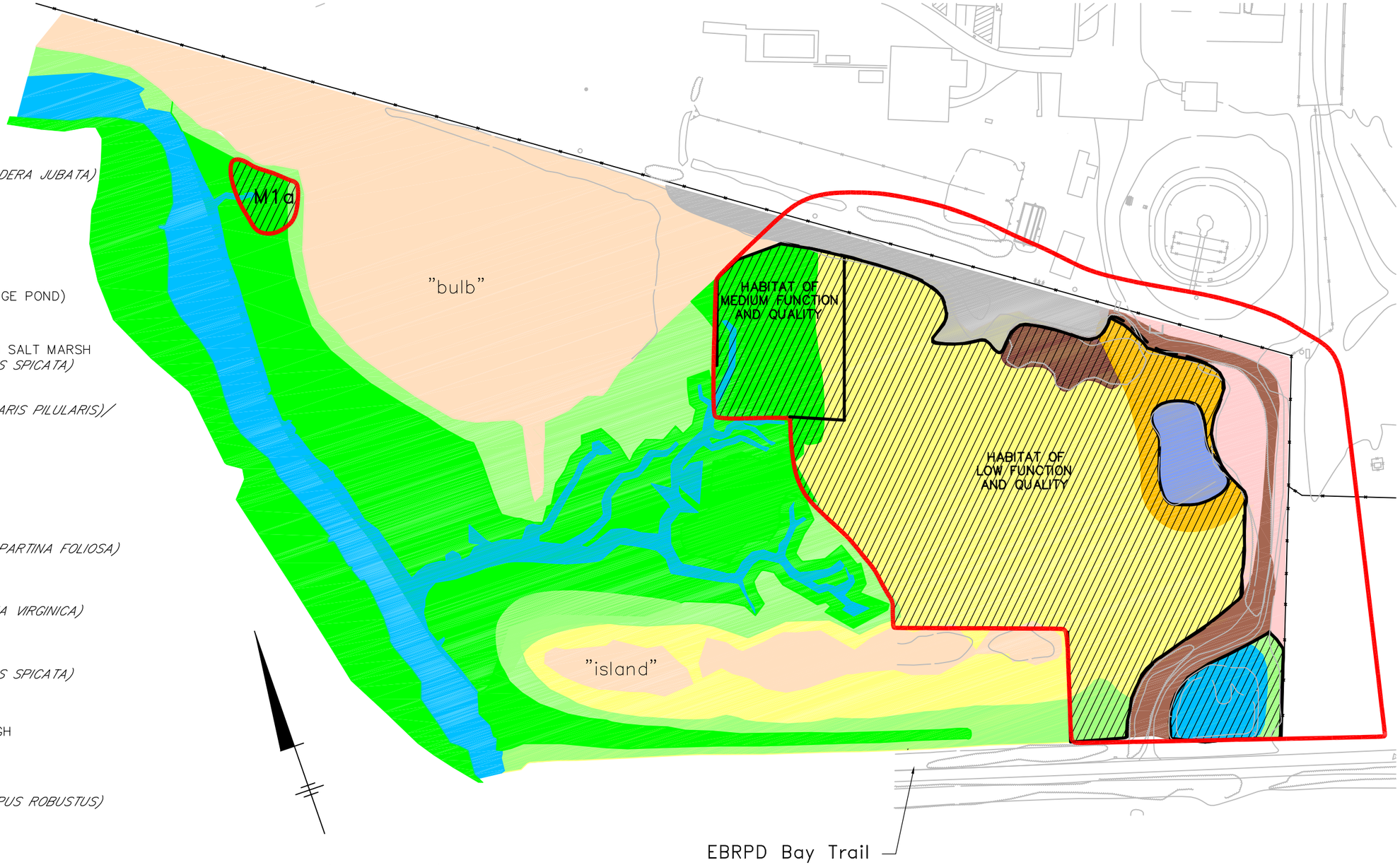
BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE **1-4**

X: (XREF)
L: OFF=REF
P: PAGESET/PLT-BL
8/6/04 IRV-85-JMS
F:/IBM/CAD/2004PROJ/24210.410/WRMP/24210B03.DWG

LEGEND

- PAMPAS GRASS *(CORTADERA JUBATA)* 0.2 ACRES
- WALKING PATH 0.25 ACRES
- SURFACE WATER (ORANGE POND) 0.1 ACRES
- DISTRESSED/DEAD HIGH SALT MARSH (SALT GRASS, *DISTICHLIS SPICATA)* 0.2 ACRES
- COYOTE BRUSH *(BACCHARIS PILULARIS)*/ CONCRETE RUBBLE 0.3 ACRES
- MIXED RUDERAL SCRUB 2.5 ACRES
- LOW SALT MARSH (PACIFIC CORDGRASS, *SPARTINA FOLIOSA)* 3 ACRES
- MIDDLE SALT MARSH (PICKLEWEED, *SALICORNIA VIRGINICA)* 1.4 ACRES
- HIGH SALT MARSH (SALT GRASS, *DISTICHLIS SPICATA)* 3.7 ACRES
- SURFACE WATER/SLOUGH 1.1 ACRES
- ALKALI BULRUSH *(SCIRPUS ROBUSTUS)* 0.1 ACRES
- FENCE LINE
- BOUNDARY OF DISTURBED MARSH AREA
- PROJECT AREA BOUNDARY
- DISTURBED MARSH HABITAT
  HABITAT OF LOW FUNCTION AND QUALITY = 2.33 ACRES
  HABITAT OF MEDIUM FUNCTION AND QUALITY = 0.5 ACRES



0 100' 200'
GRAPHIC SCALE

NOTES:

1) SOME PORTIONS OF THE HIGH SALT MARSH (SALT GRASS) AREAS ALONG THE EBRPD BAY TRAIL ALSO CONTAIN INTERMITTENT PATCHES OF PICKLEWEED.

2) BASE MAP SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.

3) WSMRP AREA BOUNDARIES ARE APPROXIMATE.

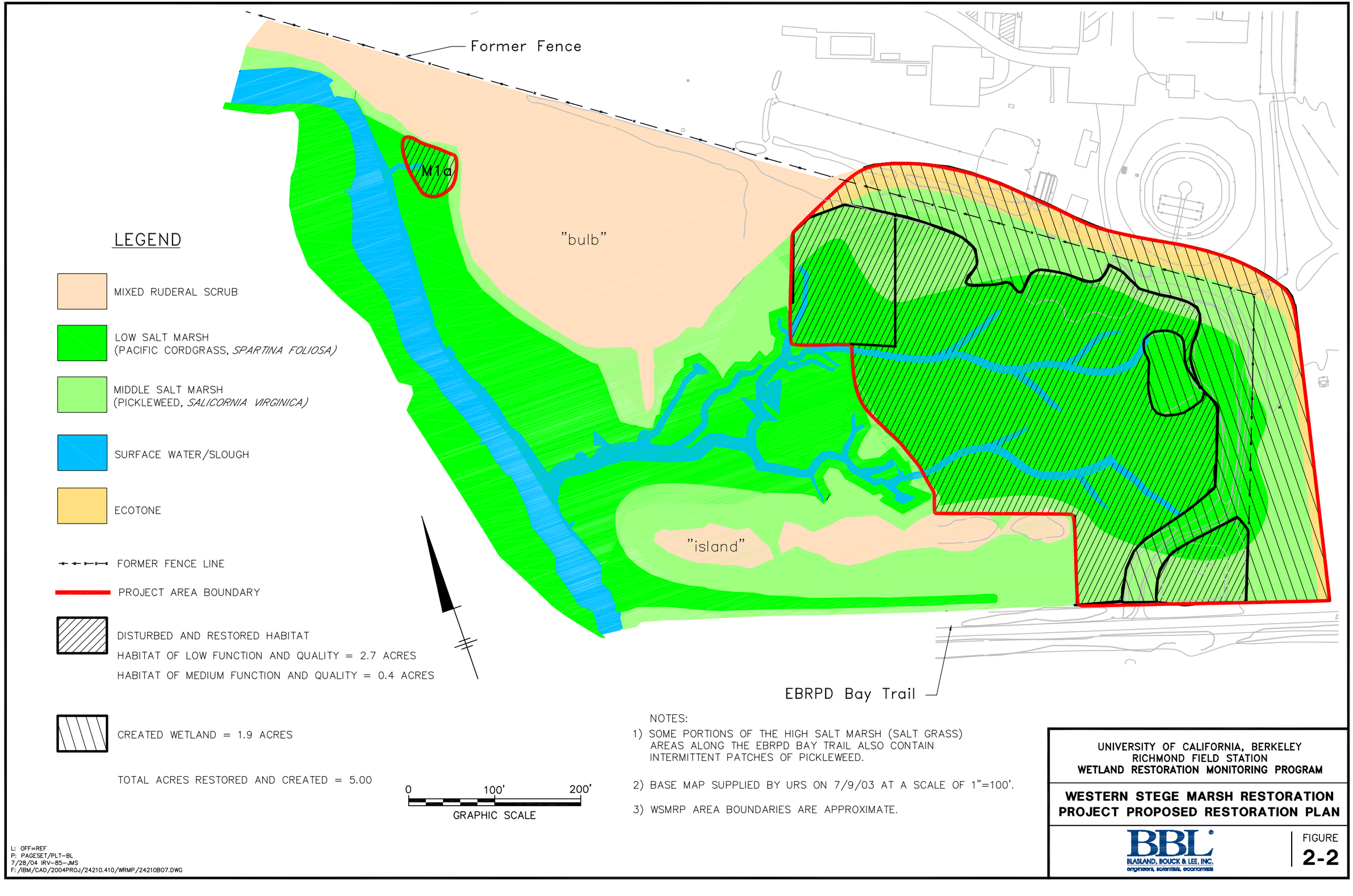
UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

WESTERN STEGE MARSH RESTORATION PROJECT DISTURBED AREAS

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE **2-1**

L: OFF=REF
P: PAGESET/PLT-BL
7/28/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.410/WRMP/24210B05.DWG



NOTES:

1) SOME PORTIONS OF THE HIGH SALT MARSH (SALT GRASS) AREAS ALONG THE EBRPD BAY TRAIL ALSO CONTAIN INTERMITTENT PATCHES OF PICKLEWEED.
2) BASE MAP SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.
3) WSMRP AREA BOUNDARIES ARE APPROXIMATE.

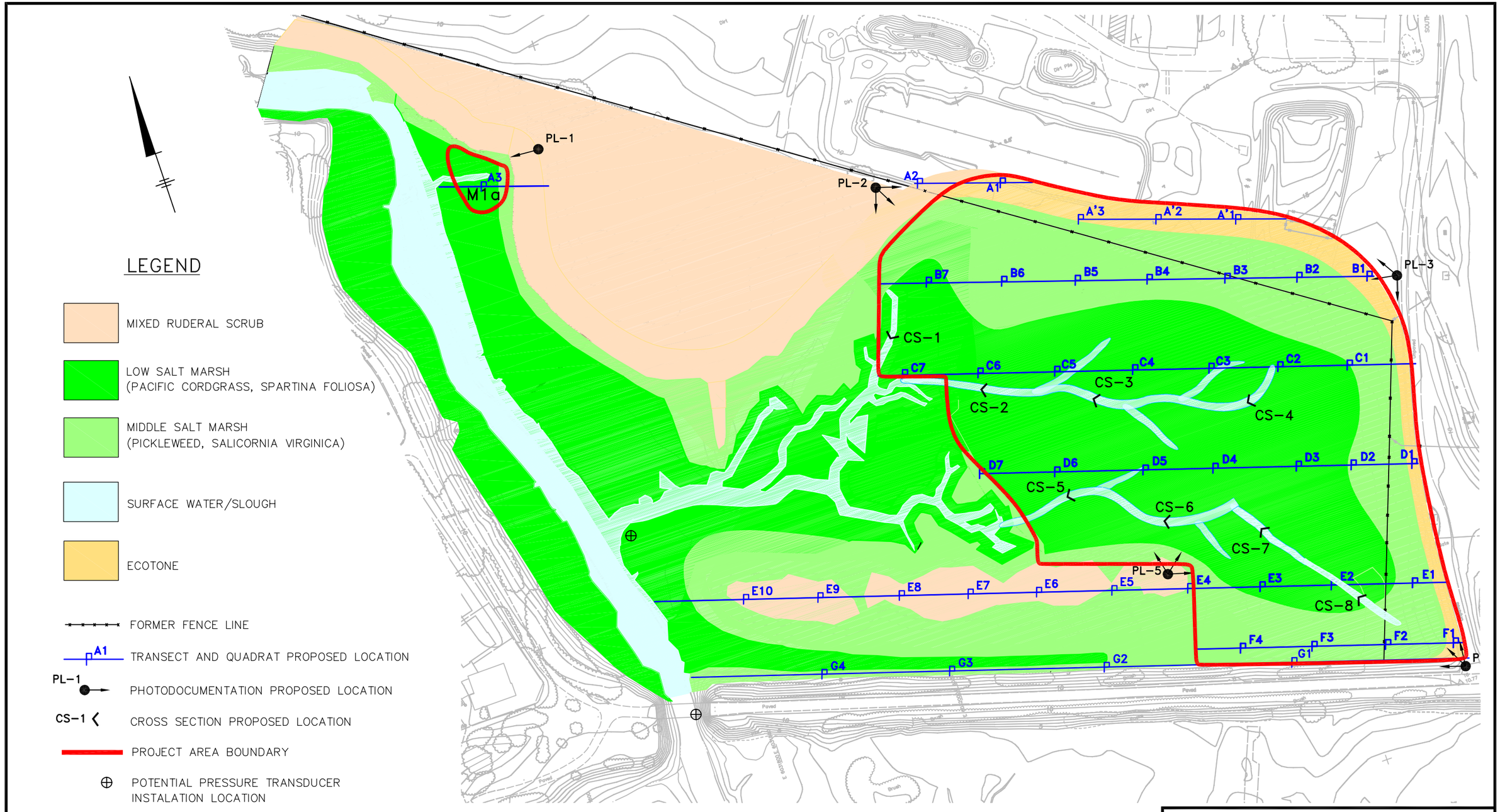
UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

WESTERN STEGE MARSH RESTORATION PROJECT PROPOSED RESTORATION PLAN

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
2-2

L: OFF=REF
P: PAGESET/PLT-BL
7/28/04 IRV-85-JMS
F:/IBM/CAD/2004PROJ/24210.410/WRMP/24210B07.DWG



LEGEND

- MIXED RUDERAL SCRUB
- LOW SALT MARSH (PACIFIC CORDGRASS, SPARTINA FOLIOSA)
- MIDDLE SALT MARSH (PICKLEWEED, SALICORNIA VIRGINICA)
- SURFACE WATER/SLOUGH
- ECOTONE
- FORMER FENCE LINE
- A1 TRANSECT AND QUADRAT PROPOSED LOCATION
- PL-1 PHOTODOCUMENTATION PROPOSED LOCATION
- CS-1 CROSS SECTION PROPOSED LOCATION
- PROJECT AREA BOUNDARY
- POTENTIAL PRESSURE TRANSDUCER INSTALATION LOCATION

0 100' 200'
GRAPHIC SCALE

NOTES:
1) SAMPLING LOCATIONS ARE APPROXIMATE AND WILL BE PLACED BASED ON FIELD CONDITIONS.
2) BASE MAP SUPPLIED BY URS ON 7/9/03 AT A SCALE OF 1"=100'.
3) WSMRP AREA BOUNDARIES ARE APPROXIMATE.

UNIVERSITY OF CALIFORNIA, BERKELEY
RICHMOND FIELD STATION
WETLAND RESTORATION MONITORING PROGRAM

PROPOSED SAMPLING LOCATIONS

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 4-1

X: BASE.DWG
L: OFF=REF
P: PAGESET/PLT-BL
8/26/04 IRV-85-JMS
F: /IBM/CAD/2004PROJ/24210.410/WRMP/24210B01.DWG