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SOUTH BAY SALT POND RESTORATION PROJECT
PHASE 1 MONITORING PLAN

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INTRODUCTION

The South Bay Salt Pond (SBSP) Restoration Project encompasses approximately 15,100 acres of former salt ponds located around the edge of South San Francisco Bay, and is the largest proposed wetlands restoration project on the West Coast of the United States. The SBSP Project is intended to restore and enhance wetlands in South San Francisco Bay while providing for flood management and wildlife-oriented public access and recreation. Prior to the arrival of Europeans in the Bay Area, the SBSP Project Area consisted of tidal marsh and associated habitats, as did much of the land fringing the Bay. Over time, 80-90 percent of this tidal marsh was lost to development. In the case of the SBSP Project Area, it was converted to use as commercial salt production facilities through diking and impoundment of Bay waters.

In 2003, Cargill Inc. (Cargill) the owner of the commercial salt production facilities in the Project Area, sold the ponds to the U. S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG), with the USFWS acquiring 9,600 acres in two complexes, one at the western end of Dumbarton Bridge (the Ravenswood pond complex) and one along the Bay from Mountain View to Fremont (the Alviso pond complex) and CDFG acquiring the remaining 5,500 acres just south of the eastern end of the San Mateo Bridge (the Eden Landing pond complex) (Figure 1).

This SBSP Restoration Project Monitoring Plan provides methods to document the effect of restoration on important elements such as mercury uptake, and water and sediment quality. It will track the geomorphic evolution of tidal salt marsh and document the use of managed pond habitat over a long-term period. It will track changes in biota, including endangered species. This monitoring will track these changes and combined with the results of pertinent applied studies, allow for informed, dynamic responses through the adaptive management plan.

RESPONSIBLE PARTIES

The SBSP Restoration Project (Project) is a collaborative effort among federal, state, and local agencies working with scientists and the public to develop a programmatic plan for habitat restoration, flood management, and wildlife-oriented public access within the 15,100 acres of former Cargill Salt Ponds in the San Francisco Bay. The responsible parties include the CDFG and USFWS as supported by the California Coastal Conservancy.

The implementation of the Project will be funded by a variety of sources, including, but not limited to grants, bonds, and appropriations and other projects requiring mitigation.

PROJECT GOALS AND OBJECTIVES

The overall goals of the Project are to restore and enhance a mix of wetland habitats, provide wildlife-oriented public access and recreation, and provide for flood management in the South Bay.

The primary purpose of the proposed Phase 1 actions is to restore a mosaic of habitats, including tidal marsh, mudflat, salt panne and open water habitats (managed ponds), to support populations

of fish and wildlife, special-status species, migratory waterfowl, shorebirds, and anadromous and resident fishes. Several animal and plant species, native to California, including the salt marsh harvest mouse (*Reithrodontomys raviventris*) and the California clapper rail (*Rallus longirostris obsoletus*) have been listed as endangered on State and Federal lists due to severe reduction of wetland habitats around the Bay. Public acquisition of these former salt ponds provides an opportunity to restore tidal salt marsh and associated habitats on a relatively large scale within the San Francisco Bay system. In addition, ongoing operations that include repair and maintenance of levees will be allowed within the managed ponds. These ponds will continue to provide quality habitat for various types of birds as well as benefits for other wildlife.

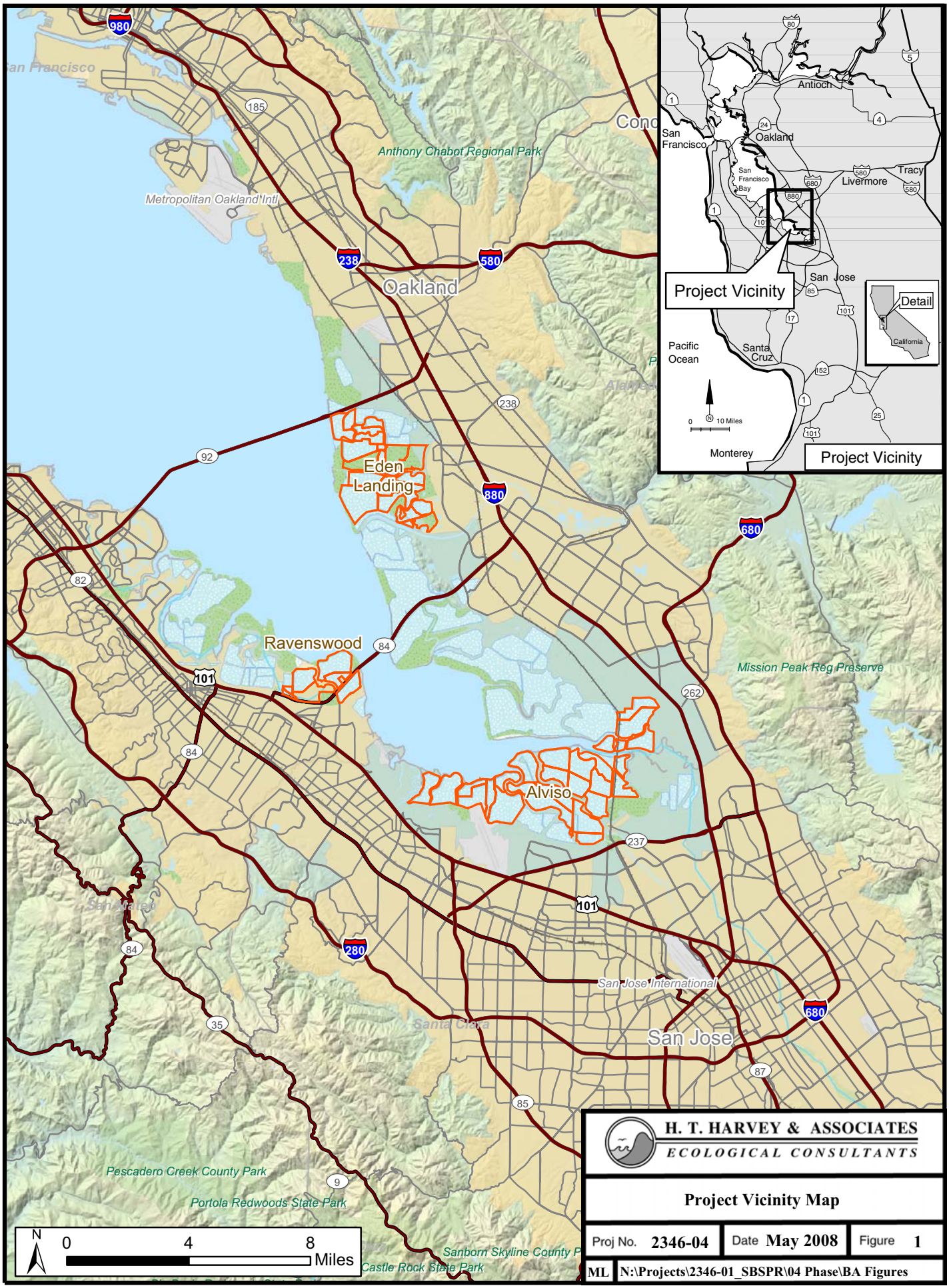
The project will be implemented in adaptive steps over a 50-yr period, resulting in 6800 to 11,880 acres of tidal habitat restoration. The project objectives are outlined in Table 1.

Table 1. South Bay Salt Pond Restoration Project Objectives.

Objective 1.	Create restore, or enhance habitats of sufficient size, function, and appropriate structure to: • Objective 1A. Promote restoration of native special-status plants and animals that depend on South San Francisco Bay habitat for all or part of their life cycles. • Objective 1B. Maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees. • Objective 1C. Support increased abundance and diversity of native species in various South San Francisco Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish, mammals, birds, reptiles and amphibians.
Objective 2.	Maintain or improve existing levels of flood protection in the South Bay area.
Objective 3.	Provide public access and recreational opportunities compatible with wildlife and habitat goals.
Objective 4.	Protect or improve existing levels of water and sediment quality in the South Bay, and take into account ecological risks caused by restoration.
Objective 5.	Implement design and management measures to maintain, or improve current levels of vector management, control predation on special-status species, and manage the spread of non-native invasive species.
Objective 6.	Protect the services provided by existing infrastructure (e.g., power lines, railroads).

A mix of restored tidal and managed pond habitats will be created by the SBSP Restoration Project. The tidal habitat will include salt and brackish marsh, mudflats, subtidal flats and channels, marsh ecotones and upland transitional zones, salt pannes and ponds, and sloughs. For managed pond habitats, multiple options for pond reconfiguration and water regime management will be used to enhance and create ponds with a variety of depths (including salt flats, very shallow ponded areas, and deep-water areas) and salinities (e.g., ponds with salinity close to bay water as well as higher salinity brine ponds), and associated levees and islands.

The final mosaic combination will be determined by an adaptive management process that will allow for lessons learned from earlier phases to be incorporated into subsequent phases as management plans and designs of future actions are updated. That mosaic may range from a minimum of 6600 acres of tidal habitat restoration and a maximum of 6600 acres of managed ponds, up to a maximum of 11,900 acres of tidal habitat and minimum of 1600 acres of managed ponds. The minimum acreage of proposed tidal restoration was determined by estimating the minimum amount needed to provide significant, large-scale tidal habitat and flood-management



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Project Vicinity Map

Proj No. 2346-04	Date May 2008	Figure 1
ML	N:\Projects\2346-01_SBSPR\04 Phase\BA Figures	

benefits, and to meet the recovery goals for threatened and endangered species within the project area footprint.

This project entails creation, restoration, and/or enhancement of habitats of sufficient size, function, and appropriate structure to promote restoration of native special-status plants and animals and maintain current migratory bird species that utilize existing salt ponds and levees. Ecosystem restoration will also support increased abundance and diversity of native species in South San Francisco Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish, mammals, birds, reptiles, and amphibians.

PROJECT TIMELINE

The Project will take place over the next 50 years in a series of subsequent phases, each of which will have a separate monitoring plan that will have common elements over time but will be adapted as more data are gathered and the overall restoration trajectory becomes more evident. Phase 1 activities are scheduled to be implemented beginning in 2008 (Table 2).

Table 2. Proposed Timeline of Phase 1 Activities.

Pond	Anticipated Start of Construction	Approximate Construction Season	Anticipated Construction Completion
A16	Summer 2009	20 September to 1 February (2-3 seasons; 24 to 36-month period)	2011 - 2012
A6	Summer 2010	20 September to 1 February	2010
A8/A8S/A5/A7	Summer 2009	30 to 36 weeks (April to mid-October)	2009
E8A/E8X/E9	Summer 2009	July to onset of rains (3 to 4-year period)	2011
E12/E13	Summer 2009	20 September to 1 February (24 months during non-breeding season)	2012
SF2	Fall 2008	20 September to 1 February (2 seasons; 24-month period)	2010

MONITORING OBJECTIVES

The objectives for the monitoring program are to ensure that the restoration meets the project's objectives by achieving the goals stated above. Monitoring and adaptive management are integral components of the Project. The Project will be implemented over many years and monitoring, combined with adaptive management will allow for lessons learned from earlier phases to be incorporated into subsequent phases as management plans and designs of future actions are updated. This approach to phased tidal restoration acknowledges that uncertainties exist and provides a framework for adjusting management decisions, as the cause-and-effect linkages between management actions and the physical and biological response of the system are more fully understood. Adaptive management is used to maximize the ability to achieve the Project Objectives. Another key aspect of the adaptive management approach is to avoid irreversible adverse environmental impacts before they occur by triggering specific pre-planned

intervention measures if monitoring reveals the ecosystem is evolving along an undesirable trajectory.

The Adaptive Management Plan (Trulio and others 2007) identifies management triggers that indicate when restoration actions are not performing as expected and potentially moving away from achieving a restoration target. The management triggers are intended to provide a warning to decision makers before a significant impact occurs. If a management trigger is tripped, further restoration would not occur until a focused evaluation is conducted to assess if a potentially significant impact would result from the Project or other factors. If the focused evaluation determines that the Project would cause a significant impact, adaptive management action to avoid the significant impact would be implemented. Ongoing monitoring would determine the effectiveness of the adaptive management action. The Project decision makers would use these results to determine whether the progression along the restoration "staircase" should continue (i.e., additional tidal restoration should occur). If the focused evaluation and/or monitoring results indicate that a significant impact would still occur even with implementation of the adaptive management action, then additional tidal restoration activities would cease. This could happen at any phase of the project.

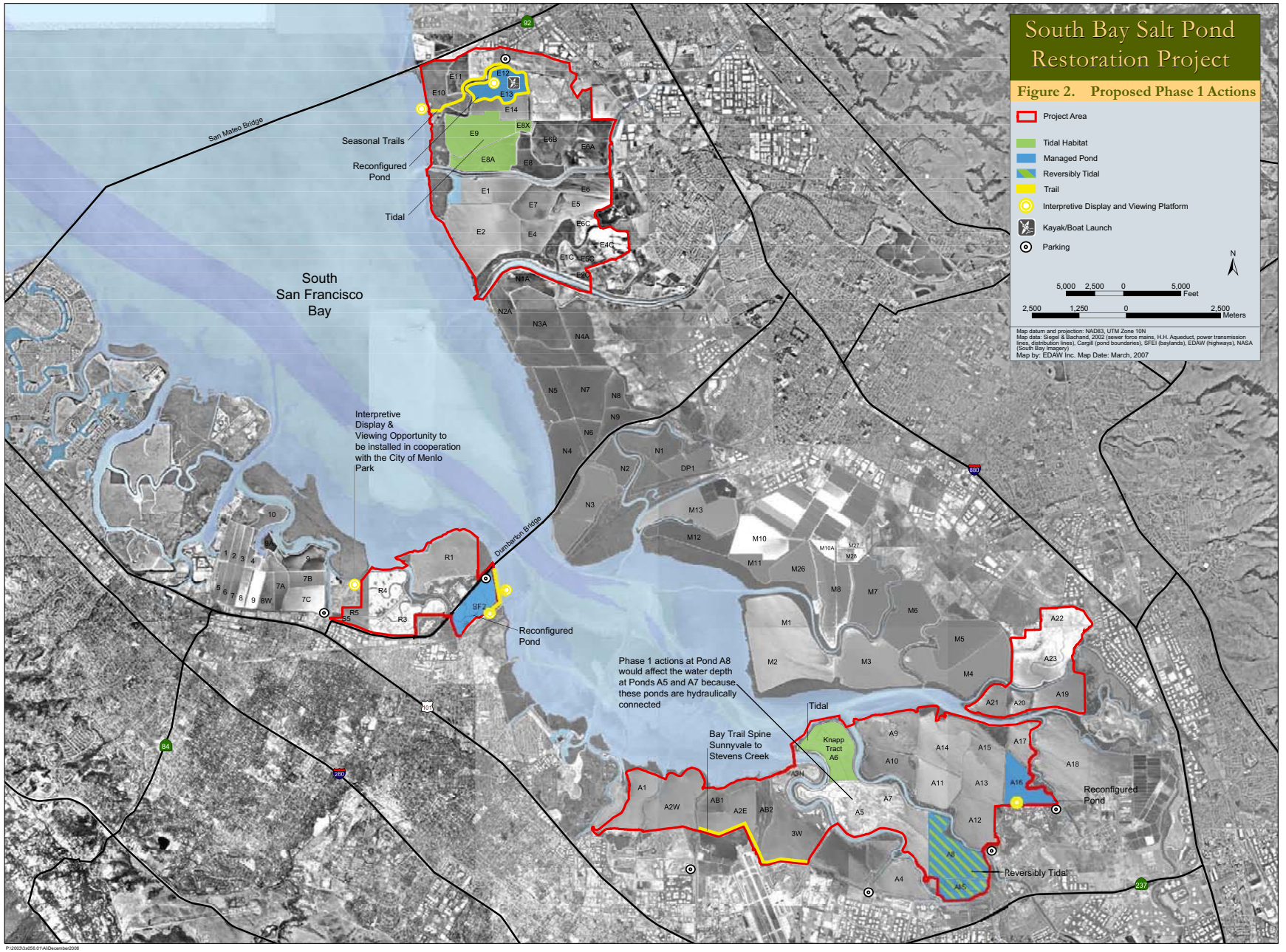
There are some special considerations for the Project. In particular, flood management actions would need to be considered in light of global climate change (e.g., sea level rise) that may require frequent reconsideration of future scenarios. This would place a premium on actions that could be successfully modified as conditions change. Public access additions would be considered in the context of species response to actions and overall response to the Project actions. Adaptive management decisions based on monitoring data will increase the project's success, especially since this project will be implemented in phases.

PHASE 1 ACTION SITE DESCRIPTIONS

Alviso Complex

Pond A6. Pond A6 is located in the South San Francisco Bay and is bordered by Coyote Creek to the north, Alviso Slough to the east, Alviso Ponds A5 and A7 to the south, and Guadalupe Slough to the west (Figure 2). Pond A6 is owned by the USFWS and is part of the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge).

Ponds A8/A8S/A5/A7. Pond A8 is located at the upstream end of Alviso Slough near the community of Alviso (Figure 2). Tidal marsh, mostly brackish, borders the outboard northern and eastern edges of Pond A8, the northern edge of Pond A7, and the southern edge of A5 (Figure 2). Ponds A5 and A7 border the western edge of Pond A8, and private property on a former landfill borders the southern edge of the A8. Pond A8 is currently managed as a seasonal pond, and Ponds A5 and A7 are operated as managed ponds. A levee, referred to as the "Hoxy Highway", currently divides Pond A8 into 2 sections, called A8N (North) and A8S (South). Ponds A5, A7, and A8 are owned by the USFWS and are part of the Refuge.


South Bay Salt Pond Restoration Project
Figure 2. Proposed Phase 1 Actions
Project Area
Tidal Habitat
Managed Pond
Reversibly Tidal
Trail
Interpretive Display and Viewing Platform
Kayak/Boat Launch
Parking
N
5,000 2,500 0 5,000 Feet
2,500 1,250 0 2,500 Meters
Map datum and projection: NAD83, UTM Zone 10N
Map data: Siegel & Bachand, 2002 (sewer force mains, H.H. Aqueduct, power transmission lines, distribution lines), Cargill (pond boundaries), SFEI (baylands), EDAW (highways), NASA (South Bay Imagery)
Map by: EDAW Inc. Map Date: March, 2007
San Mateo Bridge
Seasonal Trails
Reconfigured Pond
Tidal
South San Francisco Bay
Interpretive Display & Viewing Opportunity to be installed in cooperation with the City of Menlo Park
Dumbarton Bridge
Reconfigured Pond
Phase 1 actions at Pond A8 would affect the water depth at Ponds A5 and A7 because these ponds are hydraulically connected
Tidal
Bay Trail Spine Sunnyvale to Stevens Creek
Knapp Tract A6
Reconfigured Pond
Reversibly Tidal
92
880
101
84
237

Pond A16. Pond A16 is located in the South San Francisco Bay and is bordered by Pond A17 and Coyote Creek to the north; Artesian Slough to the east; New Chicago Marsh and the Refuge Environmental Education Center (EEC) to the south; and the New Chicago Marsh intake channel, Union Pacific Railroad (UPRR), and Alviso Ponds A15 and A13 to the west (Figure 2). Pond A16 is owned by the USFWS and is part of the Refuge.

Eden Landing Complex

Ponds E8A/E8X/E9. The Pond E8A, E8X, and E9 complex is part of the Eden Landing Ecological Reserve (ELER; Figure 2), which is owned and managed by the CDFG. The ELER is located to the south of Highway 92/San Mateo Bridge in Hayward, on the east side of San Francisco Bay. The complex is bordered by Old Alameda Creek (OAC) to the south and a tidal salt marsh (Whale's Tale Marsh) to the west. The complex is bordered by Mt. Eden Creek (MEC) on the northwest edge, Pond E14 to the north, and North Creek to the east (Figure 2). Ponds E8A, E8X, and E9 are currently managed under the Initial Stewardship Plan as system ponds.

Ponds E12/E13. Pond E12 is approximately 110 acres in size and is bordered on the south by Pond E13 and on the north and east by Mt. Eden Creek. Pond E13 is approximately 120 acres in size and is bordered by Pond E12 to the north, Mt. Eden Creek to the west and Pond E14 to the south (Figure 2). Both of these ponds are currently managed as seasonal ponds.

Ravenswood Complex

Pond SF2. Pond SF2 is adjacent to the Dumbarton Bridge and San Francisco Bay. Pond SF2 is bordered by diked marsh to the southwest and the southeast, and a small section of upland habitat borders the pond to the south. The northeast portion of the pond borders a narrow fringe marsh along the Bay. The north portion of the pond is bordered by a paved public access trail, an access road, and the Dumbarton Bridge (Highway 84), while the East Palo Alto section of University Avenue borders the west side (Figure 2). Pond SF2 is mostly owned by the USFWS and is part of the Refuge. Pond SF2 is currently managed as a seasonal pond. Cargill retains ownership of a small parcel around its Trans-bay pump in the northwest corner of the pond. In addition, Midpeninsula Regional Open Space District owns a short section of bayfront levee between the Highway 84 frontage road and the adjacent tidal marsh.

RESTORATION DESIGN

The proposed restoration will begin in 2008 with the initiation of Phase 1 actions. The timing of additional major phases of restoration is unknown. The description of future phases is fully described in the Final EIS/EIR (EDAW and others 2007). The location, extent, and timing of future restoration activities will depend largely on funding and on the results of monitoring of the effects of initial actions, the results of applied studies during the Phase 1 actions, and the construction of flood control measures relative to the restoration activities.

PHASE 1 ACTION RESTORATION

The Project will be implemented in a series of phases over many years, on the order of several decades. The initial phase (Phase 1) includes restoration and management of a range of habitat types; tidal habitat, reconfigured managed ponds, and early experiments for adaptive management. The Phase 1 restoration actions are designed to provide approximately 1,560 acres of tidal habitat (including approximately 570 acres of reversible muted tidal habitat) and 710 acres of reconfigured managed ponds across the Eden Landing, Alviso, and Ravenswood pond complexes.

The Phase 1 actions of the project will involve tidal habitat restoration, reconfiguration of managed ponds, and/or recreational/interpretive improvements at Ponds E8A, E8X, E9, E12, E13, SF2, A5, A6, A7, and A8; establishment of a kayak/boat launch, trail, and interpretive display along the northern edge of Mt. Eden Creek; establishment of the Sunnyvale-to-Stevens-Creek spine of the Bay Trail along the southern edges of Ponds A2E, AB2, and A3W; and construction of interpretive improvements at Bayfront Park (Figure 2). Because the Phase 1 actions include monitoring of a number of physical, chemical, and biological parameters, as well as applied studies, that may occur throughout the South Bay, the action area for the Phase 1 actions extends to the action area for the larger Project area. Full descriptions of restoration actions at each pond are fully described in the SBSP EIS/R (EDAW and others 2007). Brief summaries of restoration actions for each pond are summarized here.

Ponds A8/A8S/A5/A7

The Pond A8 restoration will introduce limited tidal exchange to create muted tidal habitat. Key features of the restoration design include construction of an armored notch through the perimeter levee that separates Pond A8 and upper Alviso Slough, excavation of a pilot channel outboard of the armored notch, infrastructure modification and protection, and levee improvements. These changes allow for controlled, muted tidal connections from adjacent sloughs into Ponds A8, A8S, A5, and A7 that can be subsequently modified or stopped if there is evidence of adverse ecological impacts.

Pond A6

Pond A6 will be restored to tidal habitat by breaching and lowering the outboard levee, excavating pilot channels through the fringe marsh outboard of the breaches, and constructing ditch blocks in the perimeter borrow ditch. The Pond A6 restoration will initially create large areas of emergent mudflat habitat. Over time, tidal channel and vegetated salt marsh habitats are

expected to develop in Pond A6 as tidal channels reform and as sediment accumulates and vegetation establishes on the emerging mudflats. As specified in the Adaptive Management Plan (Section 2.3 and Appendix D of the EIS/R) (EDAW and others 2007), the Pond A6 restoration will test the effectiveness of borrow ditch blocks and wave-break berms as restoration techniques.

Pond A16

Alviso Pond A16 will be reconfigured to create islands for nesting and roosting birds and shallow water habitat for shorebird foraging. Up to three cells will be created in Pond A16, with nesting islands created within each cell. Water levels in each cell will be managed using water control structures to provide optimal depths for shorebird foraging. Circulation through each cell will be managed to meet water quality targets. Outflow from Pond A16 will discharge to Artesian Slough. As specified in the Adaptive Management Plan (Section 2.3 and Appendix D of the EIS/R) (EDAW and others 2007), the Pond A16 restoration will test bird use for different island configurations, vegetation management, predator management, and water quality management.

Ponds E8A/E8X/E9

Eden Landing Ponds E8A, E9, and E8X will be restored to tidal action to create tidal salt marsh and tidal channel habitat by breaching and lowering the outboard levees, improving the levee between Pond E14 and Ponds E9 and E8X, constructing ditch blocks in the borrow ditches, maintaining existing and constructing new pond/panne habitats, and reconfiguring culvert connections. As specified in the Adaptive Management Plan (Section 2.3 and Appendix D of the EIS/R) (EDAW and others 2007), adaptive management experiments will be performed as part of the Phase 1 actions at Ponds E8A, E8X, and E9. These experiments will examine the effectiveness of mechanically disturbing a portion of the existing gypsum layer in Pond E8A prior to tidal restoration. A portion of the gypsum layer will be left undisturbed for comparison. Mapping of habitat features as part of the geomorphic evolution monitoring may be able to determine whether the gypsum layer aids in the development of marsh ponds or pannes (in higher topographic positions). Additional adaptive management experiments will help determine sedimentation rates and vegetation establishment within the tidally-restored and gypsum-covered ponds.

Ponds E12/E13

The Eden Landing Ponds E12 and E13 will be reconfigured to create shallow water foraging habitat for migratory shorebirds, with a range of salinities, and a limited number of islands for bird nesting and roosting habitat. As specified in the Adaptive Management Plan (Section 2.3 and Appendix D of the EIS/R) (EDAW and others 2007), the Ponds E12 and E13 restoration will test the extent to which focused management of shallow water habitats can increase migratory shorebird densities, the importance of salinity on the density of foraging shorebirds and their prey as applied studies, and techniques for vegetation management, predator management, and water and salinity management.

Pond SF2

The central and eastern parts of Ravenswood Pond SF2 will be reconfigured to create two cells with islands for nesting birds and shallow water habitat for shorebird foraging throughout the year. The western part of Pond SF2 will be managed to provide seasonally ponded habitat similar to existing conditions. As specified in the Adaptive Management Plan (Section 2.3 and Appendix D of the SBSP EIS/R) (EDAW and others 2007), the Pond SF2 restoration will test bird use for different island configurations as an applied study, and will also test restoration techniques for vegetation management, predator management, and water quality management.

HABITAT EVOLUTION

The Project will be implemented in a series of phases over many years, on the order of several decades. It is anticipated that each pond will be managed in a manner similar to the ISP until its implementation phase. Phase 1 will include creation of a range of habitat types (tidal habitat, and reconfigured managed ponds) as well as early experiments for adaptive management (Table 3).

Table 3. Proposed Phase 1 Restoration Actions.

Phase 1 Restoration Action	Type of Restoration	Approximate Acreage
Eden Landing Pond Complex (CDFG)		
Ponds E8A, E9, and E8X	Tidal habitat	630
Ponds E12 and E13	Reconfigured managed pond	230
Alviso Pond Complex (USFWS)		
Pond A6	Tidal habitat	330
Pond A8/A8S/A5/A7	Reversible muted tidal habitat	1400[1]
Pond A16	Reconfigured managed pond	242[2]
Ravenswood Pond Complex (USFWS)		
Pond SF2	Reconfigured managed pond	237
Total Acreage		**3,069**

[1] This acreage includes Ponds A5, A7, and A8S, which would be affected by tidal inundation over the low internal levees that separate these ponds from Pond A8.

[2] This acreage does not include Pond A17. Pond A17 will be operated to convey water from Coyote Creek into Pond A16 to manage water levels within Pond A16; species currently supported in Pond A17 are not expected to change in Phase 1.

A mosaic of habitats will be developing over the length of the phased project at varying intervals. For example, reconfigured managed ponds will begin providing the target habitats almost immediately, while the muted tidal areas will remain open water.

However, tidal restoration is a process that may take decades for the target habitat to develop. In a restoring marsh, flood tides carry in suspended estuarine sediments that deposit in the wave-protected slack waters of the flooded site. Ebb tidal currents are insufficient to resuspend deposited muds, except in the locations of nascent tidal channels. As sediment accumulates,

large areas of intertidal mudflats form. As they rise in elevation, the period of tidal-water inundation decreases and rate of sedimentation declines.

Once tidal mudflats reach a high enough elevation relative to the tidal frame, pioneer plant colonization can occur. Initial establishment usually occurs by seed or from plant fragments. Colonization becomes progressively more rapid through lateral vegetative expansion from the pioneer plants and continued deposition of seeds and plant fragments. Sites that have relatively high initial elevations will therefore reach colonization elevation more quickly than more deeply subsided sites. The Phase 1 tidal restoration projects (A6 and E8A/E9/E8X), are expected to develop over a 30-50 year timeframe resulting in the following approximate distribution of habitats:

- 50-90 % vegetated tidal marsh
- 30-50% mudflats
- 20-40% channels
- 0-10% tidal pannes

While the habitats for Phase 1 are expected to develop over a 30-50 year timeframe, habitat development in later phases of the project may take longer than the 30-50 year timeframe.

MONITORING PLAN

Monitoring elements have been designed to provide specific information for evaluating the evolution of site functions. The monitoring elements described in this plan have been selected as pertinent indicators of progress toward the project's specific goals and objectives. These elements are summarized in Table 3. More extensive descriptions of each element are provided in the Monitoring Elements section below.

MONITORING LIMITATIONS/ASSUMPTIONS

Monitoring, including the applied studies, is designed to evaluate restoration performance in light of restoration targets and to inform adaptive management and to help guide the selection of future restoration techniques. Adaptive management options are described in Section 2.3 of the SBSP Restoration Project EIS/R (EDAW and others 2007), but the very nature of adaptive management anticipates that the range of options will change.

Some elements of this monitoring plan, especially some of the physical monitoring elements, may be discontinued once there is a clear indication that the site is evolving in the predicted fashion.

MONITORING ELEMENTS

Water Quality

Water quality monitoring will begin at the initiation of each Phase 1 Action in order to ensure that South Bay water quality will not decline from baseline levels that water quality parameters in ponds meet Regional Water Quality Control Board (RWQCB) standards and that dissolved oxygen (DO) levels meet Basin Plan Water Quality Objectives to the extent possible.

Continuous discharge monitoring will occur in Ponds A5/A7/A8/A8S, A16, E12/E13, and SF2 for the first year of discharge and then be re-evaluated.

Water quality parameters (salinity, DO, pH, temperature, suspended sediment and turbidity, and trace contaminants other than mercury) will be monitored in ponds and Bay waters using methods per Takekawa and others (2005).

Water Quality Monitoring Related to Mercury

Water quality monitoring in conjunction with mercury monitoring will be based on the South Baylands Mercury Project (SBMP) sampling methods used by the San Francisco Estuary Institute (SFEI) and U.S. Geological Survey (USGS)(Collins and others 2006). Water quality sampling will be designed to provide data to evaluate the potential effects on water quality of different Pond A8 operational changes and to identify correlations between water column chemistry, sediment chemistry, methymercury production, and food web accumulation.

Table 4. Schedule for Sampling, Measurements, and Analysis for the SBSP Restoration Project.

MONITORING ELEMENT	METHODS	LANDSCAPE SCALE	PHASE 1 ACTION PONDS[2]						ISLAND[8] PONDS	OTHER[8] PONDS
WATER QUALITY	**METHODS**	**LANDSCAPE SCALE**	**A6**	**A5/A7/A8/A8S**	**A16**	**E8A/E9/ E8X**	**E12/E13**	**SF2**	**A19/A20/A21**	**OTHER PONDS**
Salinity	Methods per Takekawa and others (2005)	N/A	N/A	Monthly[3] Continuous[4]	Monthly[3] Continuous[4] In-Pond[5]	N/A	Continuous[4] In-Pond[5]	Continuous[4] In-Pond[5]	N/A	In conjunction with biological surveys
PH	Methods per Takekawa and others (2005)	N/A	N/A	Monthly[3] Continuous[4]	Monthly[3] Continuous[4] In-Pond[5]	N/A	Continuous[4] In-Pond[5]	Continuous[4] In-Pond[5]	N/A	In conjunction with biological surveys
Temperature	Methods per Takekawa and others (2005)	N/A	N/A	Monthly[3] Continuous[4]	Monthly[3] Continuous[4] In-Pond[5]	N/A	Continuous[4] In-Pond[5]	Continuous[4] In-Pond[5]	N/A	In conjunction with biological surveys
Dissolved oxygen	Methods per Takekawa and others (2005)	N/A	N/A	Monthly[3] Continuous[4]	Monthly[3] Continuous[4] In-Pond[5]	N/A	Continuous[4] In-Pond[5]	Continuous[4] In-Pond[5]	N/A	In conjunction with biological surveys
Mercury Suite: MeHg, HgT, Salinity, Temperature, DO, DOC, TOC, SSC, Sulfate, Sulfide, Nutrients, and pH	Water Sampling based on methods described in the South Baylands Mercury Project (SBMP)	N/A	Proposal to be submitted by September 1, 2009[6]	Proposal to be submitted by September 1, 2009[6]	N/A	N/A	N/A	N/A	N/A	N/A
SEDIMENT QUALITY	**METHODS**	**LANDSCAPE SCALE**	**A6**	**A5/A7/A8/A8S**	**A16**	**E8A/E9/ E8X**	**E12/E13**	**SF2**	**A19/A20/A21**	**OTHER PONDS**
Mercury Suite: HgT, MeHg, Sulfate, Sulfide	Sediment core sampling based on methods described in SBMP	N/A	N/A	Proposal to be submitted by September 1, 2009[6]	N/A	N/A	N/A	N/A	N/A	N/A
GEOMORPHIC EVOLUTION	**METHODS**	**LANDSCAPE SCALE**	**A6**	**A5/A7/A8/A8S**	**A16**	**E8A/E9/ E8X**	**E12/E13**	**SF2**	**A19/A20/A21**	**OTHER PONDS**
Mudflats and Channels	Remote sensing/aerial photography/mudflat and channel mapping[4]	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly
Habitat Development	Remote sensing/aerial photography/ habitat mapping[7]	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly	Baseline; then yearly

MONITORING ELEMENT	METHODS	LANDSCAPE SCALE	PHASE 1 ACTION PONDS[2]						ISLAND[8] PONDS	OTHER[8] PONDS
BIOTA	**METHODS**	**LANDSCAPE SCALE**	**A6**	**A5/A7/A8/A8S**	**A16**	**E8A/E9/ E8X**	**E12/E13**	**SF2**	**A19/A20/A21**	**OTHER PONDS**
Sentinel Species	Monitoring to determine Mercury uptake as described by the SBMP	N/A	N/A	Proposal to be submitted by September 1, 2009[6]	N/A	N/A	N/A	N/A	N/A	N/A
Invasive *Spartina* & hybrids and other invasive plants	Field observations and vegetation mapping / coordination with the Invasive *Spartina* Project	Yearly	Yearly	Yearly; outboard marsh	Yearly; outboard marsh	Yearly; outboard marsh	Yearly	Yearly; outboard marsh	Yearly; outboard marsh	Yearly; outboard marsh
Fish	Pelagic and demersal fish sampling using appropriate gear for fish type[9]	Quarterly; before and after construction	Quarterly; before and after construction	N/A	N/A	Quarterly; before and after construction	N/A	N/A	N/A	N/A
ENDANGERED SPECIES	**METHODS**	**LANDSCAPE SCALE**	**A6**	**A5/A7/A8/A8S**	**A16**	**E8A/E9/ E8X**	**E12/E13**	**SF2**	**A19/A20/A21**	**OTHER PONDS**
California least tern	Counts of foraging birds and breeding pairs as outlined in the EIS/R	Yearly	N/A	N/A	Yearly	N/A	Yearly	Yearly	N/A	Monthly during nesting season
California clapper rail	Habitat based, see Habitat Development above; also as outlined in the EIS/R	Yearly evaluation of habitat development	Baseline, then yearly; site specific surveys begin 5-10 years after marsh vegetation establishment	N/A	N/A	Baseline, then yearly; site specific surveys begin 5-10 years after marsh vegetation establishment	N/A	N/A	Baseline, then yearly; site specific surveys begin 5-10 years after marsh vegetation establishment	N/A
Western snowy plover	Counts of nesting birds and chicks as outlined in the EIS/R	Yearly	N/A	N/A	Monthly during nesting season	N/A	Monthly during nesting season	Monthly during nesting season	N/A	Monthly during nesting season
Salt Marsh Harvest Mice	Habitat based, see Habitat Development above; also as outlined in the EIS/R	Yearly evaluation of habitat development	Baseline, then yearly; trapping to take place 5-10 yrs after 300 acres of pickleweed establishment per unit	N/A	N/A	Baseline, then yearly; trapping to take place 5-10 yrs after 300 acres of pickleweed establishment per unit	N/A	N/A	Baseline, then yearly; no trapping proposed	N/A

NOTES:

Monthly: in Summer (May through October) for the first year of operation, then review data along with in-pond study results (see Footnote 4) to help determine future adaptive management actions and/or modification of monitoring program.
Continuous: in Summer (May through October) for the first year of operation, then review data along with in-pond study results (see Footnote 4) to help determine future adaptive management actions and/or modification of monitoring program.

[1] Consistent with the SBSP Restoration Project Adaptive Management Plan, the monitoring data generated from this program will be evaluated, together with results of Applied Studies and other monitoring, by review panels convened by the Project's Lead Scientist. All of the results and scientific evaluations will be presented to the Project Management Team and the regulatory agencies for consideration of adaptive management actions and/or monitoring program changes. In addition, the Project will convene at least one public meeting per year to present results of the prior year's actions and plans for the following year.

[2] Monitoring to begin when each Phase 1 Action is initiated.

[3] Receiving Water.

[4] Discharge.

[5] In-pond special studies are being performed in Ponds A3W, A14, and A16 during the summer of 2008 by the USGS. A proposal for Phase 1 studies will be submitted by May 1, 2009 after analysis of the 2008 in-pond study data is complete.

[6] Mercury bioavailability and mercury uptake in sentinel species are the topics of a special study associated with the Pond A8 restoration, titled the South Baylands Mercury Project (SBMP). Sampling of pre-project conditions has occurred in 2006 and 2007 and is continuing in 2008. A proposal for additional monitoring will be submitted by September 1, 2009, after analysis of the SBMP data is complete.

[7] **Satellite Imagery:** IKONOS images (or equivalent) for the entire Study Area are proposed to be captured in early summer at the lowest tide possible. The time and date of the images will be provided for use in determining the tidal datum for subsequent years' comparison. The 1-meter Multispectral (4-bands) Color Infrared & True Color satellite imagery will be projected in UTM NAD83 (meters) Zone 10 North. All habitat mapping will be based upon the imagery obtained and completed at a 1:2400 (1" = 200') scale. **Habitat Mapping:** The Project proposes to map all intertidal mudflat and subtidal habitats south of the San Bruno Shoal area. Marsh habitat mapping will be limited to SBSP Project ponds and tidal marsh areas from Steinberger Slough on the west side of the Bay (including Bair Island), to the Hayward Shoreline area on the east side of the Bay that corresponds to the USFWS Endangered Species Recovery Units. Proposed vegetation mapping units will include those alliances most likely to occur within the project site and will be assigned using the California Manual of Vegetation (Sawyer and Keeler-Wolf 1995) naming system.

[8] Ponds not part of Phase 1, but are included in order to illustrate the complete monitoring program.

[9] Pelagic fish sampling gear may include (fyke nets, beach seines, throw nets or pop nets). Demersal fish sampling may be performed using beam trawls modified to two in soft mud by hand or by winch from shore. Additional monitoring protocols may be added per ongoing discussions with the National Marine Fisheries Service (NMFS).

Mercury bioavailability and mercury uptake in sentinel species are the topics of a special study currently underway related to the Pond A8 restoration (the SBMP). Pre-project sampling has occurred in 2006 and 2007 and will continue in 2008. A proposal or additional monitoring will be submitted by September 1, 2009 after analysis of the SBMP data is complete. Water quality sampling related to mercury may be conducted monthly in Ponds A6 and A5/A7/A8/A8S, with additional sampling in response to important events.

Mercury Sediment Monitoring

Mercury sediment monitoring is expected to be based on sediment core sampling as described in ongoing work by the SBMP. It will be linked with the water quality and biota sampling identified in the previous sections of this Plan. A monitoring proposal for mercury sediment monitoring will be submitted by September 1, 2009.

Geomorphic and Marsh Evolution (Vegetation and Channel Mapping)

The habitat evolution of the Project Area will be monitored using methods as described below (or equivalent) based on responses to a Request for Proposals (RFP) to be issued by the Project sponsors.

In order to develop accurate representations of the developing vegetative marsh associations and extent of intertidal mudflat in the Study Area and to serve as a baseline from which the SBSP Restoration Project can assess year-to-year changes in those habitats, vegetation mapping will be performed based on reconnaissance site visits to pre-determined areas using an adaptation of the Reconnaissance Field Form adopted by the California Native Plant Society (CNPS) while working with Aerial Information Systems (AIS). This method is particularly valuable in assessing relatively large, ecologically defined areas, and will be used to create a draft habitat map from which an accuracy assessment will be conducted.

This monitoring effort will be performed at the landscape scale and include mapping all intertidal mudflat and subtidal habitats south of the San Bruno Shoal area. Marsh habitat mapping will be limited to tidal marsh areas from Steinberger Slough on the west side of the Bay, to the Hayward Shoreline area on the east side of the Bay that corresponds to the USFWS Endangered Species Recovery Unit. These areas will collectively be known as the Study Area and will be clearly defined before the mapping is initiated.

The following proposed mapping units include those alliances most likely to occur within the project site and were assigned using the California Manual of Vegetation (CMV) (Sawyer and Keeler-Wolf 1995) naming system. This floristic approach, which is supported by extensive field data, identifies alliances and association types that are repeatable within the landscape. The continually updated NatureServe data (www.natureserve.org) which is based upon the CMV technique and adheres to the National Vegetation Classification System in use by CDFG, our National Park System, and most federally funded programs will be used as a reference. In addition, where an appropriate alliance is not currently named, map unit names may be modified to suit the needs of this particular project (i.e., lifeform or morphologically identified names). The mapping units may include the following categories, with categories added or subtracted as needed to classify the habitats:

Subtidal/Open Water Habitat. Includes deepwater habitat below the elevation of the tidal mudflats. These are areas that are permanently inundated.

Intertidal Mudflat. Includes areas regularly flooded and drained by the tides that are not vegetated with emergent, vascular plants. Also includes areas within tidal channels and along the interface between tidal salt marsh and the subtidal/open water habitats of the Bay.

Giant Bulrush Semipermanently Flooded Herbaceous Alliance. (*Schoenoplectus californicus*): giant bulrush sole or dominant vegetative cover (considered brackish in nature); formerly *Scirpus californicus*.

Narrowleaf Cattail/Southern Cattail Tidal Herbaceous Alliance. (*Typha angustifolia*/*Typha domingensis*) is the dominant vegetative cover.

Narrowleaf Cattail/Broadleaf Cattail – Bulrush species Semipermanently Flooded Herbaceous Alliance. (*Typha angustifolia*/*Typha latifolia* with *Schoenoplectus* spp.) Cattail and bulrush species co-dominate vegetative cover.

Alkali Bulrush Semipermanently Flooded Herbaceous Alliance. (*Schoenoplectus robustus*): alkali bulrush sole or dominant vegetative cover (considered brackish in nature); formerly *Scirpus robustus*.

Peppergrass Dominated Vegetation. (*Lepidium latifolium*) is the dominant vegetative cover.

Spearscale Dominated Vegetation. (*Atriplex triangularis*) is the dominant vegetative cover.

Cordgrass Tidal Herbaceous Alliance. (*Spartina foliosa*, *S. alterniflora* and hybrid *S.* spp.) Cordgrass is the sole or dominant vegetative cover with herbs in the understory; considered saline.

Pickleweed Tidal Herbaceous Alliance. (*Sarcocornia pacifica*) Pickleweed is the sole or dominant vegetative cover; considered saline; formerly *Salicornia virginica*.

Gumplant Dominated Vegetation (not identified in NatureServe). (*Grindelia* spp.) Gumplant is the sole or dominant vegetative cover.

Dead Vegetation. Areas of dead vegetation are the sole or dominant cover.

Peripheral Halophytes. This series includes a patchwork of species that generally occur along salt marsh edges such as levee slopes. Within this mixture, no one species exceeds 15% cover. The mixture of species may include pickleweed, alkali heath (*Frankenia salina*), and Australian saltbush (*Atriplex semibaccata*) and also mapping will include non-natives and invasive plant species, such as slender-leaved iceplant (*Mesembryanthemum nodiflorum*).

Upland Species. The upland series includes species not considered by the USFWS (1988) to be wetland indicators. These include ruderal species such as black mustard (*Brassica nigra*), sweet fennel (*Foeniculum vulgare*), and coyote brush (*Baccharis pilularis*). These species are categorized as occurring primarily in upland areas near freshwater habitat types.

Vegetation Mapping Protocol

1. Field Pre-mapping Site Visits. Pre-mapping site visits will be used to collect reconnaissance data on pre-selected, unique stands of vegetation to include a subset of marshes identified through unique, distinguishable aerial imagery signatures and previous knowledge of these vegetation types. Adequate reconnaissance points will be visited to give knowledge of each distinguishable aerial photograph signature and to sample enough stands of vegetation that different salinity marshes throughout the entire project area are sampled. Particular attention will be given to areas of new marsh development (particularly in restored ponds) and to brackish/salt transition marshes, which typically have more complex photographic imagery signatures. The primary function of the pre-mapping site visits is to identify the color infrared (CIR) signatures and assign habitat associations to those signatures.

2. Habitat Mapping. Habitat mapping will be performed by wetland ecologists and botanists trained in GIS and photo-interpretation. Habitat associations will be assigned based on photographic imagery signatures and habitat associations that have been determined during earlier site visits. The study area will be mapped in the office using laptop computers (e.g., Panasonic Toughbook 18) equipped with GIS software (e.g., ArcView 9).

Muted tidal or diked marshes will not be mapped unless they are specifically a part of the SBSP project. Mapping will also include habitats within all of the SBSP project area ponds, including any vegetation establishment within those ponds.

3. Field Verification Site Visits. Quality Assurance/Quality Control (QA/QC) techniques will be used and will include extensive field verification of the preliminary vegetation mapping. A separate team of ecologists will independently spot-check a pre-selected number of sites within each habitat category using the same modified Reconnaissance Method as described above.

4. Accuracy Assessment. An accuracy assessment matrix will be constructed to compare the independent field verification mapping with the accuracy of the mapping performed in the office. The expected accuracy for all mapped habitat is 80% or greater. If the 80% criterion is not reached, areas mapped in error (i.e. where discrepancy between mapping in the office and field verification exists) will be analyzed to determine any trends in misinterpretation of the habitat signatures. A re-evaluation of the CIR signature habitat classification will be performed, and the areas of uncertainty will be re-mapped to meet the 80% criterion. If it is determined that error occurs not because of a mapping error, but because of an inability to distinguish map units (i.e. aerial signature differences are not adequate to distinguish stands of vegetation), new mapping categories will be developed to meet the 80% criterion.

5. Spatial Analysis. Acreage calculations by vegetation alliance shall be performed in a Geographic Information System (GIS) format. An electronic database will be created containing all habitat types. This database shall be linked to each corresponding map graphic polygon in the

ArcView shape file format, and an electronic copy of the ArcView files. A set of 11" x 17" hard copy maps of the Study Area to include scale, north arrow and legend, a presentation sized plan (size E), featuring the entire Study Area and illustrating habitat types, and an electronic copy of all graphic data files created for this project shall be digitized into an ArcInfo/ArcView GIS format approved by the Conservancy.

The proposed mapping will encompass all of the tidal wetlands and intertidal mudflats in South San Francisco Bay. Annual monitoring at this scale will be an important component of the Adaptive Management program to fully assess the shifts in habitat types from year-to-year and through time as large-scale restoration actions are undertaken.

6. Quadrat or Transect Sampling. Quadrat or transect sampling will occur once a restored marsh has reached 20% vegetation cover. Once 40% native vegetation cover has been achieved, species composition data will be collected (in years corresponding to the habitat mapping) in a variety of zones (low marsh, high marsh, upland transition) within each restored marsh.

Mercury Monitoring of Sentinel Species

The mercury sampling for biota for this project will be based on the SBMP sampling currently underway by SFEI, USGS, and the Santa Clara Valley Water District (SCVWD) and is fully described in Collins and others (2006). Mercury bioavailability and mercury uptake in sentinel species are the topics of the SBMP. Pre-project sampling has occurred in 2006, 2007 and 2008. A proposal for additional monitoring will be submitted by September 1, 2009, after analysis of the SBMP data is complete. Excerpts from the SBMP monitoring plan are included in this monitoring plan and are summarized in Table 3.

The information from this monitoring may be used to guide the decision-making process before, during, and after the restoration process. In addition, the monitoring results may be used to make comparisons between different habitat characteristics (e.g., to compare mercury concentrations between high and low elevation marsh plain, pond margins and marsh panes, fringing marsh and reference marshes, and across the landscape among similar habitat types).

Monitoring will consist of measuring MeHg concentrations in sentinel species populations. The following sentinel populations were developed based on cross-referencing the species with the habitat types of most interest. As the project progresses, additional sentinel species may be added if warranted (Table 5). The general sampling scheme for sentinel species monitoring is summarized in Table 6.

Table 5. Phase 1 Habitats, Geographic Areas, and Associated Candidate Sentinel Species (from Collins and others 2006).

Habitat Type	Location of Habitat Type in the Geographic Areas to be Sampled			Candidate Sentinel Species
	Ambient Marshes	Pond A8	Alviso Slough Marshes	
Vegetated marsh plains	X	--	X	Alameda song sparrow (*Melospiza melodia pusillula*)
Marsh panes and managed pond margins	X	X	X	Brine fly (*Ephydra* spp.)
Benthic zone of channels and managed ponds	X	X	X	Longjaw mudsucker (*Gillichthys mirabilis*)
Pelagic zone of channels and managed ponds	X	X	X	Topsmelt (*Atherinopsis affinis*)

Candidate species for sentinel species monitoring will be confirmed within the selected habitat types and locations in the South Bay. If necessary, alternate sentinel species candidates will be selected.

Table 6. General Sampling Scheme for Sentinel Populations during Phase 1 (from Collins and others 2006).

Habitats	Species per Habitat	Geographic Areas to Compare	Sample Replicates per Geographic Area	Sampling Periods per Year	Samples per Year
4	1	3	30	1	360

Invasive *Spartina* and its Hybrids

Spartina will be mapped during yearly mapping surveys as an element of the Geomorphic Evolution monitoring described above. Field observations, mapping, and sampling for genetic analysis will follow the Guidelines to Monitor the Distribution, Abundance, and Treatment of Non-Indigenous Species of Cordgrass in the San Francisco Estuary (Collins and May 2001). As *Spartina* is mapped during Geomorphic Evolution monitoring, input will be provided to the Invasive *Spartina* Project to help inform coordination of their ongoing eradication efforts.

Fish

A separate draft fish monitoring plan has been developed in coordination with the National Marine Fisheries Service (NMFS). The plan describes the objectives and methods for monitoring fish assemblages and habitat conditions in South San Francisco Bay and fish use of South Bay ponds being restored to tidal circulation as part of the South Bay Salt Pond Restoration Project. It partly focuses on those ponds restored to tidal action, and the fish assemblages that use these restored areas as they evolve toward mature tidal marshes with well defined channel systems. It also focuses on the Bay itself, to monitor changes in the abundance and diversity of fish and the invertebrates upon which they forage. Additionally, monitoring protocols have been established in the event that fish mortality is observed in the project ponds.

Pelagic and demersal fish assemblages will be evaluated quarterly, using appropriate gear (fyke nets, beach seines, throw nets or pop nets) to minimize potential for mortality or injury should listed steelhead be captured. Demersal fish assemblages will be evaluated using beam trawls modified to tow in soft mud by hand or by winch from shore. If deployment is required from levees, access will be primarily by foot and therefore monitoring will be subject to seasonal limitations associated with other listed bird and mammals.

California Least Tern

Monitoring for California least terns has been designed to provide data to determine whether the project is contributing to maintenance of post-breeding populations in the SBSP Project Area. Monitoring data will be also be used to determine whether the project is avoiding possible negative effects of the SBSP Restoration Project on breeding California least terns. The Project would have a negative impact on California least terns if it resulted in a decrease in foraging habitat or prey availability for post-breeding dispersants in the South Bay, leading to a decline in the Bay Area breeding population relative to baseline levels. Counts of California least terns will be performed yearly throughout the South Bay, with focused counts in Ponds A16, E12/13, and SF2. These counts will monitor the number of birds using the South Bay for post-breeding foraging (or breeding, if that occurs) and include counts of breeding pairs at Bay Area nesting colonies.

Western Snowy Plovers

Monitoring for western snowy plovers within the SBSP Restoration Project Area is designed to provide data to determine if the project is contributing to the Recovery Plan goals for plover population levels in the Bay Area, including maintaining a 5-year average productivity level as required by the Recovery Plan for snowy plovers.

Monthly monitoring will include surveys of Ponds SF2, A16, E12/E13, and other non-Phase 1 salt ponds. Surveys for plovers will determine which habitats are used for breeding, the number of adult plovers with nests, and reproductive success. Avian predator surveys will be conducted concurrently with the nesting surveys to determine predation pressure on species of concern.

California Clapper Rails

Monitoring for California clapper rails will be initiated after marsh development occurs, as described as outlined in the EIS/R (EDAW and others 2007).

Habitat monitoring will include a baseline survey, followed by yearly monitoring of habitat development at a landscape scale. Site-specific surveys in Ponds A6, E8A/E9/E8X, and in the Island Ponds will begin 5-10 years after marsh vegetation establishment. After marsh vegetation establishes, breeding season surveys (following USFWS approved survey protocols) will be implemented. Monitoring data will be used to track the rail population in the restored habitats and to implement adaptive management as determined necessary.

Salt Marsh Harvest Mice

Initially, salt marsh harvest mice monitoring will largely depend upon the vegetation mapping-based habitat assessment, as outlined in the EIS/R (EDAW and others 2007). This method will annually evaluate the amount of potential salt marsh harvest mouse habitat in the newly restored marshes and will also evaluate potential salt marsh habitat development over a landscape scale.

Habitat monitoring will include a baseline survey, followed by a yearly evaluation of vegetation establishment. Site-specific salt marsh harvest mice trapping in E8A/E9/E8X, and in the Island Ponds will begin to take place 5-10 years after a minimum of 300 acres of pickleweed establishes. Salt marsh harvest mouse trapping will be conducted using Sherman live-traps, following USFWS-approved survey protocols and permit conditions. The monitoring data will be used to track the use of restored habitats by salt marsh harvest mice.

Applied Studies

Applied studies are planned for individual Phase 1 actions (by pond or pond complex), and are described in the SBSP Restoration Project EIS/R (EDAW and others 2007). The applied studies will be performed as needed to help assist in management decisions and future pond design. The exact timing and study design for each study will be based on timing of the particular Phase 1 action, availability of funding, and results of the RFP process(es) that the Project expects to use to identify the exact study approach in each case.

Adaptive Management

The Phase 1 Adaptive Management Summary Table (Table 7) describes the management triggers and potential management actions for the Phase 1 monitoring described in this document. These activities reflect only the monitoring activities specific to Phase 1 of the South Bay Salt Pond Restoration Project.

Each row of this table focuses on a restoration target that provides a quantitative or qualitative goal. Targets are typically based on information compiled from existing literature or generated from baseline monitoring, as discussed in the overall SBSP Project Adaptive Management Plan (Trulio and others 2007). Monitoring parameters describe the physical, biological, and social variables to measure progress toward restoration targets. Management triggers define the point at which monitoring data indicate an appropriate time when intervention may be necessary. These triggers have been selected to allow for management action before any changes result in a significant adverse environmental impact. Information generated by additional applied studies will also inform the management response.

Table 7. Phase 1 Adaptive Management Summary Table.

CATEGORY	RESTORATION TARGET	EXPECTED TIME-FRAME FOR DECISION MAKING	MANAGEMENT TRIGGER	POTENTIAL MANAGEMENT ACTION
Water Quality	Water quality parameters in ponds will meet RWQCB standards South Bay water quality will not decline from baseline levels Dissolved oxygen (DO) levels meet Basin Plan Water Quality Objectives	Ongoing	• Annual data review to determine variation from past trends • Review of monitoring results indicate abnormal conditions • Other indication of abnormal conditions such as fish mortality events • Increases in chlorophyll-a to levels indicating eutrophic conditions • Increase in sediment oxygen demand to levels indicating risk of low DO • Low dissolved oxygen in ponds or receiving waters	• Applied studies to find causes of water quality problems in ponds (salinity, temperature, wind speed, solar radiation, sediment oxygen demand, and net primary production) • Applied studies of Bay-wide conditions • Applied studies of WQ effects on pond/Bay species (plankton, shrimp, fish, birds) • Active management such as baffles, aerators, etc. • Review all available data. • Reduce pond residence times. • Accelerate conversion from managed ponds to tidal habitat. • Decrease pond residence times • Introduce re-aeration mechanisms at discharge points
Sediment Dynamics	No significant decrease in South Bay intertidal and subtidal habitats (south of San Bruno shoal), including restored pond mudflat, intertidal mudflat, subtidal shallow and subtidal channel areas.	Change in tidal mudflat & subtidal shallow: 10-20 years, assuming significant tidal habitat restoration continues beyond Phase 1. Subtidal channel change: 0-5 years	• Outboard mudflat decreases greater than the range of natural variability + observation variability/error	• Convene study session to review and interpret findings to assess if observed changes are due to restoration actions or system-wide changes in the sediment budget (e.g., effects of sea level rise) • Study biological effects of loss of mudflat, subtidal shallows, and/or subtidal channel habitat. • Potential actions include remove bayfront levees to increase wind fetch and sustain tidal mudflat.
	Accretion rate of the restored ponds is sufficient to reach vegetation colonization elevations	2-10 years depending on initial pond elevation	• Projections based on the rate of inboard mudflat accretion suggest vegetation colonization elevations are not likely to be achieved within the planning time frame	• Convene study session and review findings to assess if observed changes are due to restoration actions and whether colonization is compromised. • Study biological effects of slower tidal flat evolution. • Adjust phasing and design to increase inboard mudflat accretion. Potential management actions include adding wave breaks or adding fill.

CATEGORY	RESTORATION TARGET	EXPECTED TIME-FRAME FOR DECISION MAKING	MANAGEMENT TRIGGER	POTENTIAL MANAGEMENT ACTION
	No long-term loss of vegetated tidal marsh throughout the South Bay.	10-20 years	• Observed net loss of tidal salt marsh (area of outboard fringe marsh losses > the area of tidal marsh in restored ponds) greater than the range of natural variability and/or observational variability/error.	• Convene study session to review findings to assess if observed changes are due to restoration actions. • If tidal marsh area is not meeting projections, assess biological significance of long-term loss of tidal marsh. • Adjust phasing and design to accelerate marsh development. Potential management actions include filling to colonization elevations, adding wave breaks and/or preserving levees. • Adjust phasing and design to reduce erosion of exiting marsh. For example, phase tidal restoration to match sediment supply and demand.
Mercury	Levels of Hg in sentinel species do not show significant increases over baseline conditions	1-3 years depending on specific data and overall geographic scope	• One or more sentinel species show higher levels of Hg in target habitats than existing habitats • One or more sentinel species show higher than ambient levels of Hg in Pond A8 or Alviso Slough	• Applied study of sources of Hg and causes of increases • Applied study of sediment capping methods (if relevant) • Applied study of methylation processes (e.g., photo-degradation, microbial methylation) • Undertake preventative dredging or prevent draining of interstitial spaces or pore water.
Tidal Marsh Habitat Establishment	Tidal marsh vegetation/habitat mosaic (including vegetation acreage and density, species composition, acreage of mudflat, channels, marsh ponds and transition area) is on a trajectory toward a reference marsh and/or other successful marsh restoration sites in south San Francisco Bay.	Establishment depends on initial pond elevation, vegetation colonization anticipated to be detectable within 5 years (or less) of reaching appropriate elevation, while habitat development trajectory anticipated to be detectable within 15 years (and possibly less) of	• Vegetation deviates significantly (30-50%) from projected trajectory after colonization elevation is achieved. • Channel and marsh pond formation does not occur as predicted. • Non-native *Spartina* present on the site.	• Review sediment dynamics • Study causes of slow vegetation establishment and channel development (ex: gypsum) • Active revegetation • Increased non-native invasive species control • If invasive species cannot be controlled, study biotic response to non-native vegetation • Continue to re-evaluate what is meant by "control" of invasive species and adjust monitoring and management triggers based on the latest scientific consensus

CATEGORY	RESTORATION TARGET	EXPECTED TIME-FRAME FOR DECISION MAKING	MANAGEMENT TRIGGER	POTENTIAL MANAGEMENT ACTION
		the onset of vegetation colonization		
Flood Protection	No increase in tidal or fluvial flood risk at any project phase and improve tidal and fluvial flood protection in the South Bay in specific areas.	Slough channel cross-sections, marshplain accretion, and water levels: rapid initial response (within approximately five years) followed by slower changes over decades. Flood high waters: approximately every ten years (depends on timing of large events) Levee erosion: same timeframe as channel cross-section and marshplain accretion responses above, or as dictated by rainfall, tidal, and other events. Relative sea level rise: approximately ten years or longer.	• Flood modeling predicts a current or future increase in flood rise (e.g., decrease in levee freeboard). • Significant levee erosion observed • Elevated water surface elevations projected by modeling effort and/or observed in the field • Field data collection and/or observation indicates that flood risk is greater than that predicted by models (e.g., water surface elevation is higher)	• For example, set back or lower additional levees to increase flood conveyance or dredge channels. • Adjust levee maintenance or implement levee improvements (e.g., widen shoulder, raise, armor, set back levee)
Algal Composition and Abundance	Nuisance and invasive species of algae are not released from the Project Area to the Bay Algal blooms do not cause low DO within managed ponds	Annually	• Nuisance macrophytes are observed • Harmful exotic species of phytoplankton are characterized in the Bay	• Introduce artificial shading
California Least Tern	Maintain numbers of post-breeding California least	Local changes in abundance may be immediate	• Decline in total number of birds using the south Bay as a post-breeding	• If numbers decline, first use available information to attempt to determine whether

CATEGORY	RESTORATION TARGET	EXPECTED TIME-FRAME FOR DECISION MAKING	MANAGEMENT TRIGGER	POTENTIAL MANAGEMENT ACTION
	terns in the Project Area at multi-year average levels including natural variation in numbers; avoid negative effect of SBSP Restoration Project on Bay-area least tern breeding bird numbers (multi-year average levels with natural variation)	upon changes in management (e.g., reconfiguration and management of a pond, or conversion of a salt pond bottom to intertidal mudflat upon breaching of levees). Larger-scale changes in abundance will likely be slower (on the order of years to decades).	foraging area or breeding pairs in the s. F. Bay Area below 2006 baseline levels, in any given year.	declines are resulting from SBSP Restoration Project or other factors (e.g., the impact of south Bay California gulls on nesting colonies or changes in Bay fisheries). • Conduct applied study of post-breeding habitat use and diet, especially in the South Bay. • Implement management or adjust design (e.g., if applied study finds more foraging occurs in ponds than Bay, manage more for suitable least tern foraging conditions).
California Clapper Rail	Meet recovery plan criteria for clapper rail habitat within the SBSP Restoration Area	Likely decades for high-quality tidal marsh development (10-year targets)	• See triggers for *Sediment Dynamics, Tidal Marsh Habitat Establishment*	• See *Tidal Marsh Habitat Establishment*
	Meet recovery plan criteria for clapper rail numbers (0.25 birds/ac over 10-year period) within the SBSP Restoration Project Area	Monitoring not expected to show substantial results until 5-10 years after cordgrass establishment in 300 acres or more (10-year targets)	• Numbers drop below 0.20 birds/ac in any given year for Project Area as a whole • Rate of increase in clapper rail numbers deviates significantly from projection	• See *Tidal Marsh Habitat Establishment* • Applied studies of habitat parameters, contaminant levels, and predation pressure related to rail densities and productivity (and implement related management actions as appropriate)
Western Snowy Plover	Contribute to the recovery of the western snowy plover by providing habitat to support 250 breeding birds within SBSP Restoration Project Area, and maintain a 5-year average productivity level as required by the Recovery Plan	Local changes in abundance are expected to be immediate upon changes in management (e.g., reconfiguration and water level/prey management of ponds). Longer-term trends will be monitored annually.	• Rate of population change declines substantially from projected trajectory toward target • South Bay population declines in any given year below 2006 baseline	• Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors (taking into account the downward trends in abundance of plovers over the last few decades, which are unrelated to salt pond conversion). • If declines are likely the result of SBSP Restoration Project: • Undertake applied studies of habitat parameters, contaminant levels, prey

CATEGORY	RESTORATION TARGET	EXPECTED TIME-FRAME FOR DECISION MAKING	MANAGEMENT TRIGGER	POTENTIAL MANAGEMENT ACTION
				levels/type, juxtaposition of nesting and brood rearing/foraging areas, predation pressure, and disturbance to determine appropriate management adjustments • Adjust design to construct more, or more optimal, nesting habitat, create more open salt panne habitat, and/or to reduce Hg uptake • Adjust management of water levels and salinities for optimal breeding and foraging habitat and/or control predation, vegetation, human disturbance
Salt Marsh Harvest Mouse	Meet recovery plan criteria for salt marsh harvest mouse habitat within the Phase 1 SBSP Restoration Project Area	Likely decades for high-quality tidal marsh development (10-year targets)	See triggers for *Sediment Dynamics* and *Tidal Marsh Habitat Establishment*	• See *Tidal Marsh Habitat Establishment* • Add or enhance upland transition habitat within and between restored marshes
	75% of viable habitat areas within each large marsh complex with a capture efficiency level of 5.0 or better in five consecutive years	Monitoring not expected to begin for 5-10 years after pickleweed establishment in 300 acres or more	Rate of increase deviates significantly from projection	• See *Tidal Marsh Habitat Establishment* • Add or enhance upland transition habitat within and between restored marshes

MONITORING REPORTS

Due to the large nature of the project the potential exists for numerous entities to perform the various individual monitoring elements. As a result, reporting formats and timelines will be based upon the individual approved scopes of work for each of the monitoring elements. Generally, the reports will include an executive summary, description of all methodology, data tables and figures, analysis of monitoring data, photo-documentation where appropriate, QA/QC documentation, results, conclusions and any management recommendations.

Consistent with the SBSP Restoration Project Adaptive Management Plan, the monitoring data generated from this program will be evaluated, together with results of Applied Studies and other monitoring, by review panels convened by the Project's Lead Scientist(s). All of the results and scientific evaluations will be presented to the Project Management Team and the regulatory agencies for consideration of adaptive management actions and/or monitoring program changes. In addition, the Project will convene at least one public meeting per year to present results of the prior year's actions and plans for the following year.

Annual reports will be available electronically via the SBSP Restoration Project official website (http://www.southbayrestoration.org). Regulatory agencies will be notified in writing as the reports are posted on the website, and hard copies will be made available upon request. Regulatory agencies to be notified include USACE (U. S. Army Corps of Engineers), BCDC (San Francisco Bay Conservation and Development Commission), NMFS, RWQCB, and the USFWS Endangered Species Program.

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