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SOUTH SAN FRANCISCO BAY SHORELINE PROJECT, SANTA CLARA COUNTY, CALIFORNIA

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, DEPARTMENT OF DEFENSE

TRANSMITTING

THE SOUTH SAN FRANCISCO BAY SHORELINE, SANTA CLARA COUNTY, CALIFORNIA FINAL INTEGRATED REPORT AND ENVIRONMENTAL IMPACT REPORT FOR SEPTEMBER 2015 (REVISED DECEMBER 2015)

PART 2 of 2

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Appendix B

Supporting Planning and Environmental Documentation and Information

Appendix B: Supporting Planning and Environmental Documentation and Information

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Appendix B1

Shoreline Study Preliminary Alternatives and Landscape Evolution Memo

ESA PWA

550 Kearny Street
Suite 900
San Francisco, CA 94108
415.262.2300 phone
415.262.2303 fax

memorandum

date February 10, 2012

to Brenda Buxton

from Jeremy Lowe, Mark Lindley, Lindsey Sheehan, Matt Brennan and Michelle Orr

subject **Shoreline Study Preliminary Alternatives and Landscape Evolution**

Introduction

ESA PWA is developing ecosystem restoration options for Ponds A9 to A15 and Pond A18 as part of the habitat evolution assessment for the U.S. Army Corps of Engineers (USACE) Shoreline Study. Six preliminary alternatives are being developed for habitat evolution assessment based on three Ecosystem Restoration options (No, Medium and Large Fill) combined with two Flood Risk Management alignments provided by the Shoreline Study. Professional judgment has been used to develop the candidate alternatives; no modeling has occurred at this stage.

To provide a means of comparison between the six preliminary alternatives, their habitats are being evaluated for two points in time, Time 0 (2017) and Time 50 (2067). Each alternative will be evaluated for one sea level rise curve (NRC-III curve) and three suspended sediment concentrations (including one calibrated to the Island Pond sedimentation data and two lower values). Projected pond topography in 2067 is shown in a GIS map based on existing topography and calculated accretion rates using modified Krone sedimentation equations (Krone 1985).

The first version of this memorandum, dated November 14, 2011, presented scenarios where all ponds would be restored to tidal action together beginning in 2017, 2027, and 2037. We also presented a phased scenario (West Area First) where the western most ponds (A9-11) were restored to tidal action in 2017, the east area pond (A18) was restored in 2027, and the central area ponds (A12-15) were restored in 2037. This revised memorandum presents an alternate phasing scheme (Pond A12 First) that would restore tidal action to Pond A12 in 2017, followed by the western most ponds (A9-11) in 2022, the eastern pond (A18) in 2027, and the remaining central ponds (A13-15) in 2030. The intent of this alternate Pond A12 First phasing scheme is to restore tidal action to Pond A12 as soon as possible to maximize accretion in the lowest pond in the study area.

Ecosystem Restoration Goals

The intent of the ecosystem restoration is to create 'complete' marshes – from subtidal through mudflats, low, mid and high marsh to transitional and upland – a true cross-section of the Bay shore. However simply providing a mix of habitats is insufficient – the marshes need to be physically and biologically 'healthy'. To create healthy marshes requires the restoration of physical complexity - developing the natural drainage networks, natural levees, marsh pannes, and other features that are seen in ancient marshes such as those at China Camp and on the Petaluma River. These habitats also need to be connected both across shore and along shore between each other and with adjacent marshes. To create these complex and connected marshes requires larger parcels than has been the norm for restoration in the Bay, parcels which are carefully located in the landscape – 'a few very large parcels close together are better for Bay wildlife than many small parcels farther apart' (*The State of San Francisco Bay 2011*, p28).

Challenges

There have been paradigm shifts in the scientific recognition of the risk of abrupt climate change and accelerating sea level rise (OPC 2011) and of the risk of fine sediment availability as the erodible sediment pool is depleted (Schoellhamer 2011). After 3,000 years of relatively stable sea level and 150 years of a turbid estuary, San Francisco Bay is returning to a norm of rapid sea level rise and clear water where the landscape will be more dynamic and the bayshore will be less marsh plain and more fringing marsh. This is a dynamic landscape in which there may be downshifting of high marsh to low marsh and to mudflat over the next century; there may be landward movement of the marshes and mudflats; there may be the need to actively manage marshes more than in the past to maintain their ecosystem services.

However, the dynamic landscape reflected by these paradigm shifts is, in many ways, complementary to the ecosystem restoration goals. Wide transitional and upland areas adjacent to high marsh will allow the transgression of wetlands with rising sea level, as opposed to being squeezed against steep-sided levees. Healthy transitional and upland areas transport surface and subsurface flows of water and other materials, maintain water quality, provide macrodetritus, stabilize shorelines, store flood waters, all of which are affected by their width. Lowering outboard levees to marsh elevation, in addition to breaching, will reconnect marsh to mudflat for water, sediment, and organisms while also allowing future transgression of the outboard marshes and mudflats. The mid elevation marsh plain will play a more prominent role in attenuating waves and reducing storm surges. But a dynamic landscape implies movement and the need for space – something that is lacking on the urbanized shore of the South Bay. However the very fact that there is a juxtaposition of natural wetlands and urbanized shore creates opportunities for multi-objective restoration projects which have value for flood risk management, levee stability and stormwater channel maintenance.

Alternatives

Three Ecosystem Restoration (ER) options for Ponds A9 to A15 and Pond A18 have been developed. It is assumed that once tidal flows have been restored by breaching the outboard levees, natural sedimentation will allow the evolution of a marsh plain in the ponds. The ER options have some common features, such as number and location of levee breaches. Measures in the marshplain such as pilot channels, starter channels, side cast

natural levees and ditch blocks will be used to accelerate the evolution of the ponds and to enhance the habitat. The ER options differ mainly in the amount of fill which is used to create upland and transitional habitat adjacent to the inboard levees along Pond A12 and A13 and along Pond A18: the ER options are named No, Medium and Large Fill. Using fill to create long transitional slopes provides large areas of upland habitat that has been missing from the Bay, attenuates waves and reduces run-up, and increases resiliency to sea level rise. Increasing amounts of fill also increase the cost of the project and increase the demand for dredged (or other fill) material. The ER options therefore bookend the project in terms of cost, volume of fill, habitat quality, flood risk management benefits, and resiliency to sea level rise.

The Flood Risk Management options for Ponds A9 to A15 and Pond A18 are described in the Draft FRM Option Development Memorandum (HDR 2011). For Ponds A9 to A15 the FRM options follow two alignments: either along existing levees bordering Pond A12 and A13 (FRM options 1A, 1B, 1C, 1D and 2) or along existing levee bordering pond A12, and then west along the existing railroad line to Grand Boulevard (FRM options 3 and 4). For Pond A18 the FRM options also follow two alignments: either along existing levees bordering Pond A18 (FRM options 2 and 4) or along a new alignment cutting across Pond A18 (FRM options 1A, 1B, 1C, 1D, and 3). FRM options along Pond A16 and in New Chicago Marsh will not impact the ER options for Ponds A9 to A15 and Pond A18 and so are not considered further in this memo.

The six preliminary alternatives are a combination of the FRM and ER options as shown in table 1 below. Pond A9-A15 and Pond A18 are physically separated and considered to be independent of each other; any of the alternatives chosen for Pond A9-A15 could be matched with any of the alternatives for Pond A18. The benefits of applying the other ER measures, such as starter channels and ditch blocks, are being studied as part of the Island Ponds and Pond A6 monitoring which are Phase 1 actions of the SBSP Project. The inclusion of such measures in the preliminary alternatives should be based upon information from this monitoring.

Figures 1 to 3 show the fill footprint for Preliminary Alternatives 1 to 3, where the FRM alignment follows the existing levee, together with the existing topography. Topographic shading reflects the initial habitat types that would be expected based on tidal inundation regimes if the Ponds were all breached in 2017. The levees, fill footprint and other measures are described in the next section.

Table 1: Preliminary alternatives for Ponds A9-A15 and Pond A18

Preliminary Alternative	ER option	Other ER measures	FRM alignment Pond A12 and A13	FRM alignment Pond A18
1	No Fill	Outboard levee breaches, pilot channels, and internal berm breaches	Existing levee	Existing levee
2	Medium Fill	Outboard levee breaches, pilot channels, outboard levee lowering, ditch blocks, internal berm breaches, internal berm lowering, and starter channels with side cast natural berms	Existing levee	Existing levee
3	Large Fill	Outboard levee breaches, pilot channels, outboard levee lowering, ditch blocks, internal berm breaches, internal berm lowering, and starter channels with side cast natural berms	Existing levee	Existing levee
4	No Fill	Outboard levee breaches, pilot channels, and internal berm breaches	Existing levee along Pond A12, and then along the existing railroad line	New alignment cutting across Pond A18
5	Medium Fill	Outboard levee breaches, pilot channels, outboard levee lowering, ditch blocks, internal berm breaches, internal berm lowering, and starter channels with side cast natural berms	Existing levee along Pond A12, and along the existing railroad line	New alignment cutting across Pond A18
6	Large Fill	Outboard levee breaches, pilot channels, outboard levee lowering, ditch blocks, internal berm breaches, internal berm lowering, and starter channels with side cast natural berms	Existing levee along Pond A12, and then along the existing railroad line	New alignment cutting across Pond A18

Measures

Flood Risk Management Levees

To estimate the fill footprint an approximation of levee crest heights is required. PWA (2006) documents concept level designs for levees in the Alviso pond complex classified into a number of categories the following of which are relevant to the present study:

- New levee constructed on existing pond-bottom elevations
- Upgraded levee constructed on existing perimeter levees (typically the "inboard" levee located on the landward side of the ponds)

In addition, each typical flood control levee category was separated into three different exposure levels:

- Exposed levee landward of tidal marsh
- Exposed levee landward of an upland-transition area
- Reduced exposure levee landward of a managed-pond area

Table 2 shows conceptual design levee crest elevations from the SBSP Flood Analysis Report (PWA 2006). The conceptual design elevations are based on 100-year "total water levels" with an additional 1 ft allowance for freeboard. The total water level is defined as the combination of a high bay-water level and wind-wave runup. For this preliminary analysis, the joint occurrence of a 100-year bay-water level and a 10-year wind wave event was used to estimate the total water levels and required levee crest elevations for each exposure level. Levees landward of tidal marsh and upland-transition areas are assumed to be more exposed than levees landward of managed ponds. Long and short wave modeling by the USACE and Delta Modeling Associates will provide better estimates of total water levels at the levees following breaching and in 2067 and levee design crest elevations should be updated.

Table 2 Alviso Levee Design Crest Elevation from PWA Flood Analysis Report (2006)

Levee Exposure Category	Levee Design Crest Elevation (ft, NAVD88)
With Outboard Marsh / Upland Transition	16.5
With Outboard Managed Ponds	15.5

New and upgraded levee cross-sections are assumed to have inboard and outboard slope of 3:1 (H:V) and a crest width of 20 ft. To prevent levee erosion, new and upgraded levees that are fronted with either tidal marsh or managed ponds are assumed to be armored with rock. The armoring design used in the cost estimate is a rock revetment to be placed between the top elevation of the stability berm or upland transition area and the crest of the levee.

Elevations for existing perimeter levees for Alviso and Ravenswood are from Moffatt & Nichol (2005). Table 3 summarizes the elevation data used in estimating fill volumes for design levee cross-sections.

Table 3 Typical Existing Elevations in Alviso; crest elevations from Moffatt & Nichol (2005)

Levee Exposure Category	Elevation (ft, NAVD88)
Average Pond A12 Elevation	-0.5
Average Pond A18 Elevation	0.5
Internal Managed-Pond Berm Crests	6
Existing Perimeter Levee Crests	9

Stability berms may be required to prevent subgrade failure potentially resulting from the rapid placement of between 10 and 20 feet of soil. If required, these berms would be needed on both sides of a flood control levee that is exposed to either a tidal-marsh area or a managed pond. For a flood control levee that is exposed to an upland-transition area, only the landward side of the levee will need a stability berm. Stability berms are assumed to have crest elevations approximately 2 feet above mean higher high water (MHHW). The widths of the stability berms would vary depending on the type of levee and will have assumed side slopes of 3:1 (H:V). Due to differences in fill thickness and subgrade strength, the width of the stability berms for a new levee, an upgraded internal managed-pond berm and an upgraded existing perimeter levee would be 50 ft, 40 ft and 30 ft, respectively. The locations of drainage and borrow ditches will need to be considered and may alter the alignment. Alternative methods may be available which could be less expensive. These include soil reinforcement with geotextile fabric, stone column or foundation over-excavation, or replacement with stronger soil.

Initial fill volumes will likely include an "over-build" to compensate for the initial subsidence and an allowance should be made for placing additional earth (or other action such as a flood wall) as the levees subside. Initial subsidence is anticipated to be greatest for new levees constructed on existing pond bottoms.

Transitional-Upland Slopes

Three different cross-sectional designs for the transitional-upland areas adjacent to the levees are used, which correspond to the three ER options of No, Medium and Large Fill, and described in Table 4. For each design, the top of the transitional-upland area was assumed to be the same as the proposed levee crest elevations from Table 2 and the bottom of the transitional-upland area was assumed to be about 2 feet below MHHW within the lower range of cordgrass grass dominated marsh. Below the flat transition slope, the berm would slope down to the respective average pond-bottom elevations as shown in Table 3 at a steeper 3:1 to 5:1 (H:V) slope.

Table 4 Transitional-Upland Slope Design

ER Option	Design
No Fill	3:1 (H:V) front slope of the levee and stability berms (if required) form the transitional zone.
Medium Fill	30:1 (H:V) slope for the transitional zone. The zone begins at the approximate upgraded flood-control levee crest and maintains a 30:1 slope to the pond-bed elevation. It is assumed that the upper slope of the transitional zone will need planting or hydro-seeding.
Large Fill	100:1 (H:V) slope for the transitional zone. The zone begins at the approximate upgraded flood-control levee crest and maintains a 100:1 slope to the pond-bed elevation. It is assumed that the upper slope of the transitional zone will need planting or hydro-seeding.

The 30:1 and 100:1 (H:V) slopes in the Medium and Large Fill options represent idealized slopes. During final design and construction, the slopes would include some variation both in planform to create a more natural shoreline and along the slope to create benches and shallow depressions to form pannes at a variety of elevations. The intent is to work within the overall idealized slope to create an upland transitional zone with some complexity.

To reduce the initial fill requirements it may be possible to construct the transitional-upland slopes of the Medium Fill and Large Fill options in stages. An initial, smaller, berm would be built at the outboard edge of the transitional-upland zone, followed by breaching the ponds to tidal action, then filling behind it over time as material becomes available to bring the transition areas to final grade. An alternative may be to maintain a 3:1 slope to a horizontal bench located one-foot above MHHW. The levee bench could receive fine grading to create backshore pans and a 30:1 (or 100:1) slope will continue downward from the bench to about 2 feet below MHHW within the lower range of cordgrass colonization elevations. Additional fill would be placed on the bench as required to maintain its position in the tidal frame with sea level rise.

Outboard Levee Breaches

Outboard levee breaches are excavations through the perimeter levees that open the site to tidal inundation from the adjacent tidal sloughs. Breaches through the outboard levee and pilot channels through the outboard marsh will be excavated at the locations of the major remnant historic tidal channels (Figure 4). These locations would be the same for all the Preliminary Alternatives.

The levee breaches are sized using empirical relationships between tidal channel dimensions and marsh drainage area (hydraulic geometry relationships). Hydraulic geometry relationships from Williams et al (2002) are based on data from tidal channels in mature natural marshes located throughout the San Francisco Bay. A subset of the Williams et al (2002) data from South Bay marshes, including Laumeister, Newark Slough, and Ravenswood Slough, was used to develop hydraulic geometry relationships for the South Bay.

The hydraulic geometry relationships provide expected channel dimensions once a pond has developed into a mature marsh. The breaches were sized to long-term equilibrium dimensions to balance excavation costs, scour potential, and tidal drainage (see section below). This approach is consistent with the Design Guidelines for Tidal Wetland Restoration in San Francisco Bay (PWA 2004). These dimensions are adjusted to give a trapezoidal

breach cross section with side slopes (H:V) of approximately 4:1 to 5:1 and a minimum bottom width of approximately 10 ft. On the inboard side of the levee, the breach excavation will extend to the levee toe

The breaches are expected to be undersized compared to restored tidal flows due to the larger tidal prism of the subsided ponds. The large tidal flows are expected to scour and enlarge the breaches until equilibrium between the tidal prism and channel dimensions is reached. The tidal prism will decrease as the pond fills in due to sedimentation and vegetation establishment.

Undersized breaches may initially constrict tidal flows to the restoration site and cause water to "back-up" in the site on the ebb tide, delaying drainage and increasing the low water level in the site. The pilot channel connecting the levee breach and the adjacent slough through the outboard marsh (pilot channel) may limit tidal drainage in a similar manner. Over time, tidal flows are expected to scour undersized levee breaches and pilot channels, thus improving tidal drainage.

Outboard Levee Breach Sizing

The historic channels layer from SFEI was examined in GIS to analyze historic watersheds on the site (Figure 4). The area of each restored tidal watershed was calculated in GIS and used to find long-term channel equilibrium dimensions for that watershed using Williams *et al*, 2002 (). The order of each channel was determined from Williams *et al*, 1995 (). These dimensions can be applied to the historic channel network shown in Figure 4.

Table 5. Long-Term Equilibrium Channel Dimensions

Watersheds	Area [ac]	Breach Depth [ft]	Breach Top Width [ft]	Breach Cross-Sectional Area [ft^2]	Channel Order
Pond A9	454	16.1	188	1303	6
Pond A10	228	13.5	138	820	5
Pond A11	246	13.8	143	864	5
Pond A12	265	14.0	147	907	5
Ponds A13-15	914	19.1	257	2081	6
North A18	116	11.4	101	521	5
Central A18	221	13.4	136	805	5
Southwest A18	258	13.9	146	892	5
East A18	255	13.9	145	886	5

Pilot Channels

Wide mudflats outboard of breaches may limit tidal drainage; however, the pond breaches drain to deep tidal sloughs across relatively narrow mudflat channel banks. Pilot channels will be excavated through the outboard marsh to connect each outboard levee breach to the adjacent tidal slough. The ponds will be breached at the location of historic marsh channels and so the pilot channels would also follow the historic channels (Figure 4). These locations would be the same for all the Preliminary Alternatives.

The Design Guidelines (PWA 2004) recommend excavating breaches and pilot channels to long-term equilibrium dimensions to allow for adequate tidal exchange to quickly erode breaches and improve tidal drainage. Pilot channels will be excavated to the long-term equilibrium channel depth and 60 to 80% of the long-term channel width (i.e., narrower than the breach width at MHHW) (see above). The pilot channel side slopes will be approximately 3:1. The pilot channels are somewhat undersized to reduce the amount of excavation and are expected to scour and enlarge. Marsh vegetation will be excavated down to the root zone over the long-term equilibrium width to reduce the resistance to pilot channel bank erosion.

Tidal drainage for the pond restoration is likely to be adequate in the long-term, but may be restricted within the first few years after restoration. An assessment of Island Ponds monitoring data (PWA 2007) indicates that after the under-sized Island Pond breaches scoured to long-term equilibrium widths, the breaches provided adequate tidal drainage. These monitoring data suggest that breaches sized to long-term equilibrium dimensions for ponds with marshplain elevations similar to the Island Ponds can be expected to provide adequate tidal drainage. The elevation of the ponds is on average 3 feet lower than the Island Ponds and will initially have a larger restored tidal prism, which will tend to slow drainage at low tides. However, the number of breaches per acre of restored marsh will be greater than the Island Ponds, which will tend to improve drainage. If the pilot channels do not scour and enlarge as expected, excavation could be pursued as part of adaptive management.

Outboard Levee Lowering

Levee lowering would occur in the Medium and Large Fill Preliminary Alternatives. The majority of the outboard levee will be lowered by excavation to MHHW to create pickleweed marsh habitat, restore hydraulic and habitat connectivity between the sloughs and the marshplain, and provide material for ditch block construction. Portions of the outboard levees will not be lowered to limit wave action and to provide initial high tide refugia. The bayfront levee between Pond A9, and Coyote Creek is expected to limit wave action in Pond A9 until the bayfront levee completely erodes.

Borrow Ditch Blocks

Ditch blocks inhibit flow though the existing borrow ditches to promote scour and flow through the remnant historic channels. The desired elevation of the top of the ditch blocks is MHHW; at this elevation the ditch blocks are expected to provide pickleweed habitat. The initial fill elevation needed to achieve this elevation and account for settlement will be determined during final design. Material excavated from the levee breaches and levee lowering will be used to construct ditch blocks. To reduce the potential for fish stranding, the ditch blocks will be located such that the borrow ditch on both sides of the block connects directly to a breach.

Internal Berm Breaches

The internal berms within the ponds will be breached in several locations to reconnect remnant historic channels and restore the hydraulic connection across the site (figure 4). Breaches will be sized in a similar manner to the breaches in the outboard levee. The breach excavations will extend beyond the levee toe into either the internal borrow ditch or the remnant historic channel. The existing internal berm between Ponds A9 and A14 does cut across the historical watershed (Figure 4). It is suggested that this berm is realigned further into Pond A14 so that

the tidal prism will be sufficient to maintain the channels in Pond A9. The benefits and costs of adjusting the internal berm alignment need to be addressed at a later stage in the design.

Internal Berm Lowering

Internal berms within the ponds would serve as wave-break berms to limit wave action, enhance sedimentation, and create vegetated marsh habitat (on the berm crests) in the short term while the ponds develop from mudflat to vegetated marsh. The existing low internal berms separating the ponds would be lowered by excavation to MHHW to create pickleweed marsh habitat and act as a wave-break berms. This is the concept used in the adjacent Pond A6 and monitoring of sedimentation rates following restoration will test its effectiveness. Construction of additional wave-break berms is not included at this point because the benefits to the pond restoration may be small relative to the cost of construction. Short wave modeling by USACE may indicate the need for wave-break berms.

The extent and location of internal berm lowering would be determined during project design to match project construction to funding availability.

Starter Channels with Side Cast Berms

Natural levees adjacent to tidal channels in historic marshes support pickleweed and marsh gumplant which serve as critical high tide refugia for Salt Marsh Harvest Mouse and California Clapper Rail. Excavation of the shallow remnant historic tidal channels within the ponds would provide material to create side cast berms adjacent to the channels to emulate natural levee features seen adjacent to channels in historic marshes. These low berms would create topographic complexity within the otherwise plainer intertidal mudflat.

In addition, excavating the shallow remnant historic tidal channels within the pond would re-create tidal channel habitat and improve tidal drainage more rapidly following restoration. Tidal drainage is affected by the density, complexity, and form of the channel network. As water drains off the marshplain, flows are conveyed through tidal channels within the site. Silted-in portions of the remnant historic tidal channels (Figure 4) may be too shallow to efficiently convey tidal flows, causing more flow over the marshplain. Shallow flow and friction over the marshplain may delay low tide drainage. Tidal drainage is expected to improve as remnant channels scour in response to tidal flows. Ponds with a gypsum layer on the pond bed may also require excavation of channels to convey tidal exchange – the only ponds in the Alviso complex known to have gypsum layers are the Island Ponds.

Using a similar hydraulic geometry analysis as for pilot channels, starter channels could be excavated that are sized to the long-term equilibrium channel depth and 60 to 80% of the long-term channel width. The ultimate location and extent of starter channel excavation to create side cast berms would be determined during final design to balance the habitat benefits with project funding. For instance, in Ponds A15 and A13, existing internal berms are located adjacent to the large tidal channel through those ponds, so the need for excavation to create side cast berms would be a lower priority within those ponds. By comparison, within Pond A18 there are no internal berms within a large 850 acre pond, and starter channel excavation to create side cast berms would be a much higher priority in Pond A18 because these berms would serve a number of critical functions – as wave-break

berms to enhance sedimentation, to provide topographic complexity to support vegetation colonization, and to provide high tide refugia for critical special status species.

Experience in the Island Ponds indicated that material sidecast too close to the excavated channels was liable to be eroded as the channels scoured and enlarged. In Pond A6 starter channels were not included in the design due to the cost of construction and the expected low benefits. A comparison of natural levee evolution from the Island Ponds and Pond A6 monitoring would be a useful guide for evaluating the desirability of side-casting.

Landscape Evolution

Marsh accretion was predicted using the Marsh98 analysis, a procedure that has been used widely to examine marsh sustainability to sea level rise across San Francisco Bay (e.g. Orr et al., 2003). The Marsh98 analysis is based on the mass balance calculations described by Krone (1987). This procedure assumes that the elevation of a marsh plain rises to colonization elevations at rates that depend on the (1) availability of suspended sediment and (2) depth and periods of inundation by high tides. When the level of an evolving marsh surface is low with respect to the tidal range, sedimentation rates may be high if the suspended sediment supply is sufficient. However, as the marsh surface rises through the tidal range, the frequency and duration of flooding by high tides is diminished so that the rate of sediment accumulation declines. Marsh98 implements these physical processes by calculating the amount of suspended sediment that deposits during each period of tidal inundation and sums that amount of deposition over the period of record.

Two revisions have been made to Marsh98 to more accurately represent physical conditions. These revisions include:

- Accelerating, nonlinear sea level rise is included. The sea level rise curves that were implemented were originally proposed by the National Research Council and modified by the USACE (2009), specifically NRC-I, -II and –III curves.
- Organic material is now added directly to the bed elevation at each tidal cycle. This method more accurately reflects the physical process with nonlinear sea level rise. Accretion due to organic material occurs when the marsh plain reaches a specified vegetation colonization elevation.

Model Input Parameters

Tidal Boundary Condition

The modeling was conducted relative to the tidal datum of NAVD88. The tidal boundary condition used for all model runs was a tidal month which has statistical characteristics identical to the observed tides at the Golden Gate. This boundary condition was then amplified using the Coyote Creek tidal datums to create a time series that could be applied to the Coyote Creek area. The title datums are shown in Table 6.

Table 6. Coyote Creek Tidal Datums

Datums	ft MLLW	ft NAVD	m NAVD
MHHW	9.01	7.49	2.27
MHW	8.42	6.90	2.10
MSL	4.92	3.40	1.04
MTL	4.83	3.31	1.01
NAVD88	1.52	0.00	0.00
MLW	1.24	-0.28	-0.09
MLLW	0.00	-1.52	-0.46

*NOAA Tides & Currents. Station ID: 9414575. MLLW to NAVD conversions are from NOAA unpublished (2005).

Habitat Zones

Seven habitat zones were chosen to represent different elevation within each breached pond. Table 7 presents these zones and elevations.

Table 7. Habitat Zones and Elevations

Habitat Zone	Elevation (relative to datums)	2017 Elevation (ft NAVD)	2017 Elevation (m NAVD)
Deep Subtidal	6 m below MLLW and deeper	< -21.16	< -6.45
Shallow Subtidal A	2 to 6 m below MLLW	-21.16 to -8.04	-6.45 to -2.45
Shallow Subtidal B	2 m below MLLW to MLLW	-8.04 to -1.48	-2.45 to -0.45
Intertidal Mudflat	MLLW to MTL + 0.3 m	-1.48 to 4.33	-0.45 to 1.32
Cordgrass Dominated	MTL + 0.3 m to MHW	4.33 to 6.96	1.32 to 2.12
Pickleweed Dominated	MHW to MHHW	6.96 to 7.51	2.12 to 2.29
Upland*	MHHW and above	> 7.51	> 2.29

*HTH provided the elevations for the all of the subtidal and tidal habitat zones. NAVD elevations refer to 2017.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) varies throughout San Francisco Bay because of variations in wave conditions, proximity to mudflats, and river inputs. Monitoring data from Pond A21, just north of the site, were used to calibrate the SSC to be used in the model. The data was divided by starting elevations into three categories and then elevations over time were averaged for each group. Marsh98 was run with the three averaged starting elevations from the data and with three potential SSC (100, 200, and 300 mg/L).

For the first 6 to 12 months after breaching, the Island Ponds data tracks with the 300 mg/L suspended sediment concentration curve. However, the later elevation measurements show little increase in between time steps and track better with the 100 mg/L and 200 mg/L SSC curves. It is possible that the Pond A21 mudflats accreted rapidly in the first year as easily eroded material was remobilized, perhaps from the breach and outboard marsh, which increased the local SSC. Over time this supply of easily eroded material was exhausted and the subsequent accretion rate reflects more the ambient suspended sediment concentration in Coyote Creek. We are investigating the calibration data more closely and looking for evidence to test the variable SSC hypothesis. To represent the range of SSC, all three concentrations were modeled to bracket the possibilities. Subsequent runs will focus on the

100, 200 mg/L range and will also include a better description of the initial high rates following breaching. Long term decline in SSC should also be incorporated (Schoellhamer 2011).

Organic Matter

Marshes with high rates of organic matter production have been observed to accrete at faster rates than marshes composed primary of inorganic sediments (Orr et al., 2003). Marshes associated with the highest organic matter accretion rates are typically found in brackish or freshwater environments. Based on guidance from HTH, an organic matter accretion rate of 1 mm/yr was modeled for all scenarios when the marsh plain elevation reached MTL + 1ft (MTL + 0.3 m).

Rate of Sea Level Rise

A nonlinear sea level rise scenario based on the guidance provided by the USACE (2009) was used. This document recommends scenarios modifying curves proposed by the National Research Council to extrapolate intermediate and high sea level rise projections ("NRC-I" and "NRC-III", respectively). These scenarios project 0.5 m and 1.5 m of sea level rise over the next century depending on emissions. The high rate is similar to the draft State of California planning guidelines, which recommends planning for 16" of rise in the next 50 years and 55" in the next 100 years. For the Preliminary Alternatives reported here the NRC-III curve was used.

Phasing

Two phasing schemes were examined. The West Area First phasing scheme examined phased restoration beginning in the western most ponds. The Pond A12 First phasing scheme illustrates a phased restoration beginning with Pond A12 which is the lowest pond in the study area.

West Area First phasing scheme: the site evolution projections were phased by pond area with the west region (Ponds A9-A11) beginning in 2017, the east region (Pond A18) beginning in 2027, and the central region (Pond A12-A15) beginning in 2037. The division between the west and central region includes the realignment of the internal berm between Pond A9 and A11 which more accurately reflects the historic watershed.

Pond A12 First phasing scheme: site evolution projections were phased with restoration of Pond A12 beginning in 2017, followed by the westernmost ponds (A9-11) beginning in 2022, the eastern pond (Pond A18) beginning in 2027, and the remaining central ponds (Ponds A13-15) beginning in 2030. The intent of this alternate Pond A12 First phasing scheme is to restore tidal action to the Pond A12 as soon as possible to maximize accretion in the lowest pond in the study area. This phasing also accelerates restoration of the central area ponds (Pond A13-A15) by seven years as compared to the West Area First phasing scheme.

All runs ended in 2067. The different starting times place each region on a different part of the sea level rise curve. This means that without substantial suspended sediment, the central region will end up at lower elevations than the west (or east region) because it has fewer years to accrete and it begins on a steeper part of the sea level rise curve so sea level is increasing more rapidly.

Landscape Evolution Results

In general we have found with previous Marsh98 analysis in the South Bay (Orr, et.al., 2003) that:

- SSC of 25 mg/L are unlikely to sustain marshes for all scenarios, regardless of the input parameters. These concentrations are unlikely based on the Island Ponds monitoring data.
- SSC of 50 mg/L are unlikely to sustain marshes for all scenarios except for most favorable conditions (high initial bed elevation and organic accretion rate; intermediate rate of sea level rise). These concentrations are unlikely based on the Island Ponds monitoring data.
- SSC of 100 or 150 mg/L can sustain marshes only for particular combinations of initial bed elevation, organic accretion rate and rate of sea level rise. Varying any one of these four parameters can alter whether the model predicts vegetated or unvegetated Year 100 conditions. These are the likely range of concentrations based on the Island Ponds monitoring data.
- SSC of 300 mg/L are likely to sustain marshes for all scenarios but are unlikely to occur after the initial period of tidal restoration, as shown by the Island Pond monitoring data.

The model input parameters and predicted 2067 bed elevations for the 54 combinations of initial bed elevation, SSC, and phasing are summarized in Appendix A. The colors in the last column represent the habitat zone of that elevation where blue is subtidal, brown is mudflat, light green is cordgrass, and dark green is pickleweed.

The results presented here provide a first order estimate of marsh accretion rates for San Francisco Bay under a range of input conditions. However, it should be recognized that significant uncertainties remain with respect to future changes in sea level rise as well as the physical and biological processes which affect marsh accretion. In particular, the analysis does not include the influence of waves, which become more important as site size increases and availability of sediment diminishes. Sites that are more vulnerable to waves include those with bed elevations between vegetation colonization elevation and MHHW, e.g. those elevations close to cordgrass dominated elevations.

Spatial Evolution

The results summarized in Appendix A were used to create digital elevation models (DEMs) of the site in 2067 years for different SSC and different start years (Figures 5 to 10). Phasing was not used in these figures to provide understanding of the evolution of the individual ponds. The ability to reach colonization elevation is controlled by both SSC and the start year. The start year has two influences, firstly there is less time to accrete sediment before the end of the project in 2067, and secondly the tidal inundation starts at a higher sea level and at a time when the sea level is rising faster.

Start Year 2017: Figure 5 and 6 show the likely evolution of the ponds by 2067 for a SSC of 100 and 200mg/L and a start date of 2017. It clearly shows for 100 mg/L none of the ponds attain elevations that allow for colonization and remain mudflats – all the sedimentation that is shown is due to inorganic sediment deposition at lower elevations, which is well-produced in Marsh98. The spatial pattern within the ponds reflects the initial start elevation and reflects how deeply subsided Pond A12 is, particularly adjacent to Alviso Slough and the Pond A12 inboard levee. For SSC of 200 mg/L nearly all the ponds reach colonization elevation, either cordgrass or pickleweed elevations.

Start Year 2027: Figure 7 and 8 show the likely evolution of the ponds by 2067 with a start date of 2027. For SSC of 100mg/L the mudflats within the ponds are lower than with a start date of 2017, as there has been less time to accrete. For SSC of 200 mg/L nearly all the ponds reach colonization elevation, but only attain cordgrass elevations.

Start Year 2037: Figure 9 and 10 show the likely evolution of the ponds by 2067 with a start date of 2037, a period of only 30 years. The pattern for both SSCs are the same as before but shifted lower in elevation. With the 200mg/L plot (Figure 10) there are areas in Pond A12 which do not achieve vegetation colonization elevation and remain mudflat.

Phased Evolution

Figures 11 and 12 show projections of the evolution of the site for the West Area First phasing scheme with varying start dates for the different Ponds with the west region (Ponds A9-A11) beginning in 2017, the east region (Pond A18) beginning in 2027, and the central region (Pond A12-A15) beginning in 2037. Figure 11 (SSC=100 mg/L) shows the impact of restoring tidal influence to the most deeply subsided ponds last; the elevation in Pond A12 remains low mudflat and shallow subtidal. Figure 12 (SSC=200 mg/L) shows the same basic pattern but all the elevations are higher, mostly achieving colonization elevations, except for Pond A12. This clearly shows the influence of phasing on the success in restoring a complete marsh in Ponds A9 to A15. Changing the order of restoration will have a significant impact on the outcome of the project in 2067.

Figures 13 and 14 illustrate the evolutionary projections for the Pond A12 First phasing scheme with the start dates for Pond A12 beginning in 2017, followed by west region (Pond A9-A11) in 2022, eastern region (Pond A18) in 2027, and the remaining central region ponds (Ponds A13-15) in 2030. Figure 13 (SSC=100 mg/L) shows the results of restoring the deeply subsided Pond A12 first and moving the restoration of Ponds A13-A15 up to 2030. Areas in Pond A12 that remained as shallow subtidal in the West Area First phasing scheme become low mudflat. Figure 14 (SSC=200 mg/L) illustrates that with higher sediment concentrations, restoration of Pond A12 beginning in 2017 allows this pond to reach cordgrass and pickleweed colonization elevations by 2067. Moving restoration of the remaining central area ponds (Ponds A13-15) up to 2030 allows areas of these ponds that remained as intertidal mudflat when restored in 2037, to reach low cordgrass colonization elevations by 2067.

Figures 15 and 16 present medium and large fill transitional alternatives with the projected evolution under Pond A12 First phasing scheme with the higher (200 mg/L) suspended sediment concentration.

References

Krone, R.B. "A Method for Simulating Historic Marsh Elevations." In *Coastal Sediments '87. Proceedings of the Specialty Conference on Quantitative Approaches to Coastal Sediment Processes*. New Orleans, LA. May 12-14. 1987. 316-323.

Orr, M., Crooks, C., and Williams, P. 2003. "Will Restored Tidal Marshes Be Sustainable?" In: Larry R. Brown, editor. *Issues in San Francisco Estuary Tidal Wetlands Restoration*. San Francisco Estuary and Watershed Science. Vol. 1, Issue 1 (October 2003), Article 5. http://repositories.cdlib.org/jmie/sfews/vol1/iss1/art5

PWA, 1995. *Design Guidelines for Tidal Channels in Coastal Wetlands*. Prepared for USACE Waterways Experimental Station.

PWA, 2004. *Design Guidelines for Tidal Wetland Restoration*. Prepared for the Bay Institute and the California State Coastal Conservancy.

PWA 2006. *Updated Preliminary Cost Estimate Memo*. South Bay Salt Pond Restoration Project

PWA 2006, *Flood Analysis Report*. South Bay Salt Pond Restoration Project

PWA, 2007. *Island Ponds Tidal Drainage Assessment*. South Bay Salt Pond Restoration Project

Schoellhamer, D.H. 2011. "Sudden Clearing of Estuarine Waters Upon Crossing the Threshold from Transport to Supply Regulation of Sediment Transport as an Erodible Sediment Pool is Depleted: San Francisco Bay, 1999". *Estuaries and Coasts* 34, pp885-899.

US Army Corps of Engineers. 2009. *Incorporating Sea-Level Change Considerations in Civil Works Programs*. Engineering Circular #1165-2-211.

Williams, P.B., Orr, M.K. and Garrity, N., 2002. "Hydraulic Geometry: A Geomorphic Design Tool for Tidal Marsh Channel Evolution in Wetland Restoration Projects". *Restoration Ecology*, 10:3, pp577-590.

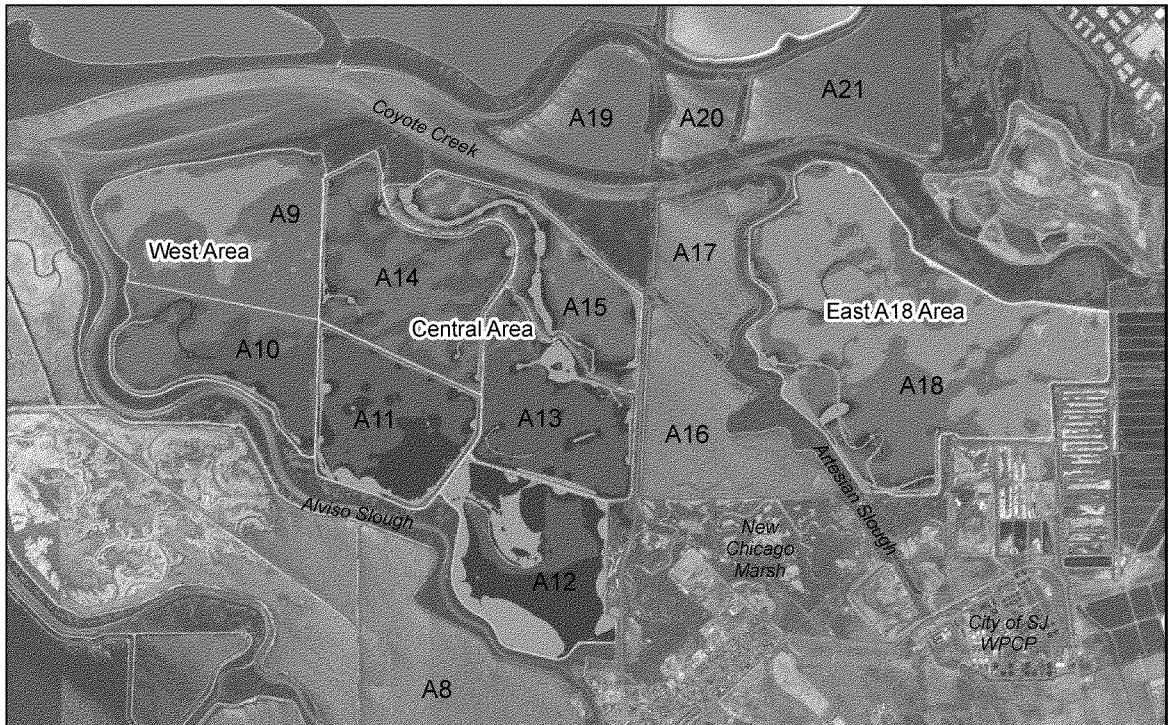
Appendix A

Summary of Landscape Evolution Projections

Habitat Zone	Elevation (relative to datums)
Deep Subtidal	6 m below MLLW and deeper
Shallow Subtidal A	2 to 6 m below MLLW
Shallow Subtidal B	2 m below MLLW to MLLW
Intertidal Mudflat	MLLW to MTL + 0.3 m
Cordgrass Dominated	MTL + 0.3 m to MHW
Pickleweed Dominated	MHW to MHHW

Run ID	Start Year	Co (mg/L)	2017 Elevations (ft NAVD)	2067 Elevation (ft NAVD)	Change in Elevation (ft)	MHHW 2067 (ft NAVD)	2067 Elevations - MHHW (ft)
1	2017	100	-12.30	-8.48	3.82	9.62	-18.10
2	2017	100	-3.28	0.54	3.82	9.62	-9.07
3	2017	100	0.00	3.53	3.53	9.62	-6.08
4	2017	100	5.74	7.55	1.81	9.62	-2.06
5	2017	100	7.38	8.58	1.20	9.62	-1.04
6	2017	100	9.84	9.62	-0.22	9.62	0.00
7	2017	200	-12.30	2.99	15.29	9.62	-6.62
8	2017	200	-3.28	8.31	11.59	9.62	-1.30
9	2017	200	0.00	9.03	9.03	9.62	-0.58
10	2017	200	5.74	9.62	3.88	9.62	0.00
11	2017	200	7.38	9.62	2.24	9.62	0.00
12	2017	200	9.84	9.62	-0.22	9.62	0.00
13	2017	300	-12.30	9.62	21.92	9.62	0.00
14	2017	300	-3.28	9.62	12.90	9.62	0.00
15	2017	300	0.00	9.62	9.62	9.62	0.00
16	2017	300	5.74	9.62	3.88	9.62	0.00
17	2017	300	7.38	9.62	2.24	9.62	0.00
18	2017	300	9.84	9.62	-0.22	9.62	0.00
19	2027	100	-12.30	-9.25	3.05	9.61	-18.86
20	2027	100	-3.28	-0.22	3.06	9.61	-9.83
21	2027	100	0.00	2.87	2.87	9.61	-6.74
22	2027	100	5.74	7.22	1.48	9.61	-2.39
23	2027	100	7.38	8.34	0.96	9.61	-1.27
24	2027	100	9.84	9.61	-0.23	9.61	0.00

Run ID	Start Year	Co (mg/L)	2017 Elevations (ft NAVD)	2067 Elevation (ft NAVD)	Change in Elevation (ft)	MHHW 2067 (ft NAVD)	2067 Elevations - MHHW (ft)
25	2027	200	-12.30	-0.05	12.25	9.61	-9.66
26	2027	200	-3.28	7.04	10.32	9.61	-2.57
27	2027	200	0.00	8.15	8.15	9.61	-1.46
28	2027	200	5.74	9.39	3.65	9.61	-0.22
29	2027	200	7.38	9.61	2.23	9.61	0.00
30	2027	200	9.84	9.61	-0.23	9.61	0.00
31	2027	300	-12.30	8.81	21.11	9.61	-0.80
32	2027	300	-3.28	9.61	12.89	9.61	0.00
33	2027	300	0.00	9.61	9.61	9.61	0.00
34	2027	300	5.74	9.61	3.87	9.61	0.00
35	2027	300	7.38	9.61	2.23	9.61	0.00
36	2027	300	9.84	9.61	-0.23	9.61	0.00
37	2037	100	-12.30	-10.01	2.29	9.61	-19.63
38	2037	100	-3.28	-0.99	2.29	9.61	-10.60
39	2037	100	0.00	2.17	2.17	9.61	-7.44
40	2037	100	5.74	6.86	1.12	9.61	-2.75
41	2037	100	7.38	8.10	0.72	9.61	-1.52
42	2037	100	9.84	9.61	-0.23	9.61	0.00
43	2037	200	-12.30	-3.13	9.17	9.61	-12.74
44	2037	200	-3.28	5.24	8.52	9.61	-4.38
45	2037	200	0.00	6.91	6.91	9.61	-2.70
46	2037	200	5.74	8.77	3.03	9.61	-0.84
47	2037	200	7.38	9.26	1.88	9.61	-0.35
48	2037	200	9.84	9.61	-0.23	9.61	0.00
49	2037	300	-12.30	6.15	18.45	9.61	-3.47
50	2037	300	-3.28	9.01	12.29	9.61	-0.61
51	2037	300	0.00	9.40	9.40	9.61	-0.21
52	2037	300	5.74	9.61	3.87	9.61	0.00
53	2037	300	7.38	9.61	2.23	9.61	0.00
54	2037	300	9.84	9.61	-0.23	9.61	0.00



Initial conditions. No Marsh98 run. No fill.

N

0 550 1,100 2,200 3,300 4,400 5,500 Feet

Habitat Zones (ft NAVD)

- Deep Subtidal (< -21.2)
- Shallow Subtidal A (-21.2 to -8.0)
- Shallow Subtidal B (-8.0 to -1.5)
- Intertidal Mudflat low (-1.5 to 0)
- Intertidal Mudflat mid low (0 to 1.3)
- Intertidal Mudflat mid high (1.3 to 3.0)
- Intertidal Mudflat high (3.0 to 4.3)
- Cordgrass Dominated low (4.3 to 5.6)
- Cordgrass Dominated high (5.6 to 7.0)
- Pickleweed Dominated (7.0 to 7.5)
- Upland (> 7.5)

figure 1

Shoreline Study Alternatives

Preliminary Alternative 1 Transitional - Upland Fill Footprint

Proj. # 211259

ESA PWA

Initial conditions. No Marsh98 run. Fill 1:30.

N

0 550 1,100 2,200 3,300 4,400 5,500 Feet

Habitat Zones (ft NAVD)

- Deep Subtidal (< -21.2)
- Shallow Subtidal A (-21.2 to -8.0)
- Shallow Subtidal B (-8.0 to -1.5)
- Intertidal Mudflat low (-1.5 to 0)
- Intertidal Mudflat mid low (0 to 1.3)
- Intertidal Mudflat mid high (1.3 to 3.0)
- Intertidal Mudflat high (3.0 to 4.3)
- Cordgrass Dominated low (4.3 to 5.6)
- Cordgrass Dominated high (5.6 to 7.0)
- Pickleweed Dominated (7.0 to 7.5)
- Upland (> 7.5)

figure 2

Shoreline Study Alternatives

Preliminary Alternative 2 Transitional - Upland Fill Footprint

Proj. # 211259

ESA PWA

Initial conditions. No Marsh98 run. Fill 1:100.

N

0 550 1,100 2,200 3,300 4,400 5,500 Feet

Habitat Zones (ft NAVD)

- Deep Subtidal (< -21.2)
- Shallow Subtidal A (-21.2 to -8.0)
- Shallow Subtidal B (-8.0 to -1.5)
- Intertidal Mudflat low (-1.5 to 0)
- Intertidal Mudflat mid low (0 to 1.3)
- Intertidal Mudflat mid high (1.3 to 3.0)
- Intertidal Mudflat high (3.0 to 4.3)
- Cordgrass Dominated low (4.3 to 5.6)
- Cordgrass Dominated high (5.6 to 7.0)
- Pickleweed Dominated (7.0 to 7.5)
- Upland (> 7.5)

figure 3

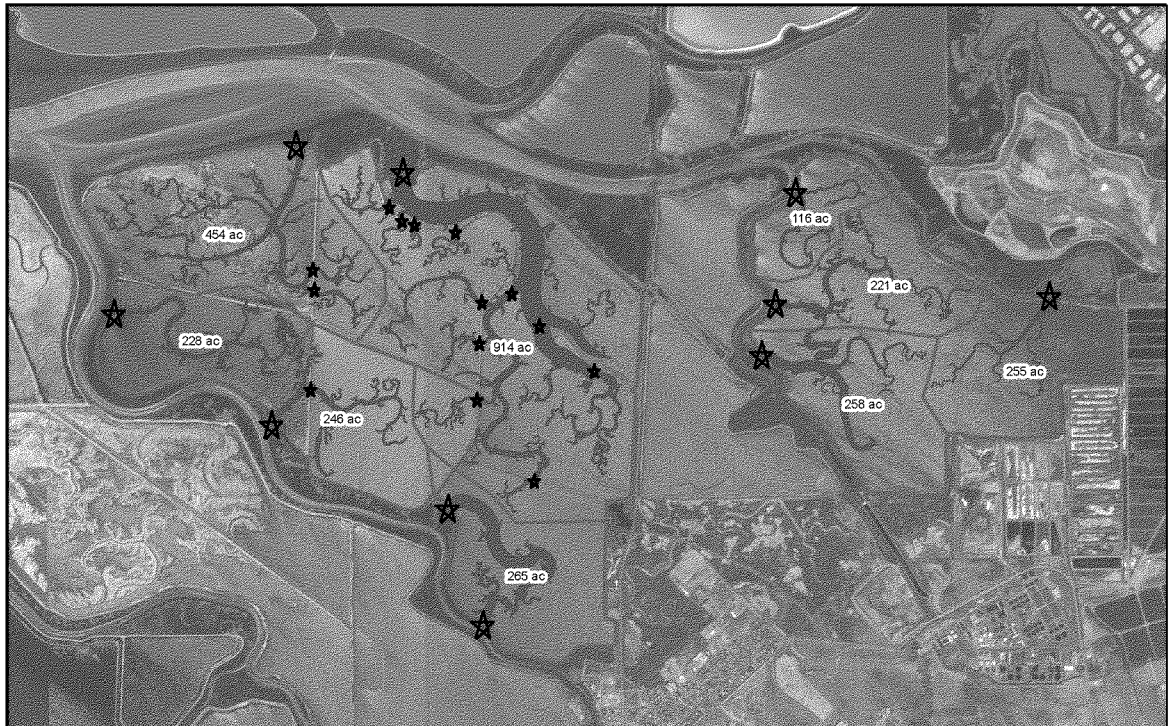
Shoreline Study Alternatives

Preliminary Alternative 3 Transitional - Upland Fill Footprint

Proj. # 211259

ESA PWA

J:\211259 Shoreline Mx Sediment Topics\CD Maps\



N

0 500 1,000 2,000 3,000 4,000 5,000 Feet

Watersheds (ac)
Historic channels
Outboard Levee Breach
Internal Levee Breach

figure 4

Shoreline Study Alternatives

Historic Tidal Watersheds and Channels

Proj. # 211259

ESA PWA

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USACE - San Francisco District
South San Francisco Bay Shoreline Phase I Study
September 2015
Page B-23

C0 = 100 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2017

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 5

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 100 mg/L and 2017 Start

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ESA PWA

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USACE - San Francisco District
South San Francisco Bay Shoreline Phase I Study
September 2015
Page B-24

C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2017

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 6

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 200 mg/L and 2017 Start

Proj. # 211259

ESA PWA

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USACE - San Francisco District
South San Francisco Bay Shoreline Phase I Study
September 2015
Page B-25

C0 = 100 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2027

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 7

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 100 mg/L and 2027 Start

Proj. # 211259

ESA PWA

J:\211259-Shoreline\Mxds\Bayfill\2027_C0-100.mxd
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C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2027

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 8

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 200 mg/L and 2027 Start

Proj. # 211259

ESA PWA

C0 = 100 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2037

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 9

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 100 mg/L and 2037 Start

Proj. # 211259

ESA PWA

J:\211259-Shoreline\wkdc\boyan\2037_C0=100.mxd

C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start all areas in 2037

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 10

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 200 mg/L and 2037 Start

Proj. # 211259

ESA PWA

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C0 = 100 mg/L, NRC-III, organics = 1 mm/yr
Start West Area in 2017, East Area (A18) in 2027, and Central Area in 2037

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 11

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 100 mg/L

Proj. # 211259

PWA

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C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start West Area in 2017, East Area (A18) in 2027,
and Central Area in 2037

N

0 1,000 2,000 4,000 6,000 Feet

Habitat Zones

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 12

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 200 mg/L

Proj. # 211259

ESA PWA

J:\211259 Shoreline\Mxds\50yr\WestEast\Central\21C0=200.mxd

C0 = 100 mg/L, NRC-III, organics = 1 mm/yr
Start A12 in 2017, A9-11 in 2022, A18 in 2027, and A13-15 in 2030

N

0 1,000 2,000 4,000 6,000 Feet

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 13

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 100 mg/L

Proj. # 211259

ESA PWA

C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start A12 in 2017, A9-11 in 2022, A18 in 2027, and A13-15 in 2030

N

0 1,000 2,000 4,000 6,000 Feet

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 14

Shoreline Study Alternatives

2067 Marsh Elevations with C0 = 200 mg/L

Proj. # 211259

ESA PWA

C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start A12 in 2017, A9-11 in 2022, A18 in 2027, and A13-15 in 2030. Fill 1:30

N

0 1,000 2,000 4,000 6,000 Feet

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 15

Shoreline Study Alternatives

2067 Marsh Elevations with Prelim Alt 2 Transitional - Upland Fill Footprint

Proj. # 211259

ESA PWA

C0 = 200 mg/L, NRC-III, organics = 1 mm/yr
Start A12 in 2017, A9-11 in 2022, A18 in 2027, and A13-15 in 2030. Fill 1:100

N

0 1,000 2,000 4,000 6,000 Feet

- Deep Subtidal
- Shallow Subtidal A
- Shallow Subtidal B
- Intertidal Mudflat low
- Intertidal Mudflat mid low
- Intertidal Mudflat mid high
- Intertidal Mudflat high
- Cordgrass Dominated low
- Cordgrass Dominated high
- Pickleweed Dominated
- Upland

figure 16

Shoreline Study Alternatives

2067 Marsh Elevations with Prelim Alt 3 Transitional - Upland Fill Footprint

Proj. # 211259

ESA PWA

Appendix B2

Environmental Benefits Analysis (CHAP) Summary and Model Outputs

South San Francisco Bay Shoreline Study

COMBINED HABITAT ASSESSMENT PROTOCOLS (CHAP) RESULTS FOR THE WITH-PROJECT AND WITHOUT-PROJECT CONDITIONS

San Francisco District, U.S. Army Corps of Engineers

July 22, 2015

1.0 Introduction

1.1 Study and Study Area

The San Francisco Estuary, including San Francisco Bay and adjoining bays, has lost approximately 90 percent of its tidal marshes over the last 165 years due to diking, filling, and other human activities. This has resulted in substantial loss of tidal marsh functions and wildlife habitat, and has led to listing of several species under the Endangered Species Act. In the south portion of San Francisco Bay (the South Bay), a large portion of these tidal marsh losses were due to conversion of tidal marsh to commercial salt ponds decades ago. Many of these ponds were acquired for conservation purposes by Federal and State agencies in 2003.

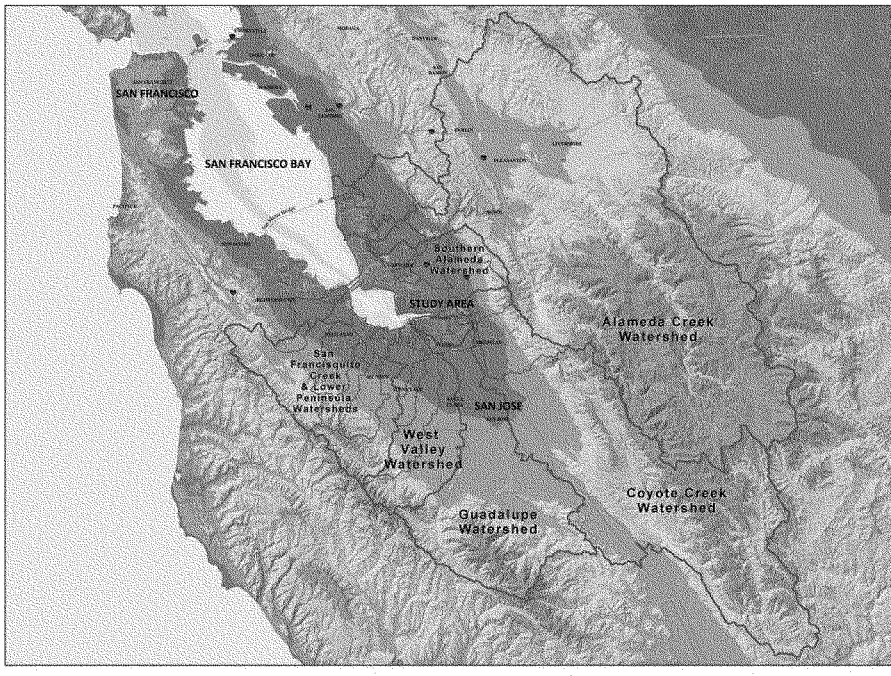
The South San Francisco Bay Shoreline Study is considering flood risk management (FRM) and ecosystem restoration (ER) actions in the Alviso area in the South Bay. FRM actions under consideration would cause loss of a small portion of existing habitats, and conversion of managed ponds into tidal and transitional habitats for ER purposes would affect existing habitat values by replacing one kind of habitat with several other types. Figure 1 shows the general location of the study area in the context of San Francisco Bay and local watersheds.

U.S. Army Corps of Engineers (USACE) planning policy requires a cost-effectiveness analysis of potential ER measures to determine the optimal components to be included in the final array of alternatives and to assist in the selection of the preferred alternative. In addition, various environmental laws and regulations require analysis of environmental impacts from a project including effects on fish and wildlife habitat. Thus, quantifying effects on fish and wildlife habitat is an important task for this study. Additional habitat and species analyses, such as acres of habitat types and effect on endangered species, were handled separately using other methods and are reported in other documents such as the Final Integrated Report for this study.

1.2 Selection of Habitat Goals

The key issue in considering the future of existing managed ponds along the shoreline of San Francisco Bay is the habitat and wildlife tradeoff between retaining or improving these ponds as habitat for water birds (waterfowl and shorebirds) versus restoring these sites to tidal action with their associated habitats, fish, and wildlife. A planning effort by federal and state agencies, the South Bay Salt Pond Restoration Study, has determined that some of the managed ponds in the South Bay should be converted to tidal habitats, primarily tidal marsh, to restore marsh functions and to further the recovery of endangered species that use these habitats (South Bay Salt Pond Project, 2007). This decision has been made with the full understanding that considerable existing habitat value for water birds will be lost in order to obtain the needed tidal habitat benefits. The South Bay Salt Pond Project has subsequently breached some ponds while enhancing other ponds for bird use to offset losses of habitat value for birds.

Figure 1: Study Area



2.0 Methods

2.1 Value and Limitations of Habitat Evaluation Methods

Habitat evaluation methods are intended to quantify the relative values of different areas whose ecological value may be lost, degraded, or improved by project activities. Determining the ecological value of an area is a complex matter, in part because any area that serves as fish or wildlife habitat will have a number of ecological functions and values in the context of a larger landscape. In a very limited context it may be relatively easy to determine what would improve habitat values in a small area, but local optimization of habitat value may not always be optimal in a landscape context. This issue will be discussed further later on in this report.

2.2 Tidal vs. Non-Tidal Habitats

Given the findings of the South Bay Salt Pond Restoration Study, the Shoreline Study has examined the feasibility of converting existing managed pond habitat to tidal habitats, with the understanding that such restoration efforts would convert one valuable habitat into another. In such cases, comparing the habitat outputs of study alternatives to the without-project condition may not show any net gain, and is not useful in comparing the cost-effectiveness of these alternatives.

Thus, *only for purposes of evaluating the cost-effectiveness of ER measures and alternatives*, this study set the habitat units for non-tidal habitats to zero. The gross tidal habitat outputs under CHAP from within the restoration area are counted as ecosystem restoration benefits for USACE planning purposes. This issue is addressed again in Section 4.

2.3 Overview of Habitat Evaluation Methods Selected for this Study

The Combined Habitat Assessment Protocols (CHAP) was selected, in consultation with the South Pacific Division of USACE, for quantifying ecosystem restoration benefits for the South San Francisco Bay Shoreline Study. CHAP is a method for quantifying the value of habitat for wildlife developed by the Northwest Habitat Institute (NHI). It builds upon older methods such as the FWS' Habitat Evaluation Procedures (HEP) and the Habitat Accounting and Appraisal (HAB) method. Unlike HEP it evaluates all the vertebrate species found in a given habitat area, and can be expanded to cover selected invertebrate species. CHAP habitat units are not comparable to HEP habitat units and should not be directly compared due to their different scaling.

CHAP looks at both the requirements of individual species (key ecological correlates or KECs) as well as the functions these species provide for their ecosystem (key ecological functions or KEFs). Given these areas of emphasis, CHAP generally gives higher scores for locations with higher biodiversity and more complex habitat structure within a given habitat type. CHAP operates within a geographic information system (GIS) environment.

A habitat study using the California Rapid Assessment Method (CRAM) was also performed. While this study provided very useful projections of future habitat conditions, it was not able to produce annualized benefits for assessing the cost-effectiveness of ecosystem restoration efforts and was not used to evaluate alternatives.

2.4 Method for Determining Baseline Conditions

The CHAP approach involves four steps: 1) preliminary mapping, 2) field inventory, 3) data compilation and analysis, and 4) production of GIS maps, spreadsheets, and report. Detailed information on methods used and the baseline findings are available in Northwest Habitat Institute (2015a). Results are provided here in summary form for reference. Habitat types are listed in Table 1 and mapped in Figure 2. The species numbers selected are listed by class in Table 2. Key ecological correlates (KECs) and key ecological functions (KEFs) were identified for each species and are presented in Northwest Habitat Institute (2015a).

To complete the determination of baseline CHAP information, GIS maps were generated that depict the habitat values (HUs) of each polygon. Supporting maps illustrated: a) study area boundaries; b) polygon numbering; c) corrected habitat value per acre; d) habitat units; e) amounts of non-native plant species by polygon; f) wildlife habitat types by polygon; and g) structural conditions by polygon. Spreadsheets were developed that contain the polygon calculations of the species-functions and habitat-functions matrices, along with an overall site or area habitat value.

2.5 Forecast of Future Without-Project Habitat Conditions

Existing wetland habitats in the south portion of San Francisco Bay are artificially fragmented and degraded, which raises the question of whether all existing wildlife species and populations in the area

are sustainable in the long term. The habitat evaluation team reviewed the species included in the CHAP analysis and projected loss of four species over the course of the habitat evaluation period, in the absence of an ecosystem restoration project.

Several external factors could affect future habitat values in the absence of a project. These include sea level rise, climate change, invasive species, or other unforeseen environmental changes. However, other than land use changes guided by existing land use plans, such changes are highly uncertain as described below. Future habitat conditions were therefore assumed to be the same as current conditions in the absence of a project, except as noted below.

Table 1: Habitat Types		
Tidal Habitats	*Non-Tidal Habitats*	
Saline Marsh	Batch Pond	Parks / Upland Grassland
Brackish Marsh	Managed Pond	Levee
Freshwater Marsh	Muted Tidal / Diked Marsh	Water / Sewage Treatment
Tidal Flats/Mudflats	Seasonal Wetland	Landfill
Open Water/Slough Channel	Upland Vegetation	Developed
	Riparian/Creek Corridor	

Table 2: Number of Vertebrate Species Included in the CHAP Analysis						
Class	Fish	Amphibians	Reptiles	Birds	Mammals	Total
Number of Species	51	0	6	177	17	251

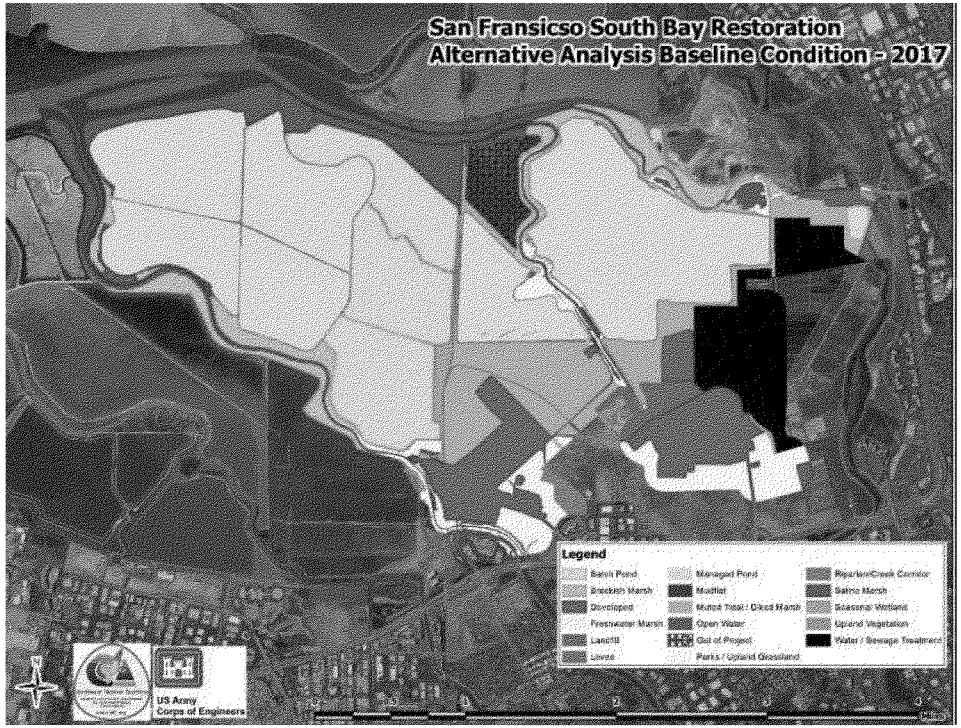
Note: Classes shown are the traditional taxonomic groupings for vertebrates that are most commonly used in planning and management of ecosystems. Evolutionarily unified (monophyletic) groups may differ from these categories.

2.5.1 Sediment Availability and Sea Level Rise

Areas already subject to tidal action would be affected by sea level rise (SLR). To evaluate this issue, consideration of the past behavior of the area as well as forecasts of future sediment dynamics should be taken into account. Due to the past construction of steep-sided levees and dikes along the shores of essentially all land areas in the study area, the transition from tidal to non-tidal areas within the study area is very abrupt. Therefore, significant encroachment of tidal waters and marshes onto currently non-tidal lands is not expected during the evaluation period.

During portions of the 20th Century, the study area experienced large amounts (2 to 6 feet in 33 years) of relative SLR due to land subsidence caused by overdraft of deep aquifers underlying the Santa Clara Valley and neighboring portions of San Francisco Bay. Due to relatively high suspended sediment concentrations in tidal waters within the study area, local tidal marshes were able to trap sufficient sediment to keep up with this relative SLR and even expand into mudflat areas (H.T. Harvey and Associates, 2012).

Figure 2: Habitat Types



Map credit: H.T. Harvey and Associates; Northwest Habitat Institute

Tidal wetlands in the San Francisco Estuary are generally accreting sediment fast enough to keep up with SLR (Callaway et al.,2012). In the immediate vicinity of the study area, Coyote Creek and Alviso Slough show much higher rates of accretion (Watson 2004, and Patrick and DeLaune 1990), which may be a response to past local subsidence coupled with the abundant fine sediment supply in the area (Patrick and DeLaune 1990). This past subsidence can be viewed as an analog for current eustatic SLR.

Projected net local SLR between the present time and the end of the evaluation period (56 years from the present) is at the low end of past relative SLR in the study area and would occur over a much longer period. Modeling of tidal marsh adaptation to SLR in San Francisco Bay suggests that the study area is expected to retain a relatively high ability to adapt to SLR over the next 60 years (Stralberg et al., 2011).

Therefore, it is reasonable to project that tidal marshes in the study area will be able to keep up with SLR through sediment capture for the duration of the evaluation period. Mudflats and subtidal habitats can be expected to evolve some during this period but no large net changes in their extent is expected. However, it should be noted that this situation may change in decades following the evaluation period, as the rate of SLR is expected to accelerate greatly later in the century.

2.5.2 Climate Change

Another factor that could affect habitat values is climate change. While most attention on this issue has focused on global forecasts, regional climate change is what would affect local conditions. However, regional forecasts contain considerable uncertainty, including that due to uncertainty over future emissions of greenhouse gases. These forecasts do agree that increasing average temperatures can be expected in California over the course of this period. However, it can reasonably be expected that sites within a short distance of tidal waters and downwind from those waters, such as those in the study area, can be expected to have relatively modest changes in average air temperatures due to the moderating effect of these waters.

The most likely means for future regional climate change to affect local habitat conditions would be through changes in moisture balance. Increased temperatures increase evapotranspiration even if precipitation stays the same. However, the Third National Climate Assessment (Melillo, et al., 2014) shows only modest (under five percent) projected reductions in soil moisture in the San Francisco Bay Area for the 2040-2071 period. This would primarily affect non-tidal habitat areas, though decreased moisture could have a modest effect on upper tidal marsh vegetation which receives relatively infrequent tidal water input.

With the exception of New Chicago Marsh which has some access to Bay water, non-tidal vegetated areas in the study area consist nearly entirely of degraded and invasive non-native vegetation types. Based on the ecological tolerances of these habitat types, they are not expected to experience substantial changes in habitat attributes and structure under the modest temperature increases and soil moisture deficits projected for the study period, and in any case it is not possible to quantify such changes with any degree of reliability at this time.

2.5.3 Invasive Species

Invasive species have continued to arrive in the study area and cause new ecological disruptions from time to time. The CHAP evaluation assumes this will continue to occur and adjusts future habitat values accordingly.

2.5.4 Site-Specific Factors

Site-specific factors that could affect habitat values in the study area consist of potential changes in land use and management. Relevant study assumptions for the without-project condition include:

•The managed ponds under study (A12-A15 and A18) would continue under similar management as present. Levee reinforcement efforts under current management would continue in the future. While pond breaches might occur sporadically, they would be repaired reasonably promptly and would not result in significant changes in habitat value in the long term. Pond A16 and A17 were not evaluated under this study as they have recently been restored or modified as part of a separate project.
•New Chicago Marsh would not change significantly. This assumes that the USFWS raises levees adequately over time to keep out regular tidal action. This would be needed for the USFWS to minimize liability for flooding of Alviso. This does not imply an adequate level of flood protection for developed areas, but rather the exclusion of tidal action under normal circumstances.
•The City of San José implements its master plan for the San José-Santa Clara Water Pollution Control Plant and surrounding lands it owns. This would include new development in some currently undeveloped areas.
•The City of San José would allow development to continue in the Alviso area as provided by existing plans. Over several decades all remaining developable private lands would become urbanized in this planning area. It is assumed that any subsequent abandonment of developed properties in the Alviso area due to increased flooding risk late in the evaluation period would not result in restoration of natural habitat values on these properties, due to the dominance of pavement and buildings on these sites which would largely prevent natural revegetation.
•Other non-tidal habitats would not be expected to change significantly.

2.6 Forecast of Future With-Project Habitat Conditions

All study alternatives include a phased approach to implementation of ecosystem restoration. Modeling of landscape evolution assumed that construction of the flood risk management levee would start in 2017 along with the restoration features within Pond A12. The pond would be breached in 2020, which would represent the start of the first phase of habitat development. Additional construction of restoration features, culminating in breaching of additional sets of ponds, would be accomplished in two successive phases to be completed in 2025 and 2030. See Section 2.7 for updates to this schedule. Following completion of each phase, the breached pond(s) would evolve naturally into mudflats and tidal marsh over time, potentially with assistance from the proposed adaptive management program.

Forecast of future habitat conditions started with the landscape evolution modeling performed by Environmental Sciences Associates/Philip Williams Associates. This modeling provided forecasts of substrate elevation in the breached ponds at discrete intervals for a period extending 50 years into the future from the expected start of construction. These forecasts provided a basis for projecting basic habitat types and acreages in the restored ponds at specific times in the future.

The next phase of forecasting was conducted by H.T. Harvey and Associates, and provided more detailed projections of habitat conditions in breached ponds to assist in the CRAM modeling. Projected habitat information available in GIS format was used by NHI to provide additional habitat details in restored ponds at specific points in the future. The result was a comprehensive set of maps of future habitat polygons. NHI then applied appropriate species, KECs, and KEFs to these polygons, based on their baseline work, to provide the basis for calculating CHAP outputs at specific points in the future under

with-project conditions. Finally, with habitat units projected for specific times in the future, these units were averaged to produce average annual habitat units (AAHUs) which were the basis for comparing alternatives.

Forecast of future conditions was also needed for two sets of habitats not directly affected by the alternatives. First, marshes already subject to tidal action could be affected by SLR; this is addressed under the discussion of without-project conditions. Second, areas not subject to tidal action and not directly affected by an alternative might change in the future for other reasons. For these areas, future habitat conditions were generally determined to be the same as under the without-project condition except as otherwise noted.

2.7 Modeling and Evaluation Periods

Analyses performed for the South San Francisco Bay Shoreline Study used a 50-year economic evaluation period running from 2017 to 2067. After the modeling efforts were completed and the draft Integrated Report was circulated, the timing and phasing of construction including pond restoration was modified to address passage of time as well as public and agency concerns:

- Construction is now projected to start in 2018, which would move all following dates one year back.
- The first phase of construction would be complete in 2021, including breaching the first ponds.
- For USACE planning purposes, the evaluation period was changed to run from 2021 to 2071 to ensure consistency with USACE planning requirements.
- Ponds A12 and A18 are now proposed to be breached in the same year, after which further phases of breaching would be sequenced as originally planned, albeit delayed by one year. This would move up the breaching of Pond A18 by five years relative to other ponds, and would likely have a similar effect on subsequent habitat evolution in this pond.

Incorporating these changes into the CHAP study would have required redoing the landscape evolution and habitat evolution modeling before redoing the CHAP modeling itself, thereby causing substantial delays in the study. However, effects of these changes should be essentially identical across all four restoration alternatives due to their similarity. Since the NHI CHAP reports (Northwest Habitat Institute, 2015a; Northwest Habitat Institute, 2015b) use the earlier dates these will be retained for this report as well. Habitat changes beyond the end of this period are considered in evaluating the long-term sustainability and adaptability of study alternatives, but are not used for calculating ecosystem restoration or flood risk management benefits for these alternatives.

3.0 Alternatives and CHAP Results

3.1 Overview

FRM and ER measures (individual actions) were considered and combined into FRM and ER options (related actions that constitute building blocks for formulating complete alternatives). The bases for formulating these measures, for initial screening of them, and for the overall restoration design are described in the Integrated Report.

The options were assembled into combined FRM/ER alternatives for evaluation. ER options could not be evaluated on their own, as their success requires additional options to be implemented. For instance, the ecotone requires both an FRM levee option and a pond restoration option to be workable.

3.2 Ecosystem Restoration Options

A variety of ER and FRM measures were assessed for possible combination into ER options. ER options carried forward for detailed evaluation are listed below. The basic pond restoration, levee, and bench options were base action conditions (the minimum restoration actions required for a functioning alternative), and the other options represent additional expense and complexity incurred in pursuit of improved ER outputs.

- Basic pond restoration
- Accelerated pond restoration (additional ER measures in ponds)
- FRM levee with bench along the pond side
- 30:1 ecotone
- 100:1 ecotone

The minimal ER action would be basic pond restoration. The bench is an integral component of the several FRM levee alternatives considered and has incidental ER value. The 30:1 ecotone and 100:1 ecotone options represent increased investment in ecosystem restoration. An additional option for increased investment, accelerated pond restoration, could not be evaluated by CHAP due to data issues.

Various combinations of these options were considered in the plan formulation process. At the time of the initial CHAP alternatives modeling, two levee alignments with the three levels of ecotone (bench, 30:1, and 100:1 were included to obtain information on the cost-effectiveness of these options. Ponds were broken into four increments of restoration, based primarily on historic drainage patterns which are important to effective tidal marsh restoration.

3.3 Initial Round of CHAP Analysis, 2012

The initial CHAP analysis showed very similar outputs for the two alternatives evaluated. This is not surprising given that the pond habitat scored about as high as the tidal marsh habitat, and under both alternatives about the same acreage was allocated to the combined total of these two habitat categories. (The north alignment in Pond A18 under the early Alternative 2 resulted in portions of the pond being retained as pond rather than being restored to tidal action.)

This analysis showed fairly similar habitat benefits for restoration of each of the several pond groupings as shown in Table 3. Note that, as discussed in Section 2.2, these numbers are only tidal habitat outputs for areas undergoing restoration. Non-tidal habitat outputs are set to zero for purposes of evaluating tidal habitat outputs.

The highest output was from Pond A12 at 19.3 annualized habitat units per acre and the lowest (Ponds A13-A15) was 14.0 habitat units per acre. The differences are probably due primarily to the phasing of restoration, with ponds breached earlier having more time to develop complex tidal marsh features which provide better habitat value.

The transitional period between the breaching of ponds and the development of tidal marshes, during which the former ponds consisted of mudflats and subtidal aquatic habitat, showed slightly lower total habitat values than either the preceding ponds or the tidal marshes which followed. Breaching initially causes a reduction in habitat units per pond grouping of eleven to fifteen percent, followed by a slow climb up to very close to the pre-breaching number of habitat units with a net difference of one to three

percent from the starting values. Both these habitat outputs and the habitat outputs for the managed ponds are similar under CHAP, so there is little net change in total CHAP outputs at the end of the evaluation period from implementing any of the final alternatives from this tradeoff.

The initial CHAP analysis showed no significant differences in outputs under the three ecotone fill options. This is because gains in marsh wildlife habitat value from additional fill were offset by losses in fish habitat from this fill. While the lower portion of the ecotone would be underwater much of the time, benefitting in turn both fish and marsh wildlife, the upper portion would nearly always or always be above water, benefitting only marsh and upland wildlife (some marsh species require adjacent upland with adequate vegetation so they can avoid predation during very high tides). This quantitative analysis does not take into account concerns over restoration of listed or otherwise rare species, as all species are weighted equally in CHAP.

Table 3: Comparison of Pond Groupings, Initial CHAP Analysis

Alternative 1 with bench	Breakpoints in Habitat Development							Annualized Outputs	Annualized Outputs per Acre
	2017	2020	2025	2030	2037	2047	2067		
Pond A9-A11	0	0	16,340	16,241	17,797	19,156	19,090	15,356	17.1
Pond A12	0	6,145	5,929	6,662	6,674	6,677	6,670	6,171	19.3
Ponds A13-A15	0	0	0	16,261	16,178	16,151	18,347	12,403	14.0
Pond A18	0	0	15,347	15,485	16,202	18,309	18,525	14,577	17.0
Total	0	6,145	37,617	54,649	58,851	60,293	62,631	48,508	

Alternative 2 (different levee alignment) had very similar outputs, as did either alternative with the 30:1 or 100:1 ecotone added. Impacts to habitats in areas which remain non-tidal, such as New Chicago Marsh, would be very small (about two percent for non-tidal habitats) compared to impacts in the pond areas to be opened to tidal action under the alternatives. The non-tidal impacts would not significantly affect the calculation of restoration benefits.

3.4 Evaluation of the Final Array of Alternatives, 2014-2015

Based in part on the results of the initial CHAP analysis, alternatives were reformulated and the final array of alternatives selected. These alternatives included four different levee alignments and two levels of ecotone: none (bench only) and 30:1. Details of the revised CHAP analysis are found in Northwest Habitat Institute (2015b).

Table 4 shows CHAP restoration outputs for the four final alternatives, within the areas where restoration measures would be implemented. Note that, as discussed in Section 2.2, these numbers are only tidal habitat outputs for areas undergoing restoration. Non-tidal habitat outputs are set to zero for purposes of evaluating tidal habitat outputs.

Differences between the alternatives were minimal because under all four alternatives, habitat conditions on the vast majority of the site would be the same at any one time during the period of habitat evaluation. As previously discussed, there would be modest differences between the output per acre of the several pond groupings.

Outputs shown are based on the original phasing of pond restoration where Pond A18 is not breached until the second phase of breaching. As discussed in Section 2.7, this phasing was later accelerated to address public and agency concerns but it was not practical to revise the results to reflect this. The effects of this acceleration should be nearly identical across the alternatives due to their great similarity in restoration actions.

Table 4: Comparison of CHAP Outputs, Final Array of Alternatives [1]								
	Breakpoints in Habitat Development [2]							Annualized Outputs
	2017	2020	2025	2030	2037	2047	2067	
Alternative 2 (NED/NER)								
Pond A9-A11	0	0	16,510	16,416	17,936	19,261	19,094	15,442
Pond A12	0	6,039	5,894	6,591	6,603	6,606	6,592	6,105
Ponds A13-A15	0	0	0	15,557	16,273	16,230	18,312	12,434
Pond A18 [3]	0	0	15,439	15,557	16,273	18,384	18,520	14,624
Total	0	6,039	37,843	54,878	57,054	60,481	62,518	48,606
Alternative 3								
Pond A9-A11	0	0	16,510	16,416	17,936	19,261	19,094	15,442
Pond A12	0	6,056	5,911	6,607	6,619	6,622	6,609	6,120
Ponds A13-A15	0	0	0	16,316	16,244	16,230	18,313	12,435
Pond A18 [3]	0	0	15,439	15,557	16,273	18,384	18,520	14,624
Total	0	6,056	37,859	54,895	57,072	60,498	62,535	48,622
Alternative 4 (LPP)								
Pond A9-A11	0	0	16,510	16,416	17,936	19,261	19,094	15,442
Pond A12	0	5,915	5,786	6,418	6,430	6,433	6,423	5,952
Ponds A13-A15	0	0	0	16,282	16,211	16,198	18,278	12,411
Pond A18 [3]	0	0	15,098	15,188	15,834	17,844	17,958	14,214
Total	0	5,915	37,393	54,304	56,412	59,737	61,753	48,019
Alternative 5								
Pond A9-A11	0	0	16,510	16,416	17,936	19,261	19,094	15,442
Pond A12	0	6,039	5,894	6,591	6,603	6,606	6,592	6,105
Ponds A13-A15	0	0	0	16,315	16,243	16,230	18,312	12,434
Pond A18 [3]	0	0	15,439	15,557	16,273	18,384	18,520	14,624
Total	0	6,039	37,843	54,878	57,054	60,481	62,518	48,606

1 Outputs are for tidal habitats in breached ponds only
2 Breakpoint dates are from the CHAP study and are expected to slip one year
3 Pond A18 is now planned to be breached in the same year as Pond A12

The ecotone was originally expected to show habitat benefits under CHAP. However, as in the first round of modeling, addition of the ecotone to the restoration plans very slightly reduced total tidal habitat benefits, with the reduction being about one percent. This difference is visible in Table 4 in comparing the NED/NER plan and the LPP. The specific reasons for this difference are discussed under subsection 3.3.

Models that tabulate site-specific habitat values (to arrive at an overall sum of habitat value for a defined area) typically are unable to assign a higher value to habitat tradeoffs which might very locally decrease total vertebrate diversity while increasing total landscape diversity, ecological function, and sustainability over a larger area. This is a common difficulty in ecosystem modeling when formulating and evaluating ecosystem restoration projects, and came into play with the evaluation of the ecotone.

Looking at all habitat units (tidal and non-tidal) combined, the 2012 and 2014-2015 analyses showed habitat units initially declining by up to eight percent after breaching of ponds as they became mudflats. Habitat units then increased over time as marshes developed in the former ponds. The final habitat values after fifty years were very close to the initial pond habitat values prior to breaching.

As a result, the restoration alternatives showed slightly lower AAHUs than the without-project condition (Northwest Habitat Institute, 2015b). This may seem to be counterintuitive, but it is not surprising considering the large bird populations which can exist in the ponds. As discussed earlier, the Shoreline Study considered conversion of one valuable habitat type to another to reverse historic losses of tidal marsh habitat value. Modeling alone cannot determine which habitat type should take precedence in a given situation, but can help inform such decisions.

The CHAP baseline and alternative reports from NHI were revised in July 2015 to provide additional information and to ensure all CHAP assumptions are consistent with study assumptions. This revision did not change the with-project habitat outputs or the zeroing out of non-tidal habitat outputs for purposes of ER formulation and evaluation.

4.0 Conclusions

The CHAP analysis provides a way of quantifying habitat values with and without a given project or alternative, by compiling animal species presence, species function, and habitat function data. In practice, it will tend to show a higher habitat value for areas with more vertebrate species and more diverse habitat features.

The CHAP analysis for the Shoreline Study showed similar values for managed ponds and tidal habitats, with slightly lower values for the initial period after breaching of ponds when little or no marsh would be present. It showed large increases in *tidal* habitat value after breaching of ponds, with tidal values continuing to increase over time to the end of the evaluation period. The analysis showed fairly similar habitat benefits per acre for restoration of the several pond groupings in the final array of alternatives. CHAP also showed slightly lower values for alternatives with an ecotone, but this was due to the method's tendency to give higher scores for areas with higher species diversity within a given evaluation polygon.

In summary, CHAP:

- Confirms the high habitat values of both managed ponds and tidal habitats in the study area.
- Shows large gains in tidal habitat value from the restoration actions under consideration.
- Shows fairly similar gains in tidal habitat value from restoration of each the several different pond groupings.
- Does not show additional gains from adding an ecotone to the restoration plan due to the nature of the CHAP analysis.

5.0 References Cited

Callaway, J. C., E. L. Borgnis, R. E. Turner, and C. S. Milan. 2012. Carbon sequestration and sediment accretion in San Francisco Bay tidal wetlands. *Estuaries and Coasts* 35:1163-1181.

H.T. Harvey & Associates, 2012. *Marsh Plant Associations of South San Francisco Bay: 2012 Comparative Study*. Prepared for the City of San Jose.

Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: *Climate Change Impacts in the United States: The Third National Climate Assessment.* U.S. Global Change Research Program, 841 pp.

Northwest Habitat Institute, 2015a: *Combined Habitat Assessment Protocols (CHAP) Fish & Wildlife Habitat Assessment Final Report, South San Francisco Bay Shoreline, Baseline Conditions*, 37 pp.

Northwest Habitat Institute, 2015b: *Combined Habitat Assessment Protocols (CHAP) Fish & Wildlife Habitat Assessment Final Report, South San Francisco Bay Shoreline, Five Ecosystem Restoration Alternatives*, 31 pp.

Patrick, W. H., JR., and R. D. Delaune. 1990. Subsidence, accretion and sea level rise in south San Francisco Bay marshes. *Limnol. Oceanogr.* 35: 1389-l 395.

Stralberg, D., M. Brennan, J. C. Callaway, J. K. Wood, L. M. Schile, D. Jongsomjit, M. Kelly, V. T. Parker, and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. *PLoS ONE* 6:e27388. doi: 10.1371/journal.pone.0027388.

South Bay Salt Pond Project, 2007. *Final Environmental Impact Statement/Report.*

Watson, E.B. (2004) Changing Elevation, Accretion, and Tidal Marsh Plant Assemblages in a South San Francisco Bay Tidal Marsh. *Estuaries* 27(4):684-698.

Combined Habitat Assessment Protocols (CHAP)
Fish & Wildlife Habitat Assessment
Final Report

South San Francisco Bay Shoreline

South San Francisco Bay Shoreline Project Area

Baseline Conditions
U.S. Army Corps of Engineers
San Francisco District

Report and Analysis by Northwest Habitat Institute

July14, 2015

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CHAP
Wildlife Habitat Assessment of South San Francisco Bay Shoreline

Executive Summary

The wildlife habitat assessment of the South San Francisco Bay Shoreline study evaluated 173 polygons. Baseline conditions that consisted of 16 different habitat types were determined to describe the 6,674 acres (2,700 ha) site. The number of fish and wildlife species associated with the project totaled 253, of which 51 were fish, 165 birds, 30 terrestrial mammals, 6 reptiles, and 1 marine mammal. The baseline condition evaluation for the project area showed a total of 119,652 habitat units. Of these, about 60,000 habitat units are associated with Ponds A9 – A18. Breaking out the different habitat types revealed that there are 2,298 acres (930 ha) managed ponds within the study site. Of these, there are 826 acres (334 ha) batch ponds, 413 acres (167 ha) saline marsh ponds, 545 acres (221 ha) muted tidal or diked marsh ponds, and 119 acres (48 ha) freshwater marsh ponds. The average per-acre value of managed ponds overall is 22.1. By type, the values are 22.0 for batch ponds, 19.9 for saline marsh, 14.4 for muted tidal and diked marsh ponds, and 21.3 for freshwater marsh ponds. All habitat types' per-acre values fell within the range of 0 and 29.8.

To examine the future conditions that might exist if the proposed project does not occur, we began to put the project site into perspective by conducting a coarse evaluation of the amount of change in land use that has occurred from historic (ca. 1800) to modern times (ca. 2001) for the shoreline around the entire San Francisco Bay. To do this, the San Francisco Estuary Institute's Historic and Modern Bayland maps were used. This assessment showed an apparent loss in value that ranges from about 1.7 to 2.3 million habitat units for the area. To develop the future perspective for the next 50 years, additional steps were taken to obtain information on fish and wildlife species populations, invasive plant species, planned development, climate change influences and earthquake frequencies. Evaluating this information suggests that there will be a low turnover in species composition, salinity levels will still be controlling the spread of some of the invasive plants, future planned development will occur in already developed areas, sea rise due to climate change may periodically expand the bay's aquatic footprint for short periods in the Alviso area, and the design and engineering of the current levees and dikes are expected to withstand predictive earthquakes for the area. However, if this infrastructure failed, some flooding may occur though the surface water is expected to flow back in the San Francisco South Bay.

Introduction

Throughout the United States, there is a move towards assessing restoration and other conservation activities at the ecosystem level. Under current U.S. Army Corps of Engineers (Corps or USACE) authority, the objective of Civil Works ecosystem restoration is to restore significant ecosystem structure, function, and dynamic processes that have been degraded to a

less degraded, more natural condition. Even partial restoration may provide significant and valuable improvements to degraded ecological resources.

Ecosystem restoration projects should examine the needs for improving or re-establishing both the structural components and the functions of the natural system. Restored ecosystems should mimic, as closely as possible, conditions that would occur in the area in the absence of human changes to the landscape and hydrology. Indicators of successful restoration would include the presence of a large variety of native plants and animals, the ability of the area to sustain larger numbers of certain indicator species or more biologically desirable species, and the ability of the restored area to continue to function and produce the desired outputs with a minimum of continuing human intervention. Those restoration opportunities that are associated with wetlands, riparian and other floodplain and aquatic systems are most appropriate for Corps involvement.

The information used in formulating, evaluating and selecting ecosystem restoration alternatives in Corps Civil Works projects includes both quantitative and qualitative information about outputs, costs, significance, acceptability, completeness, effectiveness, and reasonableness of costs. Within the USACE ecosystem restoration policy, *"An ecosystem restoration proposal must be justified on the basis of its contribution to restoring the structure or function, or both, of a degraded ecosystem, when considering the cost of the proposal. Ecosystem restoration projects are justified through a determination that the combined monetary and non-monetary benefits of the project are greater than its monetary and non-monetary costs. As such, plan selection is not based on economic justification in terms of a traditional monetary benefit to cost analysis, since the majority of benefits associated with the primary outputs of ecosystem restoration can rarely be quantified in dollars. Therefore, ecosystem restoration proposals need not have either a benefit-cost ratio greater than 1.0, or positive net economic benefits. However, any monetary incidental benefits which are anticipated from proposed ecosystem restoration projects, and relevant to the particular circumstances associated with the study, should be displayed to aide in decision making"* (USACE, EP 1165-2-502, 1999).

Instead of calculating economic benefits in monetary terms, Corps ecosystem restoration projects calculate the value and benefits of habitat using established habitat assessment methodologies. Evaluating habitat quality is the approach most often taken to compare ecosystem restoration alternatives because habitat is thought of as a surrogate for ecosystems; it is the setting where plants and animals live, interact, and reproduce. Habitat is frequently viewed in conjunction with species information to gain insight to various uses, structures, and functions existing within a landscape or site. Determining habitat structure and functional integrity of an area is supportive of an ecosystem management approach.

Habitat Units (HUs) are one of the currencies the Corps currently uses to rate and compare the value of one ecosystem restoration alternative to another. The concept of HUs is derived from the U.S. Fish and Wildlife Service's (USFWS) single-species habitat-assessment methodology known as Habitat Evaluation Procedures or HEP (1980), which the Corps has long used as a habitat evaluation tool.

The Combined Habitat Assessment Protocol (CHAP) is an accounting and appraisal methodology that utilizes an ecosystem-based habitat and biodiversity evaluation framework. CHAP generates an objective habitat-value score. This approach involves a triad assessment of habitat, species, and functions (O'Neil et al., 2005), and can provide assessments at multiple scales. The CHAP method integrates a habitat and biodiversity or HAB calculation that determines habitat units (HUs) based on an assessment of multiple species (all potential species at a site), habitat features, and functions by habitat type.

The overall goal of the South San Francisco Bay Shoreline Feasibility Study (Shoreline Study) ecosystem restoration project assessment was to evaluate baseline habitat conditions at a fine level of resolution within an ecosystem context. An ecosystem context is more holistic than assessing just a few individual species (Perkins, 2002), especially with federal or state-listed taxa. It calls for a multiple-species framework that includes an evaluation of ecological functions. Additionally, the Corps would like to assess alternative scenarios; hence a realistic depiction of actual habitat site conditions at a fine scale level was needed. The approach reported herein depicts the wildlife habitat baseline conditions at a fine resolution or site-level scale, uses multiple species and their habitat functions in its evaluation, and accounts for actual habitat types, structural conditions, and key environmental correlates within the Shoreline Study project assessment boundary based on input from knowledgeable field staff, inventories, and past studies of the area's habitat components.

Goal

The primary goal of this feasibility study is to determine the best solution under Corps criteria for provision of tidal flood risk management and/or ecosystem restoration in the study area, considering existing plans and projects such as the South Bay Salt Pond Restoration Project and the new recovery plans for listed species in the South Bay. Partners in this study include the U.S. Fish and Wildlife Service (USFWS), the State Coastal Conservancy (CSCC, a non-federal sponsor), and the Santa Clara Valley Water District (SCVWD, a non-federal sponsor).

Study Site

The Shoreline Study examines the feasibility of flood risk management and ecosystem restoration along a portion of the south shoreline of San Francisco Bay (http://www.southbayshoreline.org/. also see also Figure 1). In March 2011, the study was refocused on an area of about 6,800 acres (2,751 hectares) that cover the area between the Guadalupe River and Coyote Creek, also known as Economic Impact Area (EIA) 11. This area includes the community of Alviso, which is incorporated into San Jose, the San Jose-Santa Clara Water Pollution Control Plant (WPCP), and adjacent managed ponds formerly used as part of Cargill, Inc.'s salt production system.

The baseline condition assessment encompasses Ponds A9 through A16, Pond A18, and adjacent areas (see Figure 2). Pond A16 will be reconfigured by the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) but will still be a pond. Pond A17 will be breached for restoration of tidal habitats by the Refuge, but mapped habitat predictions are not available so this pond is excluded from the CHAP study. However, Pond A18 is being studied by the City of

San Jose as part of the reconfiguration of its wastewater treatment plant, and will also be considered by this study.

Background

The Alviso ponds were formerly part of the Cargill, Inc. solar salt production system, but were sold to the federal government in 2003. The Alviso ponds are now managed by the FWS as part of the Refuge. Current management of these ponds primarily favors various species of migratory shorebirds and waterfowl. The ponds are surrounded by sloughs and remnant tidal marshes which are habitat for listed species such as the Ridgeway's rail (formerly California Clapper rail) and the salt marsh harvest mouse. The ponds also provide other important ecological services, like retention and storage of water and filtering of water by wetland habitats.

The existing pond levees are not engineered structures. The lands behind them are low-lying and in some cases well below sea level. These lands include the community of Alviso, the New Chicago Marsh, and the San Jose/Santa Clara WPCP (Figure 2). These areas are vulnerable to tidal flooding if the perimeter pond levees fail.

The former salt ponds offer considerable potential for management of shorebirds and waterfowl populations, or for restoration to tidal habitats including marshes. Tidal marsh restoration is expected to be an important measure in assisting the recovery of several endangered species found in the study area such as the salt marsh harvest mouse and the California clapper rail. However, the ponds are currently valuable habitat for many species and hundreds of thousands of individual shorebirds, waterfowl, and other water birds.

Quantification of habitat restoration benefits will begin with the development of a baseline condition assessment and conclude with an assessment of the "no action" or without-project alternative with a 50- year projection horizon. These assessments will then be compared to various alternative scenarios to determine the overall cost-effectiveness of habitat restoration in a national context, and to determine optimum outcomes for restoration actions proposed for Ponds A9-A15 and Pond A18.

Evaluation of project benefits and impacts will be quantified for a period of 50 years from the start of construction, which is assumed to be 2017. Limited qualitative evaluation of projected effects after these 50 years will be conducted by others and is not part of this assessment.

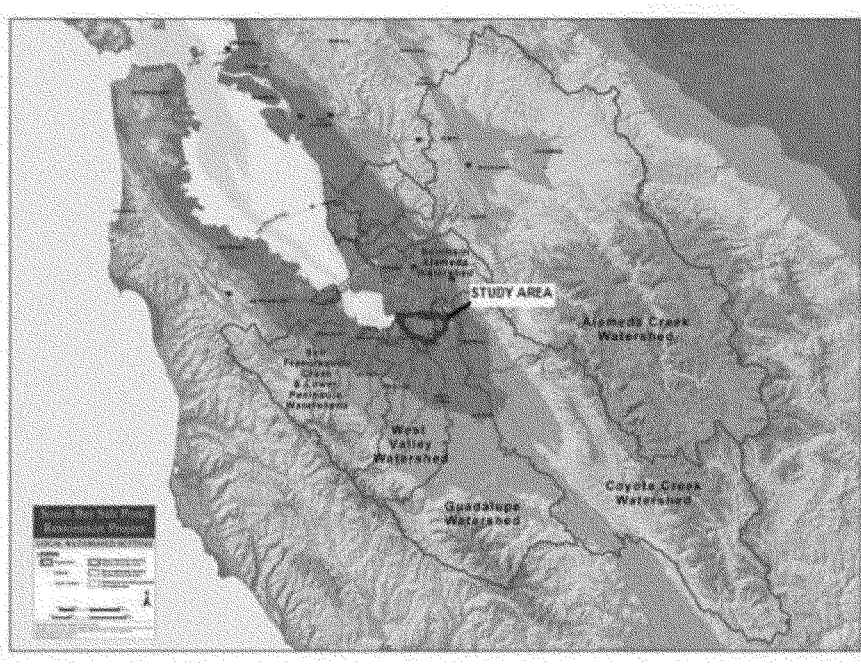

Figure 1. Regional context for Shoreline study area location
(Source map: South Bay Salt Pond Restoration Project)

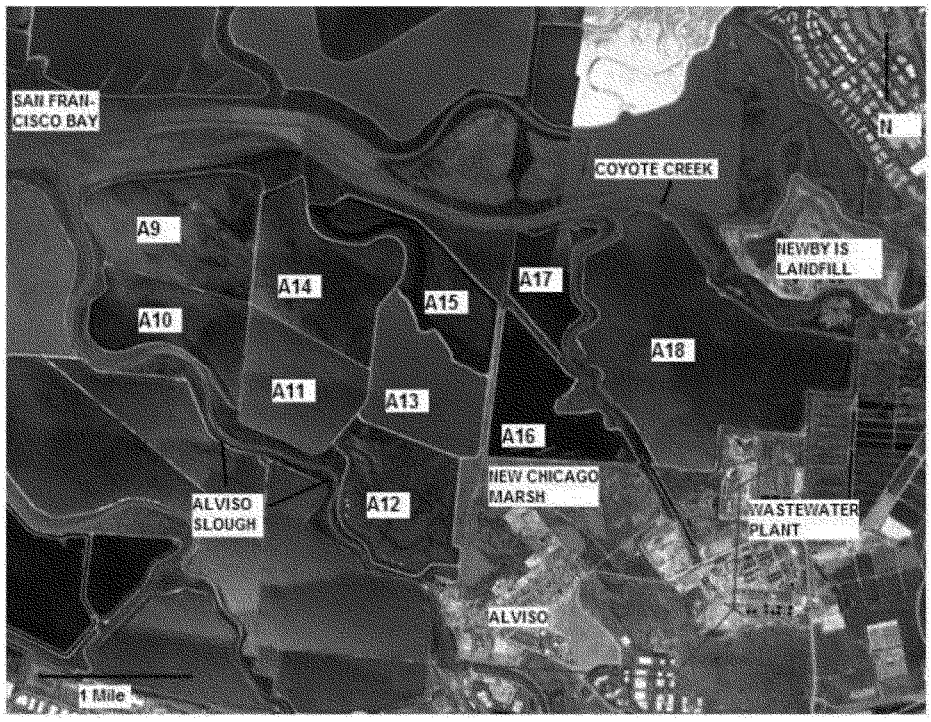

Figure 2. A local view of the Shoreline study area general project boundary delineation along with pond polygon identification numbers.

Methods for Determining Baseline Conditions

First, CHAP's habitat valuing system produces Habitat Units (HUs) for baseline and alternative future scenarios. When talking about HUs it is good to clarify (especially for non-ecologist) that CHAP's habitat values are not the same as those obtained using USFWS's Habitat Evaluation Procedures or HEP. CHAP assesses condition and function by incorporating multiple species, habitat components and functions into the analysis. When attempting to compare HUs between CHAP and HEP one would immediately see a magnitude of higher habitat values using CHAP because we do not normalize the values, evaluate only a few species, or use subjective values to determine habitat quality as HEP does.

So to begin the CHAP process, we start by developing a fish and wildlife species list for the project. The initial Habitat Evaluation Team meeting revealed that USFWS staff residing or working at the Refuge are a valuable source of wildlife information. The Habitat Evaluation Team suggested using the Refuge staff as the initial point of contact for pond and adjacent habitat information. Refuge staff in consultation with other knowledgeable people generated fish

and wildlife species lists for the baseline habitat classifications and the conditions resulting from restoration scenarios and the no-action alternative. Additionally, the Northwest Habitat Institute (NHI) also generated an initial species list for the project by accessing the California Wildlife Habitat Relationships (CWHR) geographic information system (GIS) as a cross-reference. A query of the site's potential species was done by accessing the peer-reviewed wildlife-species range maps that overlapped with the project boundary. Refuge staff was also able to review the NHI-generated potential species list, as well as develop specific bird lists for each pond along with determining their presence during the four seasons. The species listed then needed to be associated with habitat types, which required a several step process.

First, it was necessary to develop a list of wildlife habitat types located within the South Shoreline project boundary by polygon. A number of habitat classifications have been used in past and ongoing studies. Additionally, there is a strong desire by the Habitat Evaluation Team to use this existing information for this project. NHI was able to work with the Refuge staff to determine two habitat classifications that would allow fish and wildlife species habitat associations to be created and used in the baseline condition report. One habitat classification was used for assessing baseline conditions (Table 1) and the other was used to evaluate without-project future conditions for the next 50-year period (see Table 9 in 50 Year Future without-project section).

Baseline Conditions
Batch Pond
Brackish Marsh
Developed
Freshwater Marsh
Landfill
Levee
Managed Pond
Tidal Flats/Mudflats
Muted Tidal / Diked Marsh
Open Water/Slough Channel
Parks / Upland Grassland
Riparian/Creek Corridor
Saline Marsh
Seasonal Wetland
Upland Vegetation
Water / Sewage Treatment

Table 1. Habitat classification used to determine baseline conditions effects.

Because there were a number of past projects that used more specific habitat classes to breakout portions of the San Francisco Bay, the partners wanted to use them. The above habitat types show the classification that was incorporated into the baseline evaluation. Specific vegetation

types and associations were also noted when creating the crosswalk(s) [which is relating vegetation types and associations to habitat types] along with the number and extent of invasive species. Next, the Key Ecological Correlates (KECs) or fine-feature elements that may exist within each polygon were identified. Refuge staff developed a list of common KECs that would be found by habitat type that could be applied to the polygons within the project boundary.

Because CHAP is built around the triad concept of species-habitat-functions, the next step was to update the Northwest Habitat Institute's Integrated Biodiversity Information System (IBIS) data system[1] (Johnson and O'Neil, 2001) and establish the key ecological functions (KEFs) for each species. For 35 new species that were not already a part of IBIS, this required researching the species and identifying a list of KEFs for inclusion into IBIS.

To reiterate, KECs represent physical and biological habitat elements that are thought to most influence a species' distribution, abundance, fitness, and viability, while KEFs refer to the principal set of ecological roles performed by each species in its ecosystem. More specifically, KEFs refer to the main ways organisms use, influence, and alter their biotic and abiotic environments. The KECs and KEFs are crucial components in determining the wildlife habitat unit values.

An approach at the scale of the site is used to refine the habitat value calculations for the Shoreline project polygons. The CHAP approach involves four components: 1) preliminary mapping, 2) field inventory, 3) data compilation and analysis, and 4) GIS maps, spreadsheets and report.

1. Preliminary mapping: The Shoreline Study site is refined by identifying and delineating polygons with homogenous habitat types based on visual interpretation of photography or imagery. At the onset, the National Agriculture Imagery Program or NAIP imagery was used but this effort was later transferred to high-resolution imagery supplied by USACE.

2. Field inventory: This CHAP analysis used existing field inventory data generated by the project partners.

3. Data compilation and analysis: Data from the field inventory is used to generate a habitat value for each polygon within the study site. The species list developed for the project area was reviewed by the knowledgeable field staff. Additionally, the list of taxa is merged with the KEC and KEF fields within the IBIS data sets to allow the creation of two matrices for each polygon: species by functions and habitat by functions. These matrices are then summed and multiplied by the acreage of the polygon to calculate HUs for each polygon.

4. GIS maps, spreadsheets, and report: GIS maps are generated that depict the habitat values (HUs) of each polygon. Supporting maps illustrate: a) project or area boundaries; b) polygon numbering; c) corrected habitat value per acre; d) habitat

[1] The IBIS data system is based on expert knowledge and peer reviews and contains current ecological information on more than 1,000 fish and wildlife species.

units; e) amounts of non-native plant species by polygon; f) wildlife habitat types by polygon; and g) structural conditions by polygon. Spreadsheets are developed that contain the polygon calculations of the species-functions and habitat-functions matrices, along with an overall site or area habitat value.

Determining the Habitat Unit Value

To establish a habitat unit value, two matrices are developed. The first matrix determines the species' mean functional redundancies (MFRI) based on the species list (Appendix A-1). This was developed and reviewed for the baseline condition of Shoreline Study by habitat class (Appendix A-2). Determining the MFRI is the first step in the computation to determine the baseline habitat condition values [see Appendix B - Matrix Relationships, Matrix 1]. A MFRI is created for each habitat type present within the study area.

The second matrix is usually generated by conducting field inventories by polygon. However, because of the number of knowledgeable field staff located at the site and the number of past studies conducted, it was determined that enough data existed to generate this information without further fieldwork. Using these resources, a list of Key Environmental Correlates (KECs[2]) was generated for each polygon. Once this was completed, a KEC function matrix by habitat type was created [see Appendix B - Matrix Relationships, Matrix 2]. This matrix represents the habitat components which characterize potential functions within each polygon at the site. Per-acre baseline values were then computed for each polygon by adding Matrices 1 and 2 together [species-functional redundancy (MFRI) value and the KEC-functional redundancy value] for each habitat type.

The per-acre value is a strong indicator of wildlife habitat quality because it represents the animal taxa, habitat characteristics, and biodiversity as determined by accounting for species, habitats, and their functions. It is also a stronger indicator because the influence of polygon size (acres) is removed from consideration. Thus, small polygon areas can be shown to have a high per-acre value, whereas large areas may show a low per acre value. Nevertheless, to determine a site's overall baseline HU value, each polygon's per-acre value is multiplied by its acreage and then these values are summed across all polygons. This generates an uncorrected HU value because no adjustments have been considered.

Site Location Adjustment Value

Because the South Shoreline project area is located near an urban setting, there are several ecosystem drivers and stressors that can affect the baseline condition and how it is currently managed. We identified invasive plant species as one major influence that can affect the habitat value potential in each habitat type. The CHAP protocol allows us to adjust polygon values based on the presence and abundance of invasive plant species, as documented during the field inventory from past projects or based on local knowledge (see Table 2). Additionally, the percent abundance of invasive species by polygon can also be spatially displayed to show their influence on the habitat value.

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[2] See Appendix B – Matrix 2.

Subsequently, each polygon is assigned an invasive-plant value based on the occurrence of invasive species identified within the polygon. If a vegetation layer is not present, it is left blank and that layer does not contribute to the invasive factor calculation. Because invasive species generally negatively influence ecosystem function, the per-acre values were then discounted for the presence of invasive plants, using the values in Table 2; this allows us to arrive at a corrected per-acre value for each polygon.

The only locally invasive species of concern with the project area is peppergrass, also known as perennial pepperweed (*Lepidium latifolium*). Areas containing pepperweed were identified and delineated into GIS polygons by H.T. Harvey & Associates resulting during their 2010 Marsh Study. There were 10 vegetation classes within the Marsh Study that contained pepperweed as shown in Table 2 below. Based on conversations with H.T. Harvey & Associates staff about how the Marsh Study data collection methodology was designed and information collected, we were able to assign invasive plant adjustment factors that corresponded with CHAP protocols to each class. For instance, the "pickleweed/pepperweed" designation indicates that pickleweed is dominant with a pepperweed component between 15 and 49% of the total areal surface of the polygon. Conversely a "pepperweed/pickleweed" designation indicates that pepperweed is dominant with a pickleweed component between 15 and 49%. A polygon with only one species name in such as "pepperweed" indicates a composition of that species over 85% of the polygon. So, given these constructs by the Marsh Study the following adjustment factors by vegetation class are:

Adjustment Factor	Invasive Vegetation Class
0.3	Pepperweed
0.5	Pepperweed/Pickleweed
0.5	Pepperweed/Peripheral Halophytes
0.5	Pepperweed/Alkali Bulrush
0.5	Pepperweed/Upland vegetation
0.7	Pickleweed/Pepperweed
0.7	Peripheral Halophytes/Pepperweed
0.7	Alkali Bulrush/Pepperweed
0.7	Spearscale/Pepperweed
0.7	Alkali Heath/Pepperweed

Table 2. Invasive adjustment factor as identified by the 2010 Marsh study by vegetation class.

Refuge staff was also able to provide NHI with a list of adjustment factors for those polygons for which they had sufficient local knowledge to feel comfortable making recommendations. The remaining polygons were either intersected by the 2010 Marsh Study or were in the mostly upland or developed areas.

Next, the 2010 Marsh Study GIS data (Figure 3) was overlaid onto the baseline condition polygons to determine proportions of each polygon covered by invasive species. Once determined for each Marsh Study polygon with a pepperweed component, the invasive

adjustment factor from Table 2 (above) was applied. The sum of the Invasive Adjustment Factors contained within the baseline condition polygon was then calculated. Finally, the proportional values were summed for each polygon and normalized (Table 3). For example, if a polygon's total invasive scored was 0.85, then the discount class in Table 3 would be 0.8. This would mean that 20% of the total polygon value would be reduced because of the amount of invasive species present within the polygon. For example, if a total baseline condition polygon score is 24 and has an adjustment factor of 0.8, it would yield a baseline condition corrected value of 19.2.

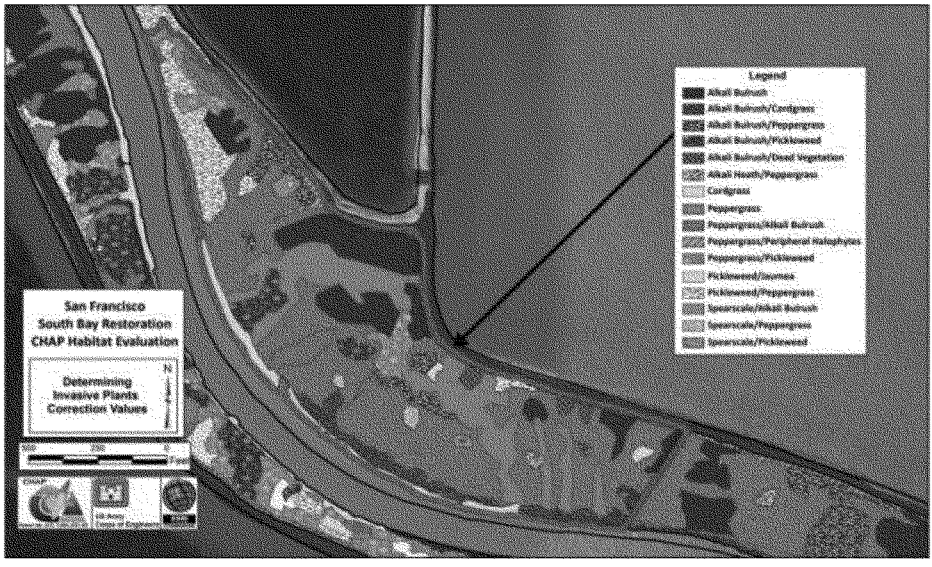


Figure 3. An example of the 2010 Marsh Study data depicting the various categories, spatial distribution and amounts of the various invasive species.

Determined Invasive Adjustment (based on area percent)	Discount Class
1 - 0.95	1
0.94 - 0.90	0.9
0.89 - 0.80	0.8
0.79 - 0.70	0.7
0.69 - 0.60	0.6
0.59 -0.50	0.5
0.49 - 0.40	0.4

Table 3. Normalizing table used to determine the appropriate discounting value for the presence and abundance of invasive species.

Areas within the study area that were not intersected by the 2010 Marsh Study or not commented on by Refuge staff did not have enough information available to allow us to apply an adjustment value. Forty-four polygons fell into the unknown category and are shown in black in Figure 5.

Results

Two hundred and fifty-three wildlife species were evaluated concurrently. The 173 polygons on the SF South Shoreline site were determined by delineating the various wildlife habitat types that occur within the project area. These include: batch pond, brackish marsh, developed area, freshwater marsh, landfill, levee, managed pond, mudflat, muted tidal/diked marsh, open water, park/upland grassland, riparian creek corridor, saline marsh, seasonal wetland, upland vegetation and water sewage treatment (see Table 4). In total these polygons account for about 6,674 acres or 2,700 ha. A complete breakout of the habitat units per polygon can be found in Table 5. The information in Table 5 illustrates by polygon that higher habitat unit scores have a higher habitat quality associated with them; conversely those with a low score would have lesser habitat quality.

Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Mudflat
825.74	328.37	573.65	119.49	67.32	197.55	2297.93	220.51
Muted Tidal / Diked Marsh	Open Water	Parks / Upland Grassland	Riparian/ Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation	Water / Sewage Treatment
545.46	349.75	251.91	14.24	413.13	33.64	26.13	409.13

Table 4. Shoreline study areas breakout of acreage of habitat type.

Polygon ID	Acres	Habitat Type	Habitat Units	Polygon ID	Acres	Habitat Type	Habitat Units
SB_001	1.58	Developed	8.33	SB_012	0.77	Upland Vegetation	12.07
SB_002	1.59	Levee	28.00	SB_013	0.90	Saline Marsh	10.16
SB_003	6.95	Upland Vegetation	98.46	SB_014	4.80	Levee	84.48
SB_004	4.87	Upland Vegetation	76.68	SB_015	8.64	Mudflat	161.72
SB_005	2.79	Freshwater Marsh	59.52	SB_016	4.57	Mudflat	59.93
SB_006	1.20	Upland Vegetation	18.86	SB_017	2.03	Mudflat	37.91
SB_007	0.81	Open Water	24.10	SB_018	1.72	Mudflat	29.02
SB_008	0.14	Open Water	3.86	SB_019	0.42	Levee	7.43
SB_009	1.57	Levee	27.66	SB_020	0.25	Levee	4.41
SB_010	0.58	Upland Vegetation	9.17	SB_021	0.17	Levee	3.02
SB_011	0.68	Saline Marsh	6.15	SB_022	0.12	Levee	2.19

Polygon ID	Acres	Habitat Type	Habitat Units	Polygon ID	Acres	Habitat Type	Habitat Units
SB_023	13.79	Levee	242.86	SB_070	0.16	Upland Vegetation	2.47
SB_024	8.29	Developed	43.83	SB_071	0.03	Upland Vegetation	0.48
SB_025	3.41	Upland Vegetation	53.74	SB_072	0.07	Upland Vegetation	1.05
SB_026	1.07	Freshwater Marsh	22.87	SB_073	16.38	Muted Tidal / Diked Marsh	165.22
SB_027	12.09	Riparian/Creek Corridor	274.50	SB_074	0.24	Upland Vegetation	3.77
SB_028	2.14	Riparian/Creek Corridor	48.63	SB_075	0.29	Open Water	8.79
SB_029	14.65	Managed Pond	323.81	SB_076	41.87	Brackish Marsh	824.30
SB_030	6.07	Developed	32.09	SB_077	34.88	Brackish Marsh	600.87
SB_031	2.54	Seasonal Wetland	40.81	SB_078	0.35	Levee	6.11
SB_032	3.49	Open Water	104.16	SB_079	0.30	Open Water	8.91
SB_033	0.51	Open Water	15.21	SB_080	0.39	Upland Vegetation	6.11
SB_034	0.39	Open Water	11.69	SB_081	0.52	Freshwater Marsh	11.07
SB_035	0.26	Open Water	7.73	SB_082	1.65	Freshwater Marsh	35.28
SB_036	29.28	Seasonal Wetland	470.47	SB_083	11.16	Freshwater Marsh	214.28
SB_037	1.00	Muted Tidal / Diked Marsh	14.41	SB_084	0.19	Upland Vegetation	3.04
SB_038	0.66	Muted Tidal / Diked Marsh	9.58	SB_085	0.69	Upland Vegetation	10.84
SB_039	0.21	Levee	3.69	SB_086	27.64	Brackish Marsh	408.10
SB_040	85.39	Levee	1504.19	SB_087	4.04	Brackish Marsh	89.47
SB_041	62.73	Mudflat	1174.01	SB_088	3.98	Saline Marsh	89.96
SB_042	6.17	Mudflat	92.40	SB_089	19.26	Brackish Marsh	474.06
SB_043	3.82	Mudflat	71.57	SB_090	18.81	Saline Marsh	339.64
SB_044	0.76	Open Water	20.38	SB_091	0.23	Upland Vegetation	3.55
SB_045	1.83	Seasonal Wetland	29.36	SB_092	29.07	Brackish Marsh	500.69
SB_046	2.27	Levee	32.01	SB_093	3.99	Brackish Marsh	68.72
SB_047	22.88	Levee	403.07	SB_094	2.14	Brackish Marsh	47.39
SB_048	11.15	Levee	196.35	SB_095	10.88	Brackish Marsh	214.13
SB_049	0.54	Open Water	16.20	SB_096	19.39	Open Water	578.59
SB_050	0.95	Freshwater Marsh	20.23	SB_097	1.70	Brackish Marsh	41.95
SB_051	15.37	Saline Marsh	312.21	SB_098	30.55	Freshwater Marsh	651.78
SB_052	41.38	Saline Marsh	934.16	SB_099	45.99	Saline Marsh	1038.31
SB_053	11.40	Saline Marsh	205.88	SB_100	16.81	Saline Marsh	379.53
SB_054	8.39	Saline Marsh	170.44	SB_101	0.25	Upland Vegetation	3.86
SB_055	15.01	Saline Marsh	271.14	SB_102	3.49	Freshwater Marsh	74.48
SB_056	0.27	Saline Marsh	6.05	SB_103	9.72	Freshwater Marsh	207.45
SB_057	4.67	Saline Marsh	105.50	SB_104	15.62	Brackish Marsh	269.13
SB_058	0.20	Saline Marsh	4.44	SB_105	14.32	Freshwater Marsh	305.55
SB_059	59.18	Saline Marsh	1335.94	SB_106	0.32	Open Water	9.41
SB_060	1.23	Saline Marsh	27.87	SB_107	2.28	Freshwater Marsh	48.55
SB_061	7.12	Saline Marsh	160.77	SB_108	3.34	Developed	17.69
SB_062	2.17	Saline Marsh	48.97	SB_109	5.53	Levee	97.46
SB_063	7.08	Saline Marsh	159.80	SB_110	0.58	Open Water	17.16
SB_064	33.20	Saline Marsh	674.56	SB_111	6.80	Parks / Upland Grassland	80.55
SB_065	13.49	Saline Marsh	243.59	SB_112	13.95	Parks / Upland Grassland	165.38
SB_066	80.58	Saline Marsh	1637.25	SB_113	20.99	Parks / Upland Grassland	248.77
SB_067	14.75	Saline Marsh	299.74	SB_114	3.30	Parks / Upland Grassland	39.15
SB_068	0.34	Upland Vegetation	5.35	SB_115	27.51	Parks / Upland Grassland	326.04
SB_069	0.47	Upland Vegetation	7.37	SB_116	0.30	Freshwater Marsh	6.50

Polygon ID	Acres	Habitat Type	Habitat Units	Polygon ID	Acres	Habitat Type	Habitat Units
SB_117	5.90	Open Water	176.16	SB_146	140.53	Muted Tidal / Diked Marsh	2024.28
SB_118	3.66	Freshwater Marsh	78.03	SB_147	198.53	Muted Tidal / Diked Marsh	2859.77
SB_119	2.84	Freshwater Marsh	60.49	SB_148	6.05	Muted Tidal / Diked Marsh	87.08
SB_120	0.38	Freshwater Marsh	8.02	SB_149	11.37	Muted Tidal / Diked Marsh	163.79
SB_121	2.29	Freshwater Marsh	48.88	SB_150	1.41	Muted Tidal / Diked Marsh	20.36
SB_122	2.55	Levee	44.98	SB_151	15.15	Parks / Upland Grassland	179.59
SB_123	9.45	Levee	166.48	SB_152	9.34	Parks / Upland Grassland	110.75
SB_124	1.01	Freshwater Marsh	21.59	SB_153	211.03	Developed	1116.24
SB_125	27.87	Brackish Marsh	480.11	SB_154	4.36	Muted Tidal / Diked Marsh	62.78
SB_126	13.45	Mudflat	251.73	SB_155	31.33	Levee	551.86
SB_127	117.37	Mudflat	2196.72	SB_156	6.38	Freshwater Marsh	122.41
SB_128	0.19	Open Water	5.75	SB_157	81.90	Parks / Upland Grassland	970.78
SB_129	4.48	Saline Marsh	60.63	SB_158	174.24	Developed	921.65
SB_130	5.99	Saline Marsh	108.27	SB_159	79.88	Developed	422.53
SB_131	75.92	Brackish Marsh	1681.33	SB_160	68.12	Muted Tidal / Diked Marsh	981.24
SB_132	33.49	Brackish Marsh	576.86	SB_161	96.98	Water / Sewage Treatment	0.00
SB_133	17.50	Freshwater Marsh	373.25	SB_162	67.32	Landfill	243.16
SB_134	1.28	Muted Tidal / Diked Marsh	18.38	SB_163	20.89	Muted Tidal / Diked Marsh	300.92
SB_135	315.87	Open Water	9423.89	SB_164	24.14	Muted Tidal / Diked Marsh	347.68
SB_136	3.71	Levee	65.44	SB_A9	365.92	Managed Pond	8087.34
SB_137	6.63	Freshwater Marsh	141.33	SB_A10	249.81	Managed Pond	5521.11
SB_138	1.66	Developed	8.77	SB_A11	261.70	Managed Pond	5783.91
SB_139	0.44	Upland Vegetation	6.96	SB_A12	308.20	Batch Pond	6763.60
SB_140	58.81	Developed	311.07	SB_A13	266.65	Batch Pond	5851.71
SB_141	50.75	Muted Tidal / Diked Marsh	731.04	SB_A14	336.92	Managed Pond	7446.24
SB_142	28.76	Developed	152.12	SB_A15	250.89	Batch Pond	5505.87
SB_143	312.15	Water / Sewage Treatment	0.00	SB_A16	242.06	Managed Pond	5349.83
SB_144	72.97	Parks / Upland Grassland	864.87	SB_A18	826.87	Managed Pond	18274.69
SB_145	4.86	Upland Vegetation	76.55				

Table 5. Acreage and habitat value (HUs) for each of the CHAP habitat evaluation polygons.

Because Ponds A9 thru 15 are a focal point of the Shoreline Study, there was some interest expressed by Habitat Evaluation Team members to break out the ponds by seasonal use for just the bird species that are known to use them. Table 6 shows the habitat units by season for each pond. During different times of the year, the habitat value changes based on the diversity of 165 bird species; habitat value is not static throughout a year. This is the first time we are aware of that the year round seasons of use by a large diversity of bird can quantify habitat values throughout the year. Table 7 shows the per-acre value by season by pond based on the diversity of the bird species that use them. Figures 4 display the same information by season by pond. Interest was also expressed in how CHAP would address abundance of species using each pond. Utilizing a weighting scale is a possible way to handle this question. For example, based on the information recorded at each site by USGS Western Ecological Research Center staff, the number of birds could be grouped by increments of 1000 to determine a weighting scale. For instance, 1-1,000 would have a weighting of 1, 1001-2,000 a 2, 2,001-3,000 a 3, etc. Weighting

has not been agreed to by the Habitat Evaluation Team; hence this information is only suggested as a possible solution to the question of considering the number of birds using each pond.

SITE_ID	Acres	Habitat Units
Spring		
SF_Pond A09	365.92	7,146.4
SF_Pond A10	249.81	4,626.3
SF_Pond A11	261.70	4,937.6
SF_Pond A12	308.20	5,662.5
SF_Pond A13	266.65	4,937.3
SF_Pond A14	336.92	6,563.2
SF_Pond A15	250.89	4,738.6
SF_Pond A16	242.06	4,778.4
SF_Pond A17*	130.88	2,583.0
SF_Pond A18	826.87	16,222.3
Total	**3,240**	**62,195.7**

SITE_ID	Acres	Habitat Units
Fall		
SF_Pond A09	365.92	7,678.3
SF_Pond A10	249.81	4,948.0
SF_Pond A11	261.70	4,766.6
SF_Pond A12	308.20	5,757.0
SF_Pond A13	266.65	5,334.2
SF_Pond A14	336.92	6,635.9
SF_Pond A15	250.89	4,963.1
SF_Pond A16	242.06	4,555.4
SF_Pond A17*	130.88	2,731.0
SF_Pond A18	826.87	16,002.5
Total	**3,240**	**63,372.1**

SITE_ID	Acres	Habitat Units
Summer		
SF_Pond A09	365.92	6,359.4
SF_Pond A10	249.81	4,196.7
SF_Pond A11	261.70	4,321.4
SF_Pond A12	308.20	5,123.7
SF_Pond A13	266.65	4,219.3
SF_Pond A14	336.92	5,756.5
SF_Pond A15	250.89	4,455.5
SF_Pond A16	242.06	4,587.8
SF_Pond A17*	130.88	2,492.3
SF_Pond A18	826.87	14,127.7
Total	**3,240**	**55,640.5**

SITE_ID	Acres	Habitat Units
Winter		
SF_Pond A09	365.92	7,437.2
SF_Pond A10	249.81	4,795.1
SF_Pond A11	261.70	4,799.4
SF_Pond A12	308.20	6,061.6
SF_Pond A13	266.65	5,130.1
SF_Pond A14	336.92	6,769.1
SF_Pond A15	250.89	4,624.6
SF_Pond A16	242.06	4,881.8
SF_Pond A17*	130.88	2,538.7
SF_Pond A18	826.87	16,543.9
Total	**3,240**	**63,581.6**

For a list of bird species associated with each pond by season, see Appendix 3. [*Note: Pond A17 is not part of this study and is shown only for informational purposes].

Table 6. Habitat unit value by pond; determined using the diversity of bird species and number of key environmental correlates associated with each pond by season

	Fall	Winter	Spring	Summer
Pond_A09	13.06	12.40	11.61	9.45
Pond_A10	11.88	11.27	10.59	8.88
Pond_A11	10.29	10.41	10.94	8.59
Pond_A12	9.47	10.46	9.16	7.41
Pond_A13	10.79	10.03	9.31	6.61
Pond_A14	11.77	12.17	11.56	9.16
Pond_A15	10.57	9.22	9.68	8.55
Pond_A16	10.89	12.24	11.82	11.03
Pond_A17	12.94	11.47	11.81	11.12
Pond_A18	11.43	12.08	11.69	9.16

Table 7. Baseline per-acre values by season by pond based on bird diversity.

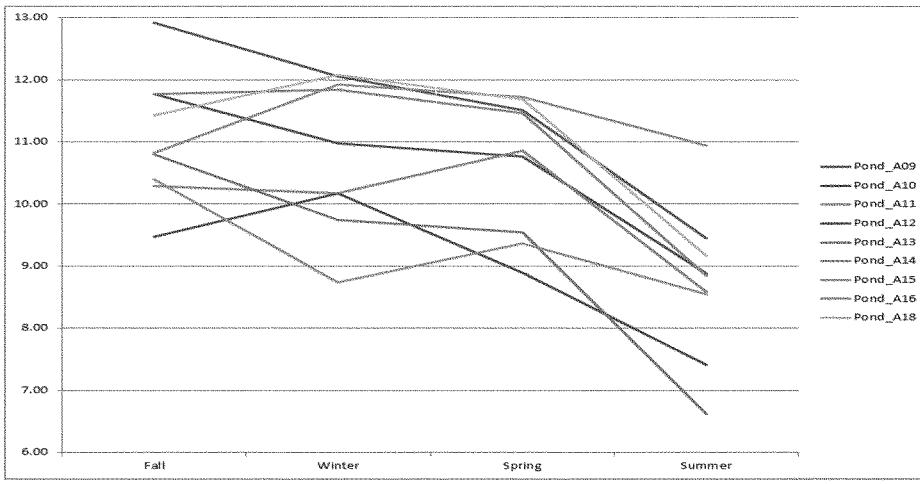


Figure 4. Baseline per-acre values by season by pond based on bird diversity.

Figures 5 & 6 further characterize the baseline conditions by showing the number of acres by habitat type and the average per-acre value for those habitat types, respectively. Figures 7 to 10 also inform baseline conditions by illustrating the spatial extent of the various habitat types (Figure 7), the amount and location of the invasive discounting (Figure 8), visual depiction of the per-acre habitat value from high to low scores (Figure 9), and finally an illustration showing the number of habitat units associated with each polygon (Figure 10).

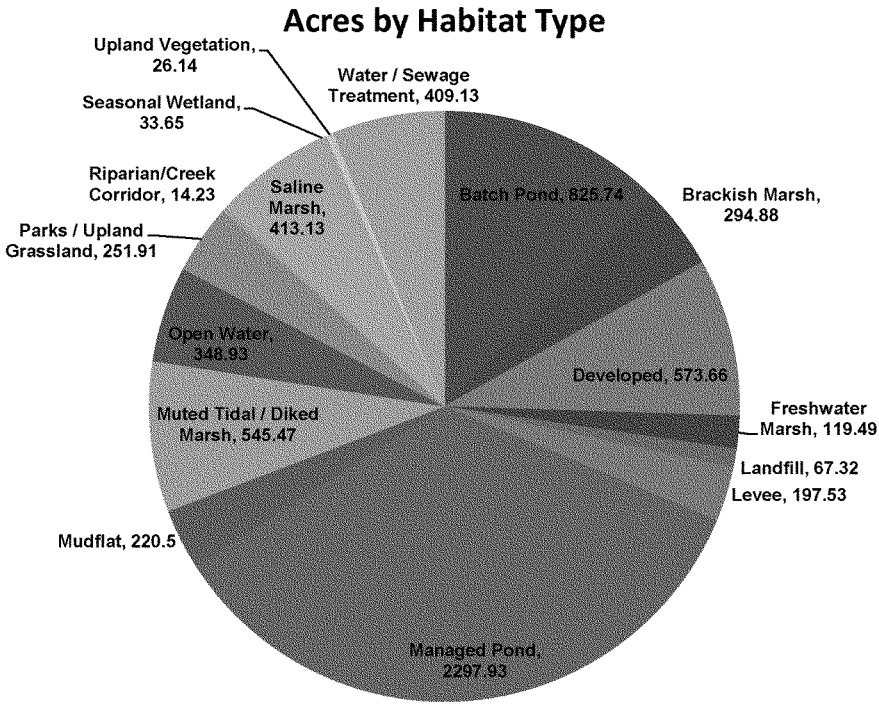


Figure 5. Breakout of baseline condition acreage by habitat type.

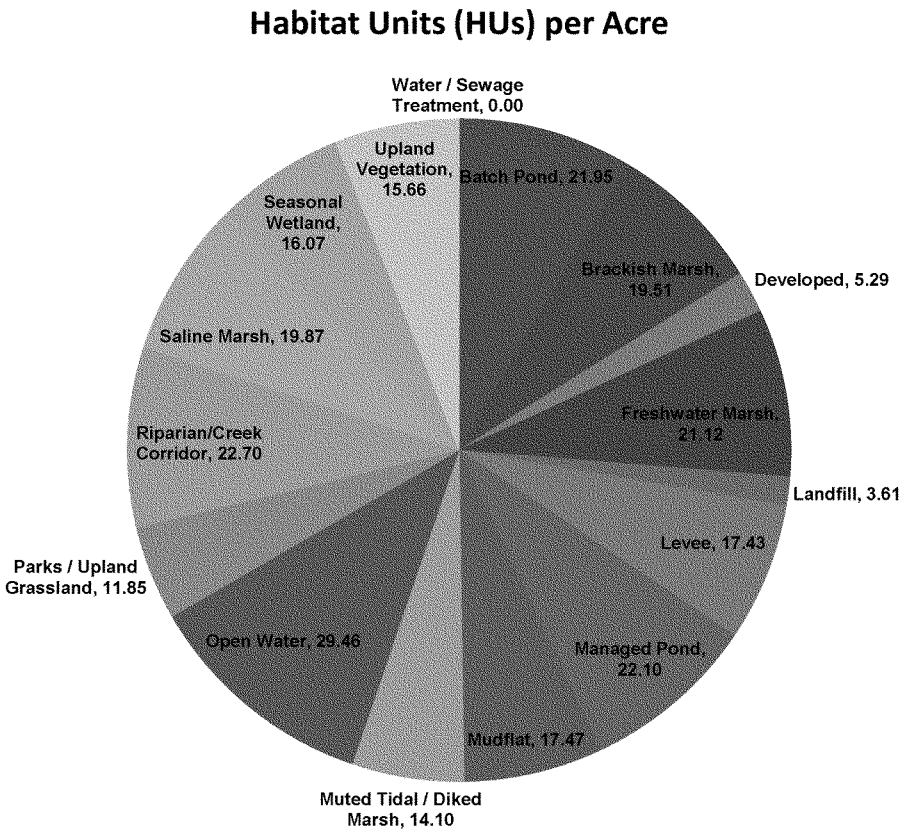


Figure 6. Breakout of the average baseline per-acre habitat value by habitat type.

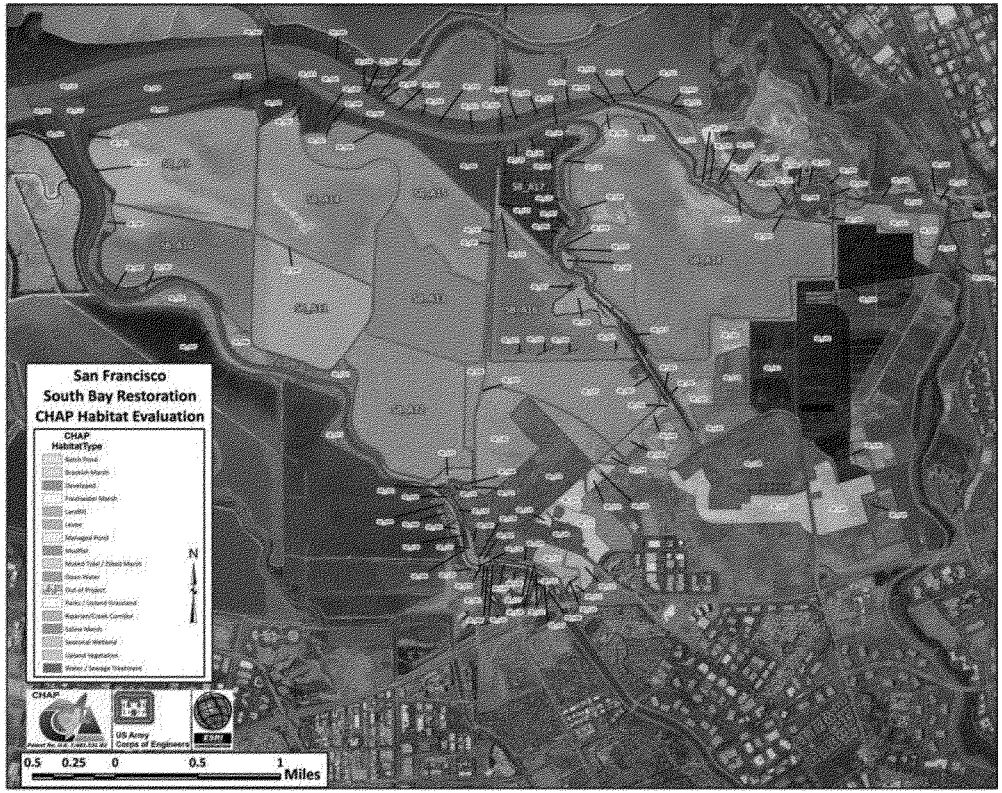


Figure 7. Shoreline study habitat assessment area showing the break out of polygons classified into the wildlife habitat types.

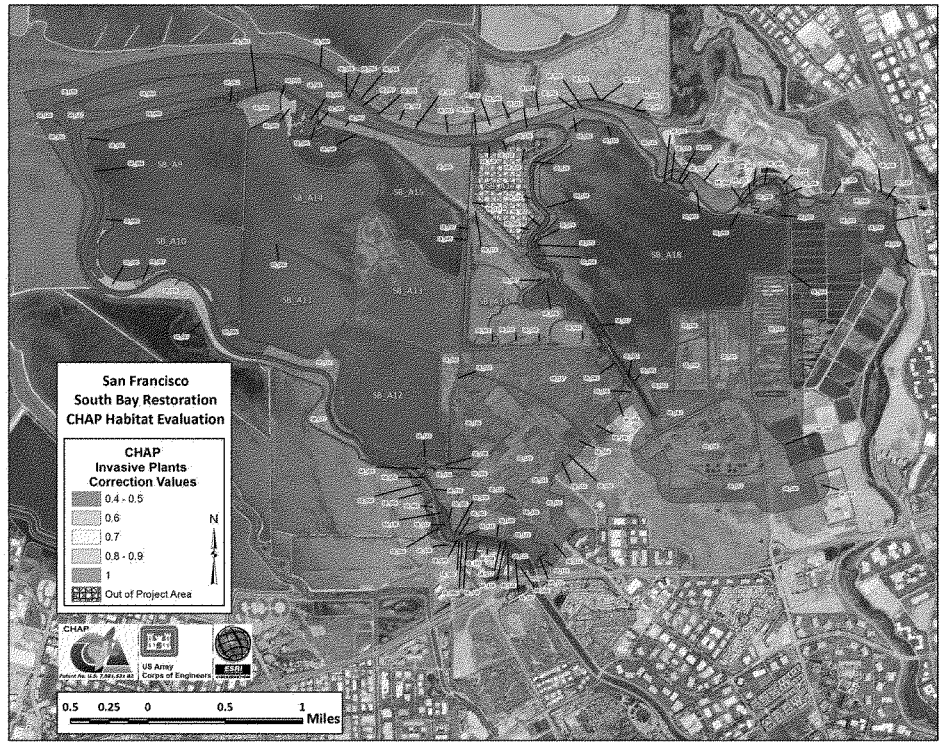


Figure 8. Depiction of the amount of invasive species as colored by their discounting value by polygon; these values were used in calculating overall habitat value within the Shoreline study project boundary.

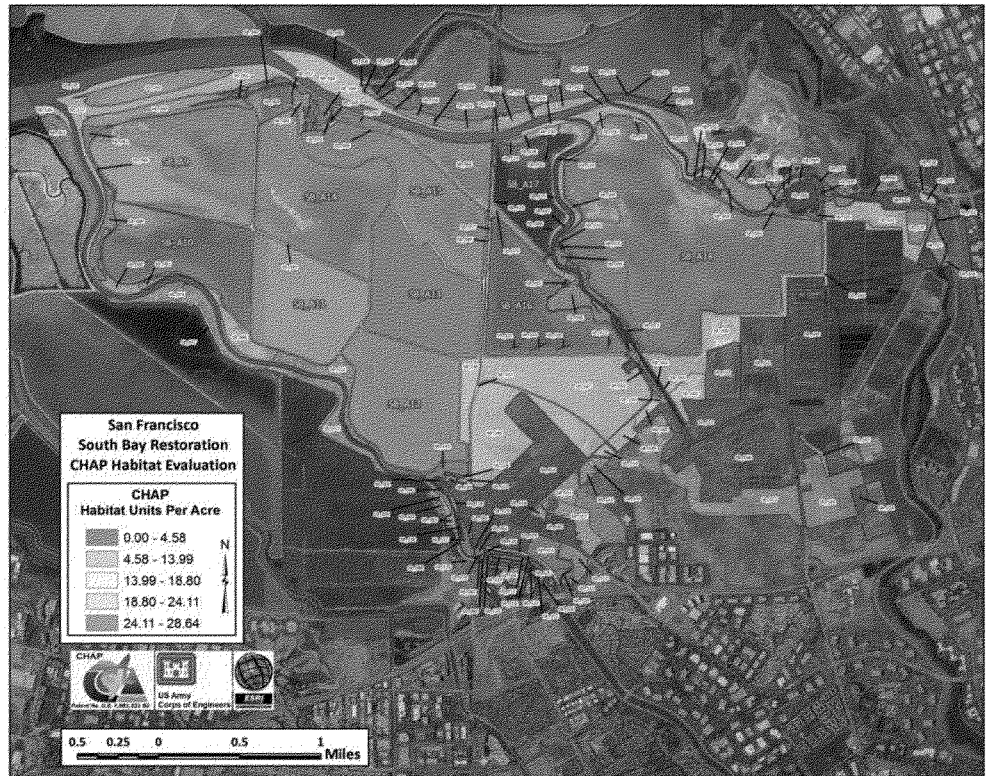


Figure 9. Illustrates the per-acre values for each polygon identified at Shoreline study project. [Note: Pond SB_A17 is not in this study. For zoom-in maps, see Appendix C]

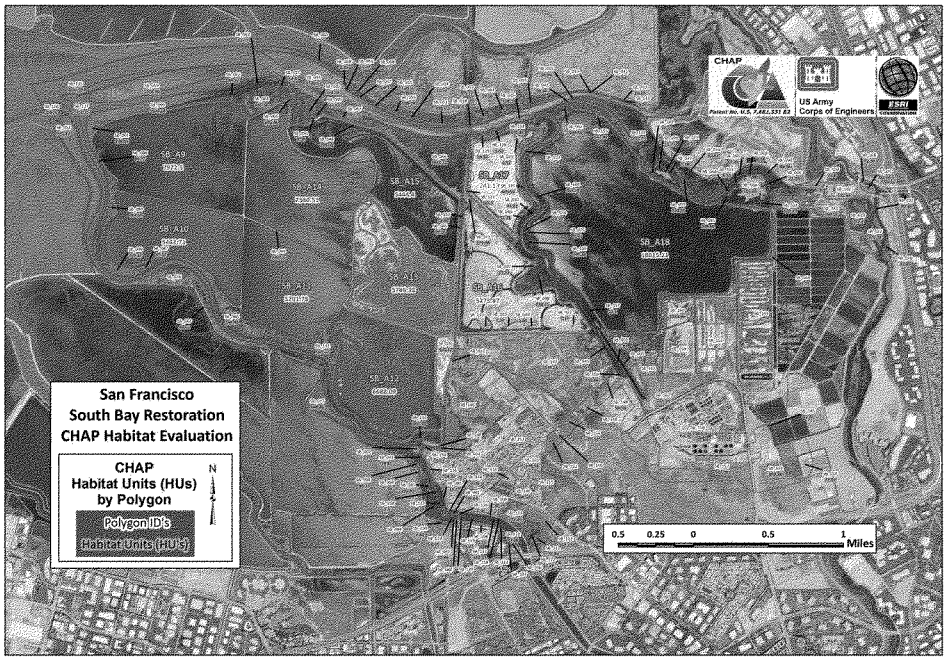


Figure 10. Shoreline study project showing the polygon number and associated habitat units (HUs). [Note: Pond SB_A17 is not in this study. For zoom-in maps, see Appendix D]

Validation

Species List - The development of the species list occurred in a series of steps. Refuge staff was able to generate a species list for both fish and wildlife by working with colleagues or based on their own knowledge of the Shoreline Study project area for baseline conditions, alternatives and without-project conditions. To help with quality control of these data, a potential species list was generated by accessing the California Wildlife Habitat Relationships (CWHR) geographic information system (GIS). A query of the site's potential species was done by accessing the peer-reviewed wildlife-species range maps that overlapped with the project boundary. Additionally, Refuge staff was also able to review the CWHR-generated species list. Refuge staff developed specific bird lists for each pond and determined their presence during the four seasons based on USGS Western Ecological Research Center. These data had been collected at the ponds and adjacent areas in 2011 by staff.. Lastly, the Refuge staff was also able to confirm the non-native species identified on the baseline condition species list can be found in Table 8.

ID	Common Name
10121	Striped bass
10149	Common carp
10177	Goldfish
10189	Western mosquito fish
10233	American shad
10234	Threadfin shad
10361	Cabezon
41190	Ring-necked Pheasant
42380	Rock Pigeon
43740	European Starling
44970	House Sparrow
50010	Virginia opossum
51070	Black rat
51080	Norway rat
51090	House mouse
51160	Red fox

Table 8. Non-native species evaluated as part of the baseline condition evaluation.

Habitat Findings – No separate vegetation transects were run to help verify the results from past habitat inventory for this project site. The data received was well attributed and based on maps that were developed and passed out for a prior review.

Conclusion

The wildlife habitat assessment of the Shoreline study evaluated 173 polygons to determine baseline conditions that consisted of 16 different habitat types to describe the 6,674 acres (or 2,700 ha) site. The number of fish and wildlife species associated with the project totaled 253, of which 51 were fish, 165 birds, 30 terrestrial mammals, 6 reptiles, and 1 marine mammal. The baseline condition evaluation for the Shoreline Study showed a total of 117,811 habitat units of which about 60,000 habitat units are associated with Ponds A9 – A18. Breaking out the different habitat types revealed that there are 2,298 managed ponds within the study site. Of these, there are 826 batch ponds, 413 saline marsh ponds, 545 muted tidal or diked marsh ponds, and 119 freshwater marsh ponds. The average per-acre value of managed ponds overall is 22.1. By type, the values are 22.0 for batch ponds, 19.9 for saline marsh, 14.4 for muted tidal and diked marsh ponds, and 21.3 for freshwater marsh ponds. All habitat types' per-acre values fell within the range of 0 and 29.8.

Year 50 Future Without-Project Condition

Introduction

CHAP habitat value utilizes species habitat functions to derive current habitat values. To determine a change in these values over time, projections are needed to alter either the species, habitat, or function parameters. Applying these changes over several time periods requires some conjecture to deduce the amount of influence that might be expected during each time period. To display the future condition outcomes and help visualize these changes in value over time, the habitat changes are applied to either a coarse or fine scale habitat map, while the species and function changes are applied to their respective data sets.

Originally, the baseline analysis of projected future conditions for the shoreline ecosystem restoration project was conducted at 25 and 50 years from the present as part of the project feasibility study. However, once the project moved onto the alternatives phase it was decided that there should be six breakpoints in time that would be studied. To keep consistent with the alternatives report, this portion of the without project analysis has been updated to reflect how this was done. The baseline year of analysis was 2017 with further analysis breakpoints occurring during 2020, 2025, 2030, 2037, 2047 and 2067. The assumptions NHI used for the without project analysis was that there would be permanent breaching of the ponds at various time intervals, which would lead to the managed ponds being restored to tidal action. This assumption has been revised to show that the managed ponds will be maintained as non-tidal in the without-project scenario throughout all six breakpoints. Breaches may occur due to heightened flood risk over time, but would be quickly repaired to avoid unacceptable risks to developed areas. The main assumption here is that because of the resilience of pond and marsh habitats in the South Bay, along with levee repairs as needed, there would be little change in habitat value over time.

Due to the uncertainties present and the high cost of developing accurate models to reflect these small changes in habitat value, it was decided that the baseline value would be used to represent the habitat value through the 2030 breakpoint. In the 2037 breakpoint onward the alternatives species list was used to re-calculate CHAP HU's for baseline to come up with an approximation of future conditions taking into account the species relationships developed for future conditions in the alternatives process. This yielded a slightly smaller total CHAP HU value for the project site in these later breakpoints.

Potential species decline

The habitat evaluation team discussed a reduction in the number of fish and wildlife taxa present within the project area over time. However, in this case, it was the consensus of the habitat evaluation team that most of the current landscape conditions in and around the project area would mostly prevail over time. Therefore, when reviewing the number of species that may decline over the 50 year period, several were discussed but the Refuge staff felt that given their current data, only 4 species might be identified as possibly declining within the project area (see Table 9). Thus, 2 species were randomly removed in the first 25 years interval and the remaining 2 species were removed in the later 25 years to reflect this potential decline over the 50 year period.

SPP ID	Common Name	Interval Species Removed
42510	Burrowing Owl	First 25 Year Period
41410	Western Snowy Plover	First 25 Year Period
41321	California Clapper Rail	Second 25 Year Period
40780	Redhead Duck	Second 25 Year Period

Table 9. Species that may decline over the next 50 year period

Because it is assumed that the remaining fish and wildlife species currently identified in the project would likely persist into the future, it was thought best to establish the current level of functional resiliency. This was done by comparing species functional redundancy between historic (343 species, Appendix A-5) and current baseline conditions (253 species, Appendix A-1). The top 20 functional categories in both time intervals are shown in Figures 11 & 12. Next, when these values are compared side-by-side, they show the potential resiliency levels for each functional category (Figure 13). A comparison of species that only perform a few functions was also done but there was little difference between the time periods. However, in a few categories in Figure 12, there is a higher level of functional resiliency occurring in the current baseline than the historic time period. This occurs in the categories of egg eaters, tertiary consumers and fish prey. This is the result of accounting for the non-native species (Table 8). These species are

mostly generalists that did not occur in the past but are now common or widespread. Examples of functions each species may perform can be found in Appendix A-4.

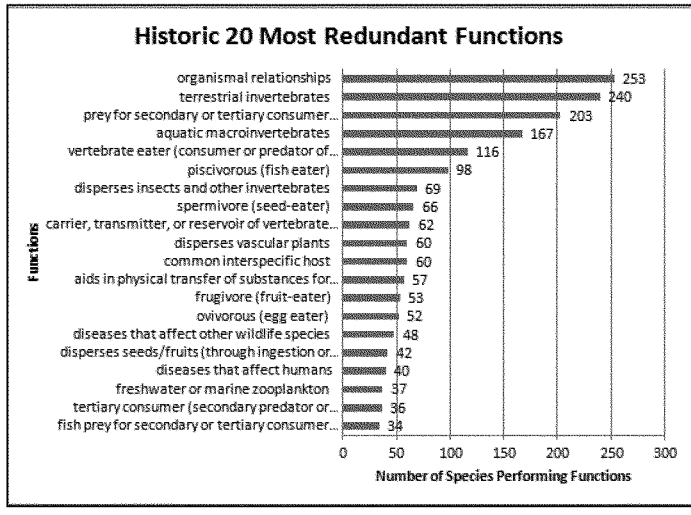


Figure 11. Top 20 key ecological functions for historic period.

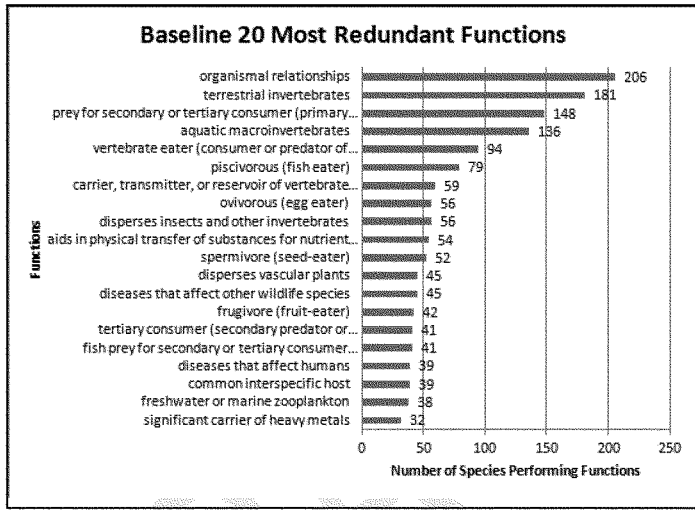


Figure 12. Top 20 key ecological functions for the current baseline.

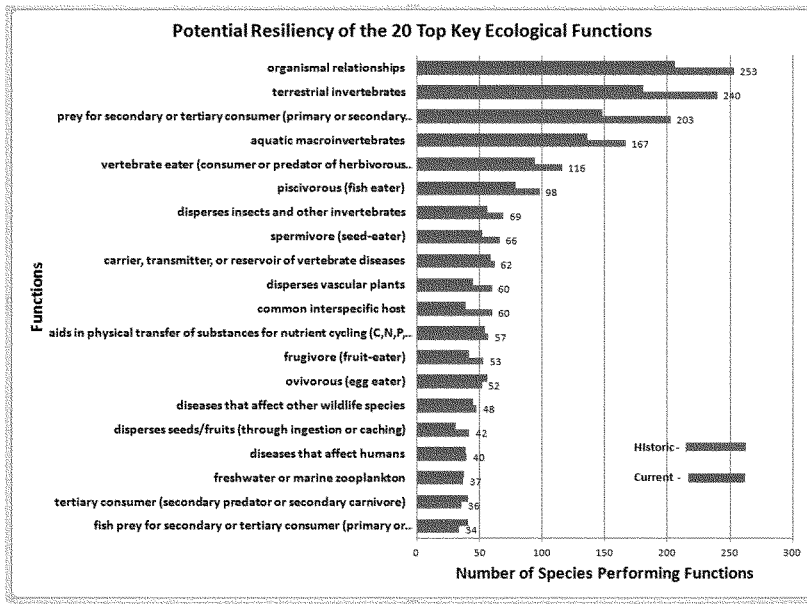


Figure 13. A comparison between historic and current baseline conditions for the Top 20 key ecological functions

Next, a quick coarse-level assessment of potential cumulative impacts can be shown by comparing San Francisco Bay habitats from historic to modern times (Figure 15). This allows a trajectory to be established that helps frame the current setting and give a general idea of how far we have come from a historical perspective. That is, a coarse-scale assessment from then to now will show approximately the change that has occurred in the San Francisco Bay area.

To determine the amount of change in habitat values, it is necessary to establish a species list for each habitat type that was mapped for both time periods. A map showing both historic and modern times can be found at the San Francisco Estuary Institute (SFEI) and is depicted in Figure 14. A species list and their habitat associations, which were determined by professional opinion (Refuge & NHI staff and IBIS data system) for the historic and modern time periods, can be found in Appendices A-5 and A-6 respectively. Table 10 shows the two separate habitat classifications (as mapped by SFEI) that were developed to allow the comparison from one time period to the other. In doing this exercise, there was a concern that the vast amount of tidal marsh shown in the historic map would receive an unrealistically high value. Hence, 2 historic species lists were generated; one consisting of 205 species and the other includes 171 species (see Appendix A-5). Table 10a shows the amount of change in habitat types from historic to modern times, while Table 10b depicts the range in habitat value change between those two time periods.

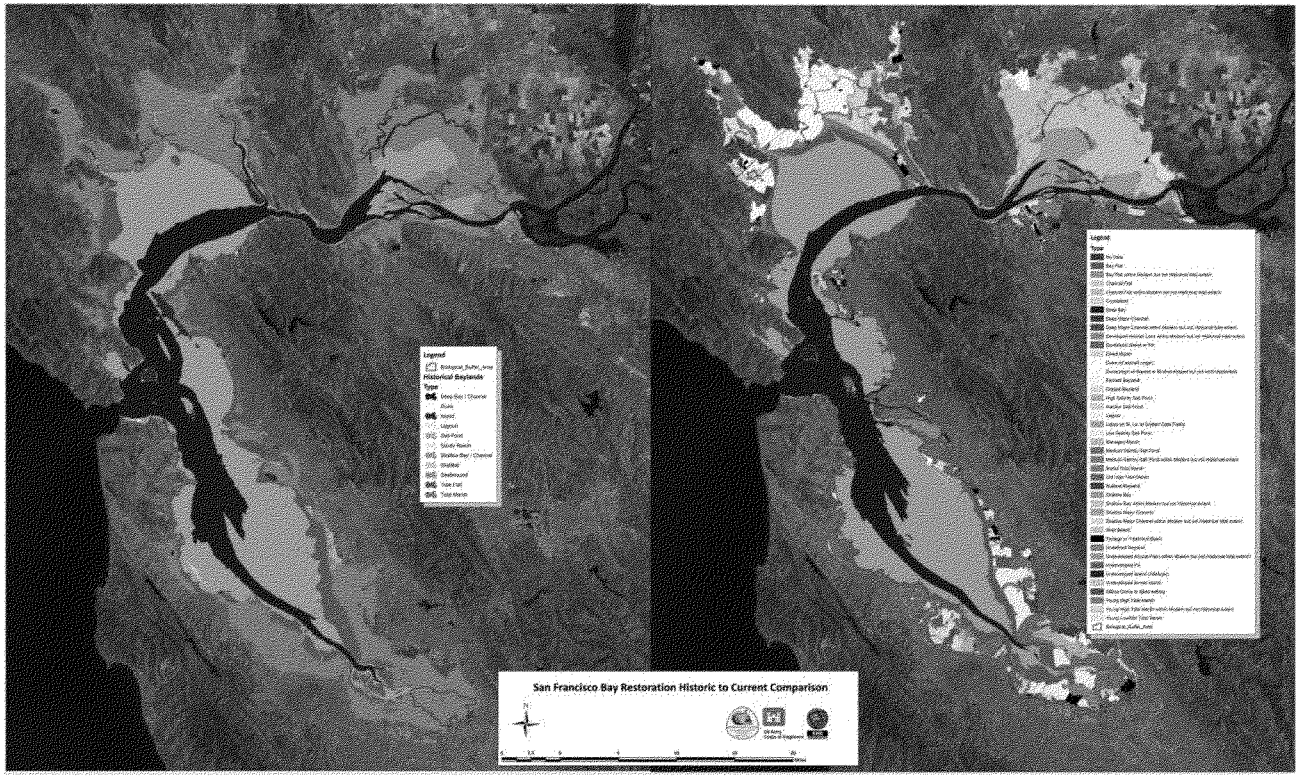


Figure 14. San Francisco Bay comparison between historic (ca. 1800) and modern times (ca. 2001) habitats (source: SFEI).

Historic Conditions San Francisco Bay	Modern Conditions San Francisco Bay
Deep Bay / Channel	Deep Bay / Channel
Dune	Dune
Island	Lagoon
Lagoon	Salt Pond
Natural Salt Pond	Shallow Bay / Channel
Sandy Beach	Tidal Flat
Shallow Bay / Channel	Tidal Marsh
Shellflat	Developed
Shell Mound	Agriculture
Tidal Flat	
Tidal Marsh	

Table 10. Habitat classifications used to compare historic (ca. 1800) to modern times (ca. 2001).

Historic Habitat Value Acreages and Proportions											
Habitats	Deep Bay / Channel	Dune	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel	Tidal Flat	Tidal Marsh	Island	Shellflat	Shell Mmound
Acres	99,527.68	54.75	84.17	1,594.53	199.33	174,440.54	50,054.73	189,985.90	4,823.86	395.34	12.01
Proportions	0.19	0.00	0.00	0.00	0.00	0.33	0.10	0.36	0.01	0.00	0.00
											Total Acres**
											521,172.83

Modern Habiat Value Acreages and Proportions											
Habitats	Deep Bay / Channel	Dune	Lagoon	Salt Pond	Shellflat	Shallow Bay / Channel	Tidal Flat	Tidal Marsh	Developed	Agriculture	No Correlation
Acres	82,530.76	2,254.80	2,325.53	29,738.39	12.41	171,838.91	35,313.67	103,501.19	50,341.78	31,738.89	13,789.87
Proportions	0.16	0.00	0.00	0.06	0.00	0.33	0.07	0.20	0.10	0.06	0.03
											Total Acres
**Note: there is a 2,213 acre discrepancy between Historic to Modern timeframe because of a gap not mapped in the Historic map											523,386.19

Table 10a. Acreage change in habitat types from historic (ca. 1800) to modern times (ca. 2001).

	Habitat Value	Difference Historic to Modern
Historic (High Range Habitat Value)	9,130,514	-2,343,419
Historic (Low Range Habitat Value)	8,516,173	-1,729,077
Modern Times Habitat Value	6,787,095	0

Table 10b. Overall habitat value change from historic (ca. 1800) to modern times (ca. 2001).

Invasive species would expand in area and abundance

Invasive plant species information for current conditions was originally collected from past studies or from knowledgeable staff on site. A value was determined and recorded for each polygon using the percent breakout in Table 11.The greater the adjustment value, the greater the discount applied.

Determined Invasive Adjustment (based on area percent)	Discount Class
1 - 0.95	1
0.94 - 0.90	0.9
0.89 - 0.80	0.8
0.79 - 0.70	0.7
0.69 - 0.60	0.6
0.59 -0.50	0.5
0.49 - 0.40	0.4

Table 11. Invasive plant species deduction factors

To determine the influence of invasive species for the without-project conditions, the habitat evaluation team expected that the presence and abundance of the invasive species would increase over time. Therefore, the percent invasive species for each polygon at the baseline condition should advance to the next highest percent level for the first 25 years, and to the next level beyond that for the next 25 years. In other words, if the current baseline condition of a polygon has .89-.80 invasive cover, then the condition at Year 25 would be assessed at .79-.70 invasive cover while the condition at Year 50 would be reflected as .69-.60 invasive cover. We recognize that these assumptions may not reflect real outcomes because salinity values within the ponds may check the spread of some invasive plants. Thus, increases in invasive plants may be more likely to occur in above-shoreline habitats.

Planned development

We used the city of San Jose Planning Services Division's future land use and transportation plan to determine future development in the project area. This document, known as *Envision San Jose 2040 General Plan* (http://www.sanjoseca.gov/planning/gp_update/default.asp) shows what the city planners envision over the next several decades. Below is their planning map for the Alviso area that would cover the project site (Figure 15). This information was overlaid onto the existing environment and shows that most of the anticipated change through 2040 will occur in the already developed area. The only significant development action proposed in Alviso aside from the Master Plan is a proposed height increase for Newby Island Landfill. Finally, there is also a recent San Jose/Santa Clara Water Pollution Control Plant Master Plan that was published in December 2011. This master plan updates the San Jose 2040 Plan. A further discussion of the Water Pollution Control Plant Master Plan can be found in the Climate Change section that follows.

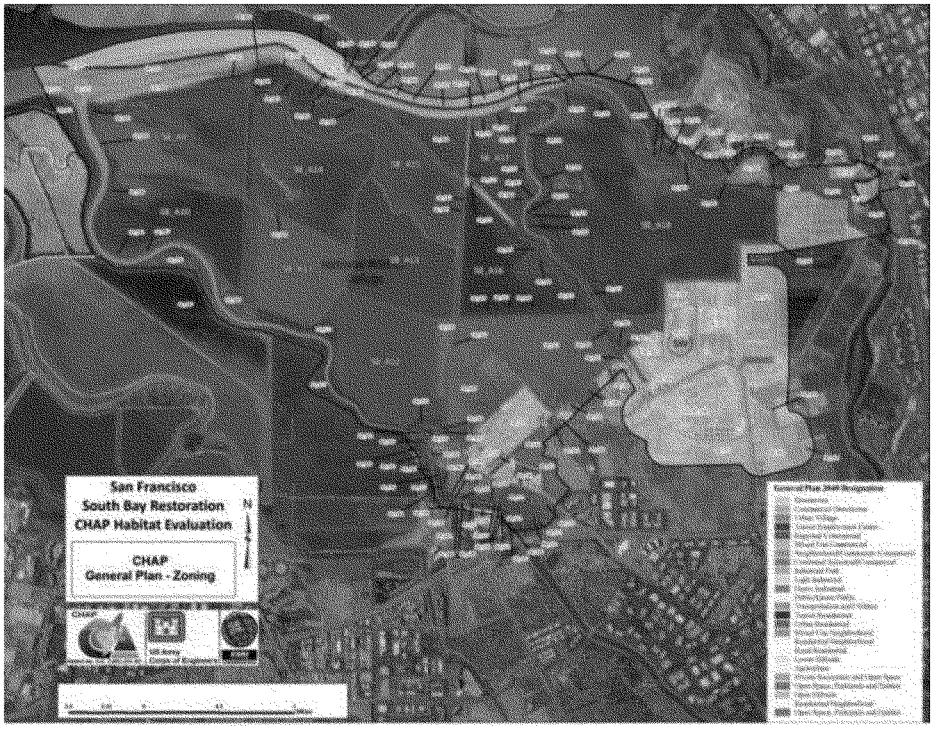


Figure 15. Alviso planning area until 2040. (Source: San Jose Services Planning Division - *Envision San Jose 2040 General Plan*).

Climate change increasing water level

The current distribution, abundance, and vitality of species and habitats are strongly dependent on climatic (and microclimatic) conditions. Climate change is expected to result in warmer temperatures year-round with most precipitation falling during winter from North Pacific storms. One of four climate model projects associated with *Cal-Adapt* shows slightly wetter winters, while others shows slightly drier winters with a 10 to 20 percent decrease in total annual precipitation. Nonetheless, even modest changes may have a significant impact to California ecosystems (http://cal-adapt.org/precip/decadal; last accessed 6-6-2012). Rising water level will significantly affect coastal wetlands because they are mostly within a few feet of sea level. As the sea level rises, these wetlands will move inland, or they will be lost if they abut development or high ground. Part of the current Climate Change Implementation Plan for Adaptation is a strategy to complete a statewide sea-level rise vulnerability assessment every five years. In 2006, the California Climate Change Center reported a historic sea-level rise of 7 inches in the last century and projected an additional rise of 4–35 inches by the end of this century. Their report uses the 20-55 inch projection, as it was the best available science at the time of the 2009 impacts assessment, but in so doing noted that future sea-level rise estimates will vary based on future greenhouse gas emissions (http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy_-_Chapter_6_-_Ocean_and_Coastal_Resources.pdf; last accessed 5-2-2012).

To assess the influence of the potential increase in sea level, the Shoreline Study used the National Research Council's (NRC) Curve III and the following comments apply only to the area south of Dumbarton Straits. This curve simulates a high rate or 1.5 meter rise in the water depth over the project area and adjacent lands (Figure 16), and we anticipated this event may likely occur once within the 50 year time period and any damage would be mitigated quickly. Under favorable sediment availability conditions, tidal marshes may be able to keep up with sea level rise; in addition, if a breach in a levee were to occur it would be quickly repaired. Thus there is a potential for an increase in aquatic habitats though the duration maybe short lived. By the end of the 50 years, it is thought that current without-project conditions might be roughly the same. This is based on past experience with relative sea level rise (due to ground subsidence) whereby tidal marshes were able to keep up with accumulating sediment fast enough; this process may be able to keep pace with the expected sea level rise over a 50-year period. However, this ability is not unlimited and that faster rates of sea level rise later in the century (after the 50-year period) may have different results for tidal marsh persistence. Additionally, USGS modeling of the non-vegetated tidal portions of the area south of the Dumbarton Bridge show it more or less has kept up with sea level rise over a 50-year period.

The City is working with the Shoreline Study to ensure that the Water Pollution Control Plant is protected from future sea-level rise, and hence are evaluating minimum and maximum levee build-out as well as other fortification options. The City is also evaluating 3 land use alternatives: Back to the Bay, Necklaces of Lakes, and Riparian Corridor (San Jose/Santa Clara Water Pollution Control Plant Master Plan, 2011). However, the City does not have funding to implement these plans. They will focus their funding on the plant makeover. Currently, habitat restoration will only occur on plant lands or in Pond A18 with the involvement of additional partners.

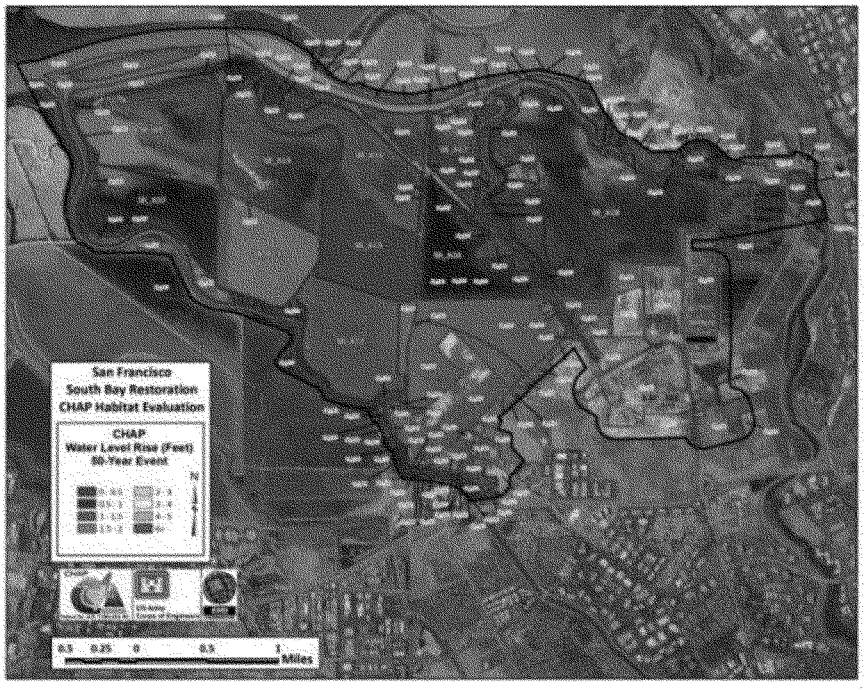


Figure 16. Depiction of the potential impact area from a 50 year flood event over the project area and adjacent lands.

Earthquakes

Earthquakes and their tremors are not uncommon in the San Francisco area. Figures 17a &17b depict the potential earthquake risk in and around the San Francisco area. If an earthquake occurred, the primary impact would be to infrastructure on the site. Salt pond levee/dikes are not engineered and might fail, but this risk is difficult to quantify and should be considered unquantifiable. That is, there is some risk of these structures failing, but during the 50-year evaluation period they are expected to be repaired after such an event even in the absence of a Corps project. Since the outermost levee is the highest one, this levee would be repaired to restore flood protection for urbanized areas and infrastructure, which would have the effect of maintaining non-tidal conditions for all the ponds. Also, liquefaction risk is high for current levees due to Bay mud that underlies the levees. Nonetheless, if this infrastructure failed, some flooding may occur and surface water is expected to flow back in the San Francisco South Bay.

The California Geological Survey has online a Probabilistic Seismic Hazards Mapping Ground Motion (Figure 17a). The USGS also indicated that the south segment of the Hayward Fault and the Peninsula segment of the San Andreas Fault are at high risk of a magnitude-7 quake in coming

decades. Such an earthquake might shake the study area more strongly than the 1989 quake. For a reasonable map of shaking potential, see http://redirect.conservation.ca.gov/cgs/rghm/pshamap/psha12237.html (last accessed 06/ 08/2012). Lastly, the USGS also depicts the likelihood of a 6.7 or greater earthquake from 2007 to 2036.

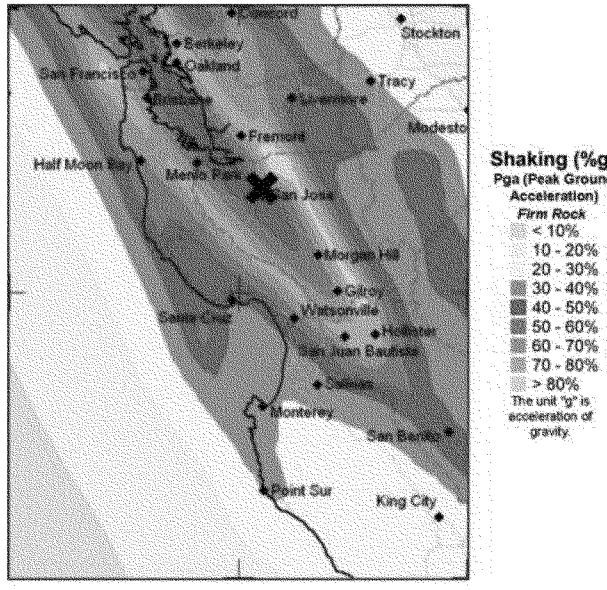


Figure 17a. Potential for ground motion within and near the project area as shown by California Geological Survey.
(Source: http://redirect.conservation.ca.gov/cgs/rghm/pshamap/psha12237.html; last accessed 06/ 08/2012).

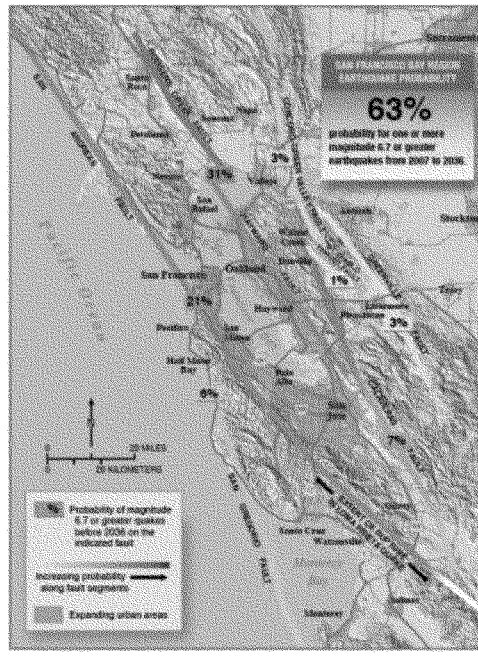


Figure 17b. USGS map depicting the probability of a 6.7 or greater earthquake from 2007 to 2036 (Source: http://earthquake.usgs.gov/regional/nca/ucerf/images/2008probabilities-lrg.jpg; last accessed 6/15/2012).

Conclusion

To examine the future conditions that might exist without the proposed project, we began to put the project site into perspective by conducting a coarse evaluation of the amount of change in land use that has occurred from historic to modern times for the shoreline around the entire San Francisco Bay. To do this, the San Francisco Estuary Institute's Historic and Modern Bayland maps were used. This assessment showed an apparent loss in value that ranges from about 1.7 to 2.3 million habitat units for the area. To develop the future perspective for the next 50 years, additional steps were taken to obtain information on fish and wildlife species populations, invasive plant species, planned development, climate change influences and earthquake frequencies. Evaluating this information shows that there may be low turnover in species composition. Salinity levels will likely continue to control the spread of some of the invasive plants. Future planned development will occur in already developed areas. Sea level rise due to climate change may periodically expand the bay's aquatic footprint for short time periods in the Alviso area, and the design and engineering of the current levees and dikes are expected to withstand predictive earthquakes for the area.

However, if this infrastructure failed, some flooding may occur though the surface water is expected to flow back in the San Francisco South Bay.

Regarding uncertainty, any time we try to predict future conditions, whether for 10, 25 or 50 years from the present, there is a underlying degree of uncertainty associated with the above statements. Projections may change dramatically with further information in the future. In addition, information sources are not perfect. Planned development is closely associated with the economic conditions for an area;, although stated as a vision for 2040 we must remember that planning is dynamic and is also subject to change. For other outcomes that maybe affected by climate change, as mentioned 1 model out of 4 shows the potential for wetter conditions while that other 3 suggest drier conditions. Lastly, regarding prediction of potential catastrophic events such as earthquakes is extremely inexact and relies heavily on professional opinion; the likelihood of occurrence has a wide time interval associated with the predictions.

Citations

City of San Jose. 2007. *Envision San Jose 2040 General Plan.* San Jose Services Planning Division. pp. 502.

City of San Jose & Santa Clara. 2011. *San Jose/Santa Clara Water Pollution Control Plant Master Plan.* Task NO 5 – Project Memorandum NO. 10. Land Use Alternatives, Elements and Land Use Plan. 83 pp.

Johnson, D. H., and T.A. O'Neil, (managing directors). 2001. *Wildlife-Habitat Relationships in Oregon and Washington.* Oregon State University Press, Corvallis, OR. pp. 736

O'Neil, T., B.G. Marcot, and P. Paquet. 2005. *The habitat-species-function triad: a planning framework for ecoprovinces and subbasins.* Northwestern Naturalist, 86(2): 111.

Perkins, J.P. *Like a cool drink of water.* Conservation Biology, 16(3):852-853.

U.S. Army Corps of Engineers (USACE) 1999. *Pamphlet No. 1165-2-502 30* September 1999, Water Resources Policies and Authorities Ecosystem Restoration Supporting Policy Information.

U.S. Fish and Wildlife Service. 1980, Habitat Evaluation Procedures. Ecological Services Manual (101-104 ESM), Division of Ecological Services, Washington D.C. unnumbered.

Appendix A-1

Shoreline Study Project Species List for Baseline Conditions

[253 Fish and Wildlife Species]

SPP ID	Common Name	Scientific Name
10001	Pacific lamprey	*Lampetra tridentata*
10071	Sacramento sucker	*Catostomus occidentalis occidentalis*
10073	Threespine stickleback	*Gasterosteus aculeatus*
10081	Prickly sculpin	*Cottus asper*
10121	Striped bass	*Morone saxatilis*
10149	Common carp	*Cyprinus carpio*
10173	Starry flounder	*Platichthys stellatus*
10177	Goldfish	*Carassius auratus auratus*
10189	Western mosquito fish	*Gambusia affinis*
10221	Pacific staghorn sculpin	*Leptocottus armatus*
10233	American shad	*Alosa sapidissima*
10234	Threadfin shad	*Dorosma petenense*
10237	Shiner perch	*Cymatogaster aggregata*
10245	Longfin smelt	*Spirinchus thaleichthys*
10249	Green sturgeon	*Acipenser medirostris*
10295	Steelhead	*Oncorhynchus mykiss*
10325	Leopard shark	*Triakis semifasciata*
10326	Brown smoothhound	*Mustelus henlei*
10329	Soupfin shark	*Galeorhinus galeus*
10333	Spiny dogfish	*Squalus acanthias*
10337	Big skate	*Raja binoculata*
10341	California skate	*Raja inornata*
10361	Cabezon	*Scorpaenichthys marmoratus*
10405	Brown rockfish	*Sebastes auriculatus*
10537	English sole	*Parophrys vetulus*
10538	California tonguefish	*Symphurus atricaudus*
10539	Diamond turbot	*Hypsopsetta guttulata*
10545	Pacific sanddab	*Citharichthys sordidus*
10561	Sand sole	*Psettichthys melanostictus*
10585	Chinook salmon	*Oncorhynchus tshawytscha*
10589	Pink salmon	*Oncorhynchus gorbuscha*
10593	Chum salmon	*Oncorhynchus keta*
10628	Longjawed mudsucker	*Gillichthys mirabilis*

SPP ID	Common Name	Scientific Name
10629	Bay goby	*Lepidogobius lepidus*
10633	Arrow goby	*Clevelandia ios*
10634	Cheekspot goby	*Ilypnus gilberti*
10637	Speckled sanddab	*Citharichthys stigmaeus*
10641	Pacific herring	*Clupea pallasii*
10648	Barred surfperch	*Amphistichus argenteus*
10653	Surf Smelt	*Hypomesus pretiosus*
10657	Whitebait smelt	*Allosmerus elongatus*
10669	Bay pipefish	*Syngnathus leptorhynchus*
10686	Dwarf surfperch	*Micrometrus minimus*
10729	Plainfin midshipman	*Porichthys notatus*
10757	Topsmelt	*Atherinops affinis*
10758	Jack smelt	*Atherinopsis californiensis*
10765	Pacific sardine	*Sardinops sagax*
10808	Bat ray	*Myliobatis californica*
10817	Northern anchovy	*Engraulis mordax*
11113	White croaker	*Genyonemus lineatus*
11197	California halibut	*Paralichthys californicus*
30100	Southern alligator lizard	*Elgaria multicarinata*
30160	Western fence lizard	*Sceloporus occidentalis*
30290	Gopher snake	*Pituophis melanoleuca*
30320	Western terrestrial garter snake	*Thamnophis elegans*
30340	Common garter snake	*Thamnophis sirtalis*
30350	Western rattlesnake	Crotalus oreganus
40050	Pied-billed Grebe	*Podilymbus podiceps*
40060	Horned Grebe	*Podiceps auritus*
40070	Red-necked Grebe	*Podiceps grisegena*
40080	Eared Grebe	*Podiceps nigricollis*
40090	Western Grebe	*Aechmophorus occidentalis*
40100	Clark's Grebe	*Aechmophorus clarkii*
40320	American White Pelican	*Pelecanus erythrorhynchos*
40330	Brown Pelican	*Pelecanus occidentalis*
40350	Double-crested Cormorant	*Phalacrocorax auritus*
40380	American Bittern	*Botaurus lentiginosus*
40390	Least Bittern	*Ixobrychus exilis*
40400	Great Blue Heron	*Ardea herodias*

SPP ID	Common Name	Scientific Name
40410	Great Egret	*Ardea alba*
40420	Snowy Egret	*Egretta thula*
40450	Cattle Egret	*Bubulcus ibis*
40460	Green Heron	*Butorides virescens*
40470	Black-crowned Night-Heron	*Nycticorax nycticorax*
40500	Turkey Vulture	*Cathartes aura*
40530	Greater White-fronted Goose	*Anser albifrons*
40570	Canada Goose	*Branta canadensis*
40640	Gadwall	*Anas strepera*
40660	Eurasian Wigeon	*Anas penelope*
40670	American Wigeon	*Anas americana*
40690	Mallard	*Anas platyrhynchos*
40700	Blue-winged Teal	*Anas discors*
40710	Cinnamon Teal	*Anas cyanoptera*
40720	Northern Shoveler	*Anas clypeata*
40730	Northern Pintail	*Anas acuta*
40760	Green-winged Teal	*Anas crecca*
40770	Canvasback	*Aythya valisineria*
40780	Redhead	*Aythya americana*
40790	Ring-necked Duck	*Aythya collaris*
40810	Greater Scaup	*Aythya marila*
40820	Lesser Scaup	*Aythya affinis*
40860	Surf Scoter	*Melanitta perspicillata*
40870	White-winged Scoter	*Melanitta fusca*
40880	Black Scoter	*Melanitta nigra*
40890	Long-tailed Duck	*Clangula hyemalis*
40900	Bufflehead	*Bucephala albeola*
40910	Common Goldeneye	*Bucephala clangula*
40920	Barrow's Goldeneye	*Bucephala islandica*
40940	Hooded Merganser	*Lophodytes cucullata*
40950	Common Merganser	*Mergus merganser*
40970	Ruddy Duck	*Oxyura jamaicensis*
40980	Osprey	*Pandion haliaetus*
40990	White-tailed Kite	*Elanus coeruleus*
41010	Northern Harrier	*Circus cyaneus*
41020	Sharp-shinned Hawk	*Accipiter striatus*

SPP ID	Common Name	Scientific Name
41030	Cooper's Hawk	*Accipiter cooperii*
41050	Red-shouldered Hawk	*Buteo lineatus*
41080	Red-tailed Hawk	*Buteo jamaicensis*
41090	Ferruginous Hawk	*Buteo regalis*
41110	Golden Eagle	*Aquila chrysaetos*
41120	American Kestrel	*Falco sparverius*
41130	Merlin	*Falco columbarius*
41150	Peregrine Falcon	*Falco peregrinus*
41190	Ring-necked Pheasant	*Phasianus colchicus*
41290	California Quail	*Callipepla californica*
41311	California Black Rail	*Laterallus jamaicensis coturniculus*
41320	Virginia Rail	*Rallus limicola*
41321	California Clapper rail	*Rallus longirostris obsoletus*
41330	Sora	*Porzana carolina*
41340	Common Moorhen	*Gallinula chloropus*
41350	American Coot	*Fulica americana*
41370	Black-bellied Plover	*Pluvialis squatarola*
41380	American Golden-Plover	*Pluvialis dominica*
41410	Western Snowy Plover	*Charadrius alexandrinus nivosus*
41420	Semipalmated Plover	*Charadrius semipalmata*
41440	Killdeer	*Charadrius vociferus*
41480	Black-necked Stilt	*Himantopus mexicanus*
41490	American Avocet	*Recurvirostra americana*
41500	Greater Yellowlegs	*Tringa melanoleuca*
41510	Lesser Yellowlegs	*Tringa flavipes*
41540	Willet	*Catoptrophorus semipalmatus*
41570	Spotted Sandpiper	*Actitis macularia*
41590	Whimbrel	*Numenius phaeopus*
41610	Long-billed Curlew	*Numenius americanus*
41640	Marbled Godwit	*Limosa fedoa*
41650	Ruddy Turnstone	*Arenaria interpres*
41700	Sanderling	*Calidris alba*
41710	Semipalmated Sandpiper	*Calidris pusilla*
41720	Western Sandpiper	*Calidris mauri*
41760	Least Sandpiper	*Calidris minutilla*
41820	Dunlin	*Calidris alpina*

SPP ID	Common Name	Scientific Name
41860	Ruff	*Philomachus pugnax*
41870	Short-billed Dowitcher	*Limnodromus griseus*
41880	Long-billed Dowitcher	*Limnodromus scolopaceus*
41900	Wilson's Phalarope	*Phalaropus tricolor*
42010	Bonaparte's Gull	*Larus Philadelphia*
42020	Heermann's Gull	*Larus heermanni*
42030	Mew Gull	*Larus canus*
42040	Ring-billed Gull	*Larus delawarensis*
42050	California Gull	*Larus californicus*
42060	Herring Gull	*Larus argentatus*
42070	Thayer's Gull	*Larus thayeri*
42100	Western Gull	*Larus occidentalis*
42110	Glaucous-winged Gull	*Larus glaucescens*
42120	Glaucous Gull	*Larus hyperboreus*
42130	Sabine's Gull	*Xena sabini*
42180	Caspian Tern	*Sterna caspia*
42201	Black Skimmer	*Rynchops niger*
42220	Forster's Tern	*Sterna forsteri*
42230	California Least Tern	*Sterna antillarum browni*
42380	Rock Pigeon	*Columba livia*
42390	Band-tailed Pigeon	*Columba fasciata*
42410	Mourning Dove	*Zenaida macroura*
42440	Barn Owl	*Tyto alba*
42470	Great Horned Owl	*Bubo virginianus*
42510	Burrowing Owl	*Athene cunicularia*
42560	Short-eared Owl	*Asio flammeus*
42650	Anna's Hummingbird	*Calypte anna*
42700	Allen's Hummingbird	*Selasphorus sasin*
42710	Belted Kingfisher	*Ceryle alcyon*
42840	Northern Flicker	*Colaptes auratus*
42940	Pacific-slope Flycatcher	*Empidonax difficilis*
42960	Black Phoebe	*Sayornis nigricans*
42980	Say's Phoebe	*Sayornis saya*
43060	Loggerhead Shrike	*Lanius ludovicianus*
43200	Western Scrub-Jay	*Aphelocoma californica*
43240	American Crow	*Corvus brachyrhynchos*

SPP ID	Common Name	Scientific Name
43260	Common Raven	*Corvus corax*
43280	Horned Lark	*Eremophila alpestris*
43300	Tree Swallow	*Tachycineta bicolor*
43310	Violet-green Swallow	*Tachycineta thalassina*
43320	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
43330	Bank Swallow	*Riparia riparia*
43340	Cliff Swallow	*Petrochelidon pyrrhonota*
43350	Barn Swallow	*Hirundo rustica*
43380	Chestnut-backed Chickadee	*Poecile rufescens*
43400	Oak Titmouse	Baeolophus inornatus
43420	Bushtit	*Psaltriparus minimus*
43490	Bewick's Wren	*Thryomanes bewickii*
43500	House Wren	*Troglodytes aedon*
43520	Marsh Wren	*Cistothorus palustris*
43550	Ruby-crowned Kinglet	*Regulus calendula*
43640	Hermit Thrush	*Catharus guttatus*
43660	American Robin	*Turdus migratorius*
43700	Northern Mockingbird	*Mimus polyglottos*
43740	European Starling	*Sturnus vulgaris*
43820	Cedar Waxwing	*Bombycilla cedrorum*
43970	Yellow-rumped Warbler	*Dendroica coronata*
44000	Townsend's Warbler	*Dendroica townsendi*
44180	Common Yellowthroat	*Geothlypis trichas*
44180	San Francisco Common Yellowthroat	*Geothlypis trichas sinuosa*
44270	Spotted Towhee	*Pipilo maculatus*
44280	California Towhee	*Pipilo crissalis*
44390	Bryant's savannah sparrow	*Passerculus sandwichensis alaudinus*
44430	Fox Sparrow	*Passerella iliaca*
44440	Alameda song sparrow	*Melospiza melodia pusillula*
44440	Song sparrow	*Melospiza melodia*
44490	White-crowned Sparrow	*Zonotrichia atricapilla*
44500	Golden-crowned Sparrow	*Zonotrichia atricapilla*
44510	Dark-eyed Junco	*Junco hyemalis*
44590	Black-headed Grosbeak	*Pheucticus melanocephalus*
44660	Red-winged Blackbird	*Agelaius phoeniceus*

SPP ID	Common Name	Scientific Name
44670	Tricolored Blackbird	*Agelaius tricolor*
44680	Western Meadowlark	*Sturnella neglecta*
44710	Brewer's Blackbird	*Euphagus cyanocephalus*
44740	Brown-headed Cowbird	*Molothrus ater*
44760	Hooded Oriole	*Icterus cucullatus*
44790	Bullock's Oriole	*Icterus bullockii*
44870	House Finch	*Carpodacus mexicanus*
44930	Lesser Goldfinch	*Carduelis psaltria*
44950	American Goldfinch	*Carduelis tristis*
44970	House Sparrow	*Passer domesticus*
50010	Virginia opossum	Didelphis virginiana
50035	Ornate Shrew	Sorex ornatus
50040	Salt marsh wandering shrew	*Sorex vagrans halicoetes*
50110	Trowbridge's Shrew	Sorex trowbridgii
50200	Yuma myotis	*Myotis yumanensis*
50285	Western red bat	*Lasirurs blossevillii*
50290	Hoary bat	*Lasiurus cinereus*
50330	Mexican free-tailed bat	*Tadarida brasiliensis*
50360	Brush rabbit	*Sylvilagus bachmani*
50381	Audubon's cottontail	*Sylvilagus audubonii*
50420	Black-tailed jackrabbit	*Lepus californicus*
50610	California ground squirrel	*Spermophilus beecheyi*
50730	Botta's pocket gopher	*Thomomys bottae*
50820	Western harvest mouse	*Reithrodontomys megalotis*
50821	Salt marsh harvest mouse	*Reithrodontomys raviventris raviventris*
50830	Deer mouse	*Peromyscus maniculatus*
50990	California vole	*Microtus californicus*
51050	Common muskrat	*Ondatra zibethicus*
51070	Black rat	*Rattus rattus*
51080	Norway rat	*Rattus norvegicus*
51090	House mouse	*Mus musculus*
51140	Coyote	*Canis latrans*
51160	Red fox	*Vulpes vulpes*
51180	Gray fox	*Urocyon cinereoargenteus*
51220	Raccoon	*Procyon lotor*

SPP ID	Common Name	Scientific Name
51260	Long-tailed weasel	*Mustela frenata*
51300	Western spotted skunk	*Spilogale gracilis*
51310	Striped skunk	*Mephitis mephitis*
51330	Mountain lion	*Felis concolor*
51405	Mule Deer	*Odocoileus hemionus*
60040	Pacific harbor seal	*Phoca vitulina richardsi*

Appendix A-2

Species and Habitat Associations for Baseline Conditions

[253 Fish and Wildlife Species]

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Pacific lamprey		1								1					
Sacramento sucker										1					
Threespine stickleback	1	1		1			1	1		1			1		
Prickly sculpin		1		1				1		1					
Striped bass		1		1				1		1			1		
Common carp		1		1						1					
Starry flounder		1		1						1			1		
Goldfish				1						1					
Western mosquito fish		1		1						1					
Pacific staghorn sculpin	1	1					1	1		1			1		
American shad		1		1				1		1					
Threadfin shad		1		1				1		1					
Shiner perch	1	1					1	1		1			1		
Longfin smelt		1						1		1					
Green sturgeon				1						1					
Steelhead				1						1					
Leopard shark	1						1	1		1			1		
Brown smoothhound	1						1			1					

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Soupfin shark										1					
Spiny dogfish										1					
Big skate										1					
California skate										1					
Cabezon										1					
Brown rockfish								1		1					
English sole										1			1		
California tonguefish										1					
Diamond turbot	1						1			1					
Pacific sanddab										1					
Sand sole										1					
Chinook salmon		1		1						1			1		
Pink salmon		1		1						1					
Chum salmon		1		1						1					
Longjawed mudsucker	1	1					1	1		1					
Bay goby	1							1		1					
Arrow goby	1							1		1			1		
Cheekspot goby										1					
Speckled sanddab							1			1					
Pacific herring	1	1						1		1			1		
Barred surfperch	1						1	1		1			1		
Surf Smelt		1								1					

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Whitebait smelt										1					
Bay pipefish		1					1			1			1		
Dwarf surfperch										1					
Plainfin midshipman	1							1		1					
Topsmelt	1	1					1	1		1			1		
Jack smelt	1	1						1		1			1		
Pacific sardine										1					
Bat ray	1	1					1	1		1			1		
Northern anchovy	1	1					1	1		1			1		
White croaker										1					
California halibut										1					
Southern alligator lizard					1						1				1
Western fence lizard					1						1				1
Gopher snake					1						1	1			1
Western terrestrial garter snake					1						1	1			1
Common garter snake					1						1	1			1
Western rattlesnakes					1						1				1
Pied-billed Grebe	1			1			1			1		1	1		
Horned Grebe	1			1			1			1		1	1		
Red-necked Grebe	1			1			1								
Eared Grebe	1						1			1			1	1	
Western Grebe	1			1			1			1					

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Clark's Grebe	1			1			1			1					
American White Pelican	1					1	1			1					
Brown Pelican	1					1	1								
Double-crested Cormorant	1					1	1			1					
American Bittern		1		1								1	1		
Least Bittern		1		1					1			1	1		
Great Blue Heron	1	1		1	1	1	1	1	1			1	1	1	
Great Egret		1		1		1	1	1	1			1	1	1	
Snowy Egret	1	1		1		1	1	1				1	1		
Cattle Egret		1		1		1						1			
Green Heron		1		1								1			
Black-crowned Night-Heron		1		1	1							1			
Turkey Vulture	1				1	1			1						1
Greater White-fronted Goose						1	1		1		1				
Canada Goose		1	1	1		1	1		1	1	1		1	1	1
Gadwall	1	1		1		1	1			1		1	1	1	
Eurasian Wigeon							1		1	1					
American Wigeon				1					1	1			1	1	
Mallard	1	1		1		1	1		1	1	1	1	1	1	
Blue-winged Teal		1		1					1	1		1	1		
Cinnamon Teal		1		1					1	1		1	1	1	
Northern Shoveler	1	1		1		1	1		1	1			1	1	

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Northern Pintail	1			1					1	1			1	1	
Green-winged Teal	1	1		1			1		1	1			1	1	
Canvasback		1		1			1			1					
Redhead				1			1			1				1	
Ring-necked Duck							1			1					
Greater Scaup	1						1								
Lesser Scaup	1	1					1								
Surf Scoter							1								
White-winged Scoter							1								
Black Scoter							1								
Long-tailed Duck							1								
Bufflehead	1			1			1			1					
Common Goldeneye							1			1					
Barrow's Goldeneye							1								
Hooded Merganser				1			1			1		1			
Common Merganser				1			1			1		1			
Ruddy Duck	1			1		1	1			1				1	
Osprey										1		1			1
White-tailed Kite		1							1			1			1
Northern Harrier		1		1									1		1
Sharp-shinned Hawk												1			1
Cooper's Hawk					1							1			1

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Red-shouldered Hawk					1							1			1
Red-tailed Hawk					1							1			1
Ferruginous Hawk					1							1			1
Golden Eagle					1										1
American Kestrel													1		1
Merlin															1
Peregrine Falcon					1								1		1
Ring-necked Pheasant					1						1	1			1
California Quail											1	1			1
California Black Rail									1				1		
Virginia Rail		1		1					1				1		
California Clapper rail													1		
Sora		1		1									1		
Common Moorhen		1		1					1			1	1		
American Coot	1	1		1			1	1		1	1	1	1	1	1
Black-bellied Plover	1					1	1	1						1	
American Golden-Plover						1	1	1							
Western Snowy Plover						1	1	1							
Semipalmated Plover						1	1	1					1	1	
Killdeer	1		1			1	1	1	1					1	1
Black-necked Stilt	1					1	1	1	1				1	1	
American Avocet	1	1				1	1	1	1				1	1	

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Greater Yellowlegs	1					1	1	1	1				1	1	
Lesser Yellowlegs	1					1	1	1					1	1	
Willet	1					1	1	1	1				1	1	
Spotted Sandpiper								1					1		
Whimbrel	1					1	1	1	1						
Long-billed Curlew	1					1	1	1	1				1	1	
Marbled Godwit	1					1	1	1					1	1	
Ruddy Turnstone						1	1	1							
Sanderling	1						1	1							
Semipalmated Sandpiper						1	1	1							
Western Sandpiper						1	1	1					1	1	
Least Sandpiper	1					1	1	1					1	1	
Dunlin	1					1	1	1	1				1	1	
Ruff	1							1							
Short-billed Dowitcher	1					1	1	1						1	
Long-billed Dowitcher	1					1	1	1						1	
Wilson's Phalarope	1			1			1							1	
Bonaparte's Gull	1					1	1							1	
Heermann's Gull						1	1								
Mew Gull	1					1	1							1	
Ring-billed Gull	1		1		1	1	1		1	1	1		1	1	
California Gull	1		1		1	1	1			1	1		1	1	

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Herring Gull	1				1	1	1			1			1	1	
Thayer's Gull	1				1	1	1			1				1	
Western Gull	1		1		1	1	1			1	1		1		
Glaucous-winged Gull					1	1	1			1	1				
Glaucous Gull					1	1	1								
Sabine's Gull						1	1								
Caspian Tern	1			1		1	1			1					
Black Skimmer						1	1			1					
Forster's Tern	1			1		1	1			1					
California Least Tern						1	1			1					
Rock Pigeon			1		1						1				1
Band-tailed Pigeon			1								1				1
Mourning Dove			1		1						1				1
Barn Owl											1	1			1
Great Horned Owl									1		1	1			1
Burrowing Owl					1						1				1
Short-eared Owl															1
Anna's Hummingbird											1	1			1
Allen's Hummingbird											1	1			1
Belted Kingfisher		1		1								1			
Northern Flicker											1	1			1
Pacific-slope Flycatcher									1			1			1

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Black Phoebe			1								1	1	1		1
Say's Phoebe											1	1			1
Loggerhead Shrike											1	1			1
Western Scrub-Jay			1		1						1	1			1
American Crow			1		1						1	1			1
Common Raven	1		1		1						1	1			1
Horned Lark					1										1
Tree Swallow				1						1		1	1		1
Violet-green Swallow				1						1		1	1		1
Northern Rough-winged Swallow				1						1		1	1		1
Bank Swallow				1						1		1	1		1
Cliff Swallow				1						1		1	1		1
Barn Swallow				1						1		1	1		1
Chestnut-backed Chickadee											1	1			1
Oak Titmouse											1	1			1
Bushtit											1	1			1
Bewick's Wren												1			1
House Wren			1						1		1	1			1
Marsh Wren				1								1	1		
Ruby-crowned Kinglet											1	1			1
Hermit Thrush											1	1			1
American Robin			1								1	1			1

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Northern Mockingbird			1		1						1	1			1
European Starling			1		1						1	1			1
Cedar Wa1wing											1	1			1
Yellow-rumped Warbler											1	1			1
Townsend's Warbler									1		1	1			1
Common Yellowthroat		1		1					1		1	1			1
San Francisco common yellowthroat		1		1								1			
Spotted Towhee											1	1			1
California Towhee											1	1			1
Bryant's savannah sparrow											1	1		1	1
Fox Sparrow									1		1	1			1
Alameda song sparrow		1		1								1	1		1
Song sparrow		1		1					1		1	1	1		
White-crowned Sparrow		1							1		1	1			1
Golden-crowned Sparrow		1									1	1			1
Dark-eyed Junco											1	1			1
Black-headed Grosbeak											1	1			1
Red-winged Blackbird		1		1								1	1	1	1
Tricolored Blackbird		1		1								1			1
Western Meadowlark		1		1							1	1			1
Brewer's Blackbird			1		1						1	1			1
Brown-headed Cowbird											1	1			1

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
Hooded Oriole											1	1			1
Bullock's Oriole											1	1			1
House Finch			1								1	1			1
Lesser Goldfinch											1	1			1
American Goldfinch											1	1			1
House Sparrow			1		1						1	1			1
Virginia opossum			1		1				1		1	1			1
Ornate Shrew		1							1				1		1
Salt marsh wandering shrew		1											1		1
Trowbridge's Shrew															1
Yuma myotis				1							1	1	1		1
Western red bat											1	1	1		1
Hoary bat				1							1	1	1		1
Mexican free-tailed bat				1							1	1	1		1
Brush rabbit											1	1			1
Audubon's cottontail											1	1			1
Black-tailed jackrabbit					1							1			1
California ground squirrel					1						1				1
Botta's pocket gopher					1				1		1				1
Western harvest mouse		1							1				1	1	
Salt marsh harvest mouse		1							1				1	1	
Deer mouse				1					1				1		1

Common Name	Batch Pond	Brackish Marsh	Developed	Freshwater Marsh	Landfill	Levee	Managed Pond	Tidal Flats/ Mudflat	Muted Tidal / Diked Marsh	Open Water /Slough Channel	Parks / Upland Grassland	Riparian/Creek Corridor	Saline Marsh	Seasonal Wetland	Upland Vegetation
California vole		1			1				1		1	1	1		1
Common muskrat		1		1						1		1	1		1
Black rat			1		1				1			1			1
Norway rat			1		1				1				1	1	1
House mouse			1		1								1	1	1
Coyote											1	1			1
Red fox												1			1
Gray fox												1			1
Raccoon			1	1	1						1	1	1		1
Long-tailed weasel												1			1
Western spotted skunk												1			1
Striped skunk			1	1	1							1			1
Mountain lion												1			1
Mule Deer											1	1			1
Pacific harbor seal								1		1			1		

Appendix A-3

Pond Species by Season (present=1, not present=0)

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
40050	Pied-billed Grebe	Fall	1	1	1	1	1	1	1	1	1	1
40060	Horned Grebe	Fall	1	1	1	0	1	1	1	1	1	1
40080	Eared Grebe	Fall	1	1	1	1	1	1	1	1	1	1
40090	Western Grebe	Fall	1	1	1	1	1	1	1	1	1	1
40100	Clark's Grebe	Fall	1	1	1	1	1	1	1	1	1	1
40320	American White Pelican	Fall	1	1	1	1	1	1	1	1	1	1
40330	Brown Pelican	Fall	1	1	1	1	1	1	0	1	1	1
40350	Double-crested Cormorant	Fall	1	1	1	1	1	1	1	1	1	1
40400	Great Blue Heron	Fall	1	1	1	1	1	1	1	1	1	1
40410	Great Egret	Fall	1	1	1	1	1	1	1	1	1	1
40420	Snowy Egret	Fall	1	1	1	1	1	1	1	1	1	1
40470	Black-crowned Night-Heron	Fall	1	0	0	0	0	1	0	1	1	1
40500	Turkey Vulture	Fall	1	1	1	1	1	1	1	1	1	1
40571	Canada Goose	Fall	1	1	0	0	0	0	0	1	1	0
40640	Gadwall	Fall	1	1	1	0	1	1	1	1	1	1
40660	Eurasian Wigeon	Fall	1	0	0	0	0	0	0	0	1	0
40670	American Wigeon	Fall	1	1	1	1	0	1	0	1	1	1
40690	Mallard	Fall	1	1	1	1	1	1	1	1	1	1
40700	Blue-winged Teal	Fall	1	0	0	0	0	0	0	1	1	0
40710	Cinnamon Teal	Fall	1	1	0	0	0	0	0	0	1	0
40720	Northern Shoveler	Fall	1	1	1	1	1	1	1	1	1	1
40730	Northern Pintail	Fall	1	1	1	0	1	1	0	1	1	1
40760	American Green-winged Teal	Fall	1	1	0	0	0	0	1	1	1	0
40770	Canvasback	Fall	1	1	1	0	1	1	0	0	1	1
40780	Redhead	Fall	1	1	1	0	0	1	0	1	0	1
40810	Greater scaup	Fall	1	1	1	0	1	1	1	1	1	1
40820	Lesser scaup	Fall	1	1	1	0	1	1	1	1	1	0

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
40860	Surf Scoter	Fall	1	1	1	0	0	0	0	0	0	0
40870	White-winged scoter	Fall	0	0	1	0	0	0	0	0	0	0
40900	Bufflehead	Fall	1	1	1	0	0	9	1	1	1	1
40910	Common Goldeneye	Fall	1	1	1	0	0	1	1	1	1	1
40940	Hooded Merganser	Fall	0	1	0	0	0	0	0	0	0	0
40950	Common Merganser	Fall	0	1	0	0	0	1	0	0	0	1
40960	Red-breasted Merganser	Fall	1	1	1	1	1	1	0	0	1	1
40970	Ruddy Duck	Fall	1	1	1	1	1	1	1	1	1	1
40990	White-tailed Kite	Fall	1	0	0	0	0	0	0	0	0	0
41010	Northern Harrier	Fall	1	0	0	0	1	1	1	2	1	1
41080	Red-tailed Hawk	Fall	1	1	1	1	1	1	1	0	0	1
41130	Merlin	Fall	0	0	0	0	0	0	0	0	0	0
41150	Peregrine Falcon	Fall	1	1	0	1	1	1	1	0	1	1
41350	American Coot	Fall	1	1	1	1	1	1	1	1	1	1
41370	Black-bellied Plover	Fall	1	0	1	1	1	1	1	1	1	1
41420	Semipalmated Plover	Fall	1	0	0	1	0	0	0	1	1	0
41440	Killdeer	Fall	0	0	0	1	0	0	1	1	1	0
41480	Black-necked Stilt	Fall	1	0	0	1	1	1	1	1	1	1
41490	American Avocet	Fall	1	1	1	1	1	1	1	1	1	1
41500	Greater Yellowlegs	Fall	1	1	1	1	1	1	1	1	1	1
41510	Lesser Yellowlegs	Fall	1	0	0	1	1	1	1	1	1	1
41540	Willet	Fall	1	1	1	1	1	1	1	1	1	1
41590	Whimbrel	Fall	1	1	0	0	0	0	1	0	0	0
41610	Long-billed Curlew	Fall	1	1	0	0	0	1	1	0	1	1
41640	Marbled Godwit	Fall	1	1	1	0	1	1	1	1	1	1
41700	Sanderling	Fall	0	0	0	1	0	0	1	0	0	0
41720	Western Sandpiper	Fall	1	1	1	1	1	1	1	1	1	1
41760	Least Sandpiper	Fall	1	1	1	1	1	1	1	1	1	1
41790	Pectoral Sandpiper	Fall	0	0	0	0	0	0	0	1	0	0
41820	Dunlin	Fall	1	0	1	1	0	1	1	1	0	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
41860	Ruff	Fall	0	0	0	0	1	0	0	0	0	0
41870	Short-billed Dowitcher	Fall	1	0	0	0	1	1	1	1	1	1
41880	Long-billed Dowitcher	Fall	1	0	0	0	1	1	1	1	1	0
41910	Red-necked Phalarope	Fall	0	0	0	1	1	1	1	0	0	1
42010	Bonaparte's Gull	Fall	1	1	1	1	1	1	1	1	1	1
42030	Mew Gull	Fall	0	0	1	0	1	0	1	1	0	0
42040	Ring-billed Gull	Fall	1	1	1	1	1	1	1	1	1	1
42050	California Gull	Fall	1	1	1	1	1	1	1	1	1	1
42060	Herring Gull	Fall	1	1	1	1	1	1	1	1	1	1
42070	Thayer's Gull	Fall	0	0	0	0	1	0	0	0	1	0
42100	Western Gull	Fall	1	1	1	1	1	1	1	1	1	1
42110	Glaucous-winged Gull	Fall	0	0	1	0	0	0	0	0	0	0
42180	Caspian Tern	Fall	1	1	1	1	1	1	1	0	1	1
42190	Elegant Tern	Fall	1	1	1	0	1	0	1	1	1	0
42201	Black Skimmer	Fall	0	0	0	0	0	0	0	1	0	0
42220	Forster's Tern	Fall	1	1	1	1	1	1	1	1	1	1
42230	Least Tern	Fall	0	1	0	0	0	0	0	0	0	0
42240	Black Tern	Fall	0	0	1	0	0	0	0	1	0	0
43240	American Crow	Fall	0	0	0	0	0	0	0	0	1	0
43260	Common Raven	Fall	1	1	1	1	1	1	1	1	1	1
40020	Pacific Loon	Winter	0	0	1	0	0	0	0	0	0	0
40050	Pied-billed Grebe	Winter	1	1	1	1	1	1	1	1	1	1
40060	Horned Grebe	Winter	1	1	1	0	1	0	1	1	0	0
40080	Eared Grebe	Winter	1	1	1	1	1	1	1	1	1	1
40090	Western Grebe	Winter	1	1	1	1	1	1	1	1	1	1
40100	Clark's Grebe	Winter	1	1	1	1	1	1	0	1	0	1
40320	American White Pelican	Winter	1	1	1	0	1	1	0	1	1	1
40330	Brown Pelican	Winter	0	1	1	1	1	1	0	1	1	1
40350	Double-crested Cormorant	Winter	1	1	1	1	1	1	1	1	1	1
40400	Great Blue Heron	Winter	1	1	1	1	1	1	1	1	1	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
40410	Great Egret	Winter	1	1	1	1	1	1	1	1	1	1
40420	Snowy Egret	Winter	1	1	1	1	1	1	0	1	1	1
40470	Black-crowned Night-Heron	Winter	1	0	1	0	0	0	0	1	0	0
40500	Turkey Vulture	Winter	1	1	1	1	1	1	1	1	1	1
40550	Snow Goose	Winter	1	0	0	0	0	0	0	0	0	0
40571	Canada Goose	Winter	1	1	1	1	1	1	1	1	1	1
40640	Gadwall	Winter	1	1	1	1	1	1	1	1	1	1
40660	Eurasian Wigeon	Winter	1	1	0	0	0	1	0	1	1	0
40670	American Wigeon	Winter	1	1	1	1	1	1	0	1	1	1
40690	Mallard	Winter	1	1	1	1	0	1	1	1	1	1
40700	Blue-winged Teal	Winter	0	0	0	0	0	0	0	0	1	0
40710	Cinnamon Teal	Winter	1	1	0	0	0	0	0	1	1	0
40720	Northern Shoveler	Winter	1	1	1	1	1	1	1	1	1	1
40730	Northern Pintail	Winter	1	1	1	1	1	1	0	1	1	1
40760	American Green-winged Teal	Winter	1	1	1	0	1	1	0	1	1	1
40770	Canvasback	Winter	1	1	1	1	0	1	0	0	0	1
40780	Redhead	Winter	1	1	1	0	0	1	1	1	1	1
40810	Greater scaup	Winter	1	1	1	1	1	1	1	1	1	1
40820	Lesser scaup	Winter	1	1	1	1	1	1	1	1	1	1
40860	Surf Scoter	Winter	0	1	1	0	0	1	0	1	1	1
40870	White-winged scoter	Winter	0	1	1	0	0	1	0	0	0	1
40900	Bufflehead	Winter	1	1	1	1	1	1	1	1	1	1
40910	Common Goldeneye	Winter	1	1	1	1	1	1	1	1	1	1
40950	Common Merganser	Winter	0	1	0	1	0	1	0	0	0	1
40960	Red-breasted Merganser	Winter	1	1	1	1	1	1	1	1	1	1
40970	Ruddy Duck	Winter	1	1	1	1	1	1	1	1	1	1
40990	White-tailed Kite	Winter	0	0	1	0	0	1	0	0	0	1
41010	Northern Harrier	Winter	1	1	1	0	0	1	2	1	3	1
41080	Red-tailed Hawk	Winter	1	1	1	0	1	1	1	1	1	1
41120	American Kestrel	Winter	0	0	0	0	0	1	0	0	0	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
41130	Merlin	Winter	1	1	0	0	0	0	0	0	0	0
41150	Peregrine Falcon	Winter	0	1	1	1	1	1	1	0	1	1
41350	American Coot	Winter	1	1	1	1	1	1	0	1	1	1
41370	Black-bellied Plover	Winter	1	1	1	1	0	1	1	1	0	1
41420	Semipalmated Plover	Winter	1	0	0	0	0	1	1	1	0	1
41440	Killdeer	Winter	0	0	0	1	0	0	0	1	0	0
41480	Black-necked Stilt	Winter	1	1	0	1	1	1	1	1	1	1
41490	American Avocet	Winter	1	1	1	1	1	1	1	1	1	1
41500	Greater Yellowlegs	Winter	1	0	1	1	1	1	1	1	1	1
41510	Lesser Yellowlegs	Winter	1	1	0	1	0	1	0	1	1	1
41540	Willet	Winter	1	1	1	1	1	1	1	1	1	1
41590	Whimbrel	Winter	1	0	0	0	0	1	1	0	0	1
41610	Long-billed Curlew	Winter	1	0	0	0	0	1	1	1	1	1
41640	Marbled Godwit	Winter	1	1	0	0	0	1	1	1	1	1
41700	Sanderling	Winter	1	0	0	1	1	1	1	1	0	1
41720	Western Sandpiper	Winter	1	1	1	1	1	1	1	1	1	1
41760	Least Sandpiper	Winter	1	1	1	1	1	1	1	1	1	1
41820	Dunlin	Winter	1	0	0	1	1	1	1	1	1	1
41870	Short-billed Dowitcher	Winter	1	0	0	1	0	1	1	1	1	1
41880	Long-billed Dowitcher	Winter	1	0	0	1	0	1	1	1	1	1
41910	Red-necked Phalarope	Winter	0	0	1	0	0	0	0	0	0	0
42010	Bonaparte's Gull	Winter	0	0	1	1	1	1	1	1	1	1
42030	Mew Gull	Winter	0	1	1	1	1	1	1	1	1	1
42040	Ring-billed Gull	Winter	1	1	1	1	1	1	1	1	1	1
42050	California Gull	Winter	1	1	1	1	1	1	1	1	1	1
42060	Herring Gull	Winter	1	1	1	1	1	1	1	1	1	1
42070	Thayer's Gull	Winter	1	0	0	1	1	0	1	1	1	0
42100	Western Gull	Winter	1	1	1	1	1	1	1	1	1	1
42110	Glaucous-winged Gull	Winter	0	1	1	0	1	1	0	1	1	1
42220	Forster's Tern	Winter	1	1	1	1	1	1	1	1	1	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
42230	Least Tern	Winter	1	0	0	0	0	0	0	0	0	0
42710	Belted Kingfisher	Winter	0	0	1	0	0	0	0	0	0	0
43240	American Crow	Winter	1	1	1	0	0	0	1	1	0	0
43260	Common Raven	Winter	1	1	1	1	1	1	1	1	1	1
40030	Common Loon	Spring	0	1	0	0	0	0	0	0	0	0
40050	Pied-billed Grebe	Spring	1	1	1	1	0	1	1	1	1	1
40060	Horned Grebe	Spring	0	1	1	0	0	0	1	0	1	0
40080	Eared Grebe	Spring	1	1	1	1	1	1	1	1	1	1
40090	Western Grebe	Spring	1	1	1	1	1	1	1	1	1	1
40100	Clark's Grebe	Spring	1	1	1	1	1	1	0	1	1	1
40320	American White Pelican	Spring	1	1	1	0	1	1	0	1	1	1
40330	Brown Pelican	Spring	0	1	1	0	0	0	0	1	1	0
40350	Double-crested Cormorant	Spring	1	1	1	1	1	1	1	1	1	1
40400	Great Blue Heron	Spring	1	1	1	1	1	1	0	1	1	1
40410	Great Egret	Spring	1	1	1	1	1	1	1	1	1	1
40420	Snowy Egret	Spring	1	1	1	1	1	1	1	1	1	1
40470	Black-crowned Night-Heron	Spring	1	1	0	0	0	1	0	1	1	1
40500	Turkey Vulture	Spring	1	1	1	0	0	0	0	1	0	0
40571	Canada Goose	Spring	1	1	1	1	1	1	1	1	1	1
40640	Gadwall	Spring	1	1	1	1	1	1	1	1	1	1
40660	Eurasian Wigeon	Spring	0	0	0	0	0	1	0	1	1	1
40670	American Wigeon	Spring	1	1	1	0	1	1	0	1	1	1
40690	Mallard	Spring	1	1	1	1	1	1	1	1	1	1
40710	Cinnamon Teal	Spring	1	0	1	0	0	0	0	1	1	0
40720	Northern Shoveler	Spring	1	1	1	0	1	1	1	1	1	1
40730	Northern Pintail	Spring	1	1	1	0	0	1	0	1	1	1
40760	American Green-winged Teal	Spring	1	1	1	0	0	1	0	0	1	1
40770	Canvasback	Spring	1	1	1	0	0	1	0	1	1	1
40780	Redhead	Spring	1	1	1	1	0	0	0	1	1	0
40810	Greater scaup	Spring	1	1	1	1	1	1	1	1	1	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
40820	Lesser scaup	Spring	1	1	1	1	1	1	1	1	1	1
40860	Surf Scoter	Spring	0	1	1	1	0	0	0	0	1	0
40870	White-winged scoter	Spring	0	1	1	0	0	0	0	0	0	0
40900	Bufflehead	Spring	1	1	1	1	1	1	1	1	1	1
40910	Common Goldeneye	Spring	1	1	1	1	0	1	1	1	1	1
40950	Common Merganser	Spring	1	1	0	0	0	0	0	0	0	0
40960	Red-breasted Merganser	Spring	1	1	1	1	1	1	1	1	1	1
40970	Ruddy Duck	Spring	1	1	1	1	1	1	1	1	1	1
40990	White-tailed Kite	Spring	0	0	0	0	0	0	1	0	0	0
41010	Northern Harrier	Spring	1	1	1	1	0	1	1	1	1	1
41080	Red-tailed Hawk	Spring	0	1	0	0	0	0	1	1	1	0
41150	Peregrine Falcon	Spring	1	1	0	0	1	1	1	0	0	1
41350	American Coot	Spring	1	1	1	1	0	1	0	1	1	1
41370	Black-bellied Plover	Spring	1	0	1	1	1	1	0	1	0	1
41410	Snowy Plover	Spring	0	0	0	0	1	0	0	0	0	1
41420	Semipalmated Plover	Spring	0	0	0	1	0	0	0	0	0	0
41440	Killdeer	Spring	0	0	0	0	0	0	1	1	0	0
41480	Black-necked Stilt	Spring	0	0	0	1	1	0	1	1	1	0
41490	American Avocet	Spring	1	0	0	1	1	1	1	1	1	1
41500	Greater Yellowlegs	Spring	1	0	1	1	1	1	1	0	1	1
41510	Lesser Yellowlegs	Spring	1	0	0	1	1	0	1	0	1	0
41540	Willet	Spring	1	0	0	1	1	1	1	1	1	1
41590	Whimbrel	Spring	1	0	0	0	0	1	0	0	0	1
41610	Long-billed Curlew	Spring	1	0	0	0	0	1	1	0	0	1
41640	Marbled Godwit	Spring	1	0	0	0	0	1	0	0	1	1
41690	Red Knot	Spring	0	0	0	0	0	1	0	0	0	1
41700	Sanderling	Spring	0	0	0	0	1	1	0	0	0	1
41720	Western Sandpiper	Spring	1	1	1	1	1	1	1	1	1	1
41760	Least Sandpiper	Spring	1	1	1	1	1	1	1	1	1	1
41820	Dunlin	Spring	1	1	0	1	1	1	1	1	1	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
41870	Short-billed Dowitcher	Spring	1	0	0	1	1	1	1	1	1	1
41880	Long-billed Dowitcher	Spring	1	0	0	1	1	1	1	1	1	1
41910	Red-necked Phalarope	Spring	1	0	0	1	1	1	1	1	1	1
41980	Franklin's Gull	Spring	0	0	0	0	0	0	0	1	0	0
42010	Bonaparte's Gull	Spring	1	0	1	1	1	1	1	1	1	1
42030	Mew Gull	Spring	1	1	0	1	1	1	1	1	0	1
42040	Ring-billed Gull	Spring	1	1	1	1	1	1	1	1	1	1
42050	California Gull	Spring	1	1	1	1	1	1	1	1	1	1
42060	Herring Gull	Spring	1	1	1	1	1	1	1	1	1	1
42070	Thayer's Gull	Spring	0	1	1	0	1	0	0	1	0	0
42100	Western Gull	Spring	1	1	1	1	1	1	1	1	1	1
42110	Glaucous-winged Gull	Spring	1	0	1	0	1	1	1	1	1	1
42120	Glaucous Gull	Spring	0	0	0	0	0	1	0	0	0	1
42180	Caspian Tern	Spring	1	1	1	1	1	1	0	1	1	1
42201	Black Skimmer	Spring	0	0	0	0	0	0	0	1	0	0
42220	Forster's Tern	Spring	1	1	1	1	1	1	1	1	1	1
42240	Black Tern	Spring	0	0	0	0	0	0	0	0	1	0
43240	American Crow	Spring	1	1	1	1	0	0	1	1	0	0
43260	Common Raven	Spring	1	1	1	1	1	1	1	1	1	1
40050	Pied-billed Grebe	Summer	1	1	1	1	0	1	1	1	1	1
40080	Eared Grebe	Summer	1	1	1	1	1	0	1	1	1	0
40090	Western Grebe	Summer	0	1	1	1	0	1	0	1	0	1
40100	Clark's Grebe	Summer	1	1	1	1	0	1	0	1	1	1
40320	American White Pelican	Summer	1	1	1	1	1	1	1	1	1	1
40330	Brown Pelican	Summer	1	1	1	1	1	1	0	1	1	1
40350	Double-crested Cormorant	Summer	1	1	1	1	1	1	1	1	1	1
40400	Great Blue Heron	Summer	1	1	1	1	1	1	1	1	1	1
40410	Great Egret	Summer	1	1	1	1	1	1	1	1	1	1
40420	Snowy Egret	Summer	1	1	1	1	1	1	1	1	1	1
40430	Little Blue Heron	Summer	0	1	0	0	0	0	0	0	0	0

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
40470	Black-crowned Night-Heron	Summer	1	1	1	0	0	1	1	1	1	1
40500	Turkey Vulture	Summer	1	0	0	0	1	1	0	1	1	1
40571	Canada Goose	Summer	0	0	0	0	0	1	0	1	1	1
40640	Gadwall	Summer	1	1	1	1	1	1	1	1	1	1
40670	American Wigeon	Summer	0	0	0	0	0	0	0	1	1	0
40690	Mallard	Summer	1	1	1	1	0	1	1	1	1	1
40710	Cinnamon Teal	Summer	0	0	0	0	0	0	0	1	1	0
40720	Northern Shoveler	Summer	1	0	0	0	0	1	0	1	1	1
40730	Northern Pintail	Summer	1	0	0	0	0	0	1	1	1	0
40760	American Green-winged Teal	Summer	0	0	0	0	0	0	0	0	1	0
40770	Canvasback	Summer	0	0	1	0	0	0	0	1	0	0
40810	Greater scaup	Summer	1	1	1	0	0	0	0	1	1	0
40820	Lesser scaup	Summer	1	1	1	0	0	0	0	1	1	0
40860	Surf Scoter	Summer	0	1	0	0	0	0	0	0	0	0
40870	White-winged scoter	Summer	0	1	0	0	0	0	0	0	0	0
40900	Bufflehead	Summer	1	0	0	0	0	0	0	0	0	0
40910	Common Goldeneye	Summer	0	0	0	0	0	0	0	0	1	0
40970	Ruddy Duck	Summer	1	1	1	0	0	1	0	1	1	1
41010	Northern Harrier	Summer	1	1	0	1	0	0	0	0	1	0
41150	Peregrine Falcon	Summer	0	1	0	0	0	0	1	0	0	0
41350	American Coot	Summer	1	1	1	0	0	0	0	1	1	0
41370	Black-bellied Plover	Summer	1	0	1	1	1	1	1	0	1	1
41410	Snowy Plover	Summer	0	0	1	1	0	0	0	0	0	0
41420	Semipalmated Plover	Summer	1	0	0	1	0	1	1	1	1	1
41440	Killdeer	Summer	0	0	0	0	1	0	1	1	1	0
41480	Black-necked Stilt	Summer	1	1	1	1	1	1	1	1	1	1
41490	American Avocet	Summer	1	1	1	1	1	1	1	1	1	1
41500	Greater Yellowlegs	Summer	1	1	0	0	0	1	1	1	1	1
41510	Lesser Yellowlegs	Summer	1	1	0	0	0	1	0	1	1	1
41540	Willet	Summer	1	1	1	1	1	1	1	1	1	1

SPPID	Common Name	Season	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18
41590	Whimbrel	Summer	0	0	0	0	0	1	1	1	1	1
41610	Long-billed Curlew	Summer	1	1	1	0	0	1	1	0	1	1
41640	Marbled Godwit	Summer	1	1	1	0	0	1	1	1	1	1
41650	Ruddy Turnstone	Summer	0	0	0	1	0	0	0	0	0	0
41690	Red Knot	Summer	0	0	0	0	1	0	0	0	0	0
41720	Western Sandpiper	Summer	1	1	1	1	1	1	1	1	1	1
41760	Least Sandpiper	Summer	1	1	0	1	1	1	1	1	1	1
41820	Dunlin	Summer	1	0	0	1	1	1	1	0	0	1
41870	Short-billed Dowitcher	Summer	1	0	1	0	1	1	1	1	1	1
41880	Long-billed Dowitcher	Summer	1	0	1	0	1	1	1	1	1	1
41900	Wilson's Phalarope	Summer	0	0	0	1	1	1	1	1	1	1
41910	Red-necked Phalarope	Summer	0	1	1	1	1	1	1	1	1	1
41980	Franklin's Gull	Summer	0	0	0	0	0	0	0	0	0	0
42010	Bonaparte's Gull	Summer	0	1	1	0	0	0	1	1	1	0
42040	Ring-billed Gull	Summer	1	0	0	1	1	1	1	1	1	1
42050	California Gull	Summer	1	1	1	1	1	1	1	1	1	1
42060	Herring Gull	Summer	0	0	0	0	0	1	0	1	1	1
42100	Western Gull	Summer	1	1	1	1	0	1	1	1	1	1
42180	Caspian Tern	Summer	1	1	1	0	1	1	1	1	0	1
42201	Black Skimmer	Summer	0	0	0	0	0	0	0	1	1	0
42220	Forster's Tern	Summer	1	1	1	1	1	1	1	1	1	1
42230	Least Tern	Summer	0	1	0	0	0	0	0	0	0	0
42240	Black Tern	Summer	0	0	1	0	0	0	0	1	0	0
43240	American Crow	Summer	1	0	0	0	1	0	0	0	0	0
43260	Common Raven	Summer	1	1	1	0	1	1	1	1	1	1

Data Source: USGS Western Ecological Research Center and a review by USFWS Refuge staff.

Appendix A-4
Example Species Performing Functions for Select Key Ecological Functions (KEFs)

SppID	Common Name	KEFCode	KEFDescription
40640	Gadwall	1.1.1.2	spermivore (seed-eater)
40670	American Wigeon	1.1.1.2	spermivore (seed-eater)
40690	Mallard	1.1.1.2	spermivore (seed-eater)
40700	Blue-winged Teal	1.1.1.2	spermivore (seed-eater)
40710	Cinnamon Teal	1.1.1.2	spermivore (seed-eater)
40730	Northern Pintail	1.1.1.2	spermivore (seed-eater)
40760	Green-winged Teal	1.1.1.2	spermivore (seed-eater)
41260	Wild Turkey	1.1.1.2	spermivore (seed-eater)
41290	California Quail	1.1.1.2	spermivore (seed-eater)
41330	Sora	1.1.1.2	spermivore (seed-eater)
41360	Sandhill Crane	1.1.1.2	spermivore (seed-eater)
41390	Pacific Golden-Plover	1.1.1.2	spermivore (seed-eater)
41670	Surfbird	1.1.1.2	spermivore (seed-eater)
41690	Red Knot	1.1.1.2	spermivore (seed-eater)
41850	Buff-breasted Sandpiper	1.1.1.2	spermivore (seed-eater)
41860	Ruff	1.1.1.2	spermivore (seed-eater)
41900	Wilson's Phalarope	1.1.1.2	spermivore (seed-eater)
42030	Mew Gull	1.1.1.2	spermivore (seed-eater)
42390	Band-tailed Pigeon	1.1.1.2	spermivore (seed-eater)
42410	Mourning Dove	1.1.1.2	spermivore (seed-eater)
42700	Allen's Hummingbird	1.1.1.2	spermivore (seed-eater)
42730	Acorn Woodpecker	1.1.1.2	spermivore (seed-eater)
42770	Red-breasted Sapsucker	1.1.1.2	spermivore (seed-eater)
42900	Least Flycatcher	1.1.1.2	spermivore (seed-eater)
42940	Pacific-slope Flycatcher	1.1.1.2	spermivore (seed-eater)
43200	Western Scrub-Jay	1.1.1.2	spermivore (seed-eater)

SppID	Common Name	KEFCode	KEFDescription
43240	American Crow	1.1.1.2	spermivore (seed-eater)
43280	Horned Lark	1.1.1.2	spermivore (seed-eater)
43380	Chestnut-backed Chickadee	1.1.1.2	spermivore (seed-eater)
43550	Ruby-crowned Kinglet	1.1.1.2	spermivore (seed-eater)
43670	Varied Thrush	1.1.1.2	spermivore (seed-eater)
43880	Nashville Warbler	1.1.1.2	spermivore (seed-eater)
44270	Spotted Towhee	1.1.1.2	spermivore (seed-eater)
44280	California Towhee	1.1.1.2	spermivore (seed-eater)
44300	Chipping Sparrow	1.1.1.2	spermivore (seed-eater)
44310	Clay-colored Sparrow	1.1.1.2	spermivore (seed-eater)
44320	Brewer's Sparrow	1.1.1.2	spermivore (seed-eater)
44340	Vesper Sparrow	1.1.1.2	spermivore (seed-eater)
44350	Lark Sparrow	1.1.1.2	spermivore (seed-eater)
44370	Sage Sparrow	1.1.1.2	spermivore (seed-eater)
44390	Bryant's savannah sparrow	1.1.1.2	spermivore (seed-eater)
44430	Fox Sparrow	1.1.1.2	spermivore (seed-eater)
44440	Alameda song sparrow	1.1.1.2	spermivore (seed-eater)
44450	Lincoln's Sparrow	1.1.1.2	spermivore (seed-eater)
44460	Swamp Sparrow	1.1.1.2	spermivore (seed-eater)
44470	White-throated Sparrow	1.1.1.2	spermivore (seed-eater)
44490	White-crowned Sparrow	1.1.1.2	spermivore (seed-eater)
44500	Golden-crowned Sparrow	1.1.1.2	spermivore (seed-eater)
44510	Dark-eyed Junco	1.1.1.2	spermivore (seed-eater)
44590	Black-headed Grosbeak	1.1.1.2	spermivore (seed-eater)
44610	Lazuli Bunting	1.1.1.2	spermivore (seed-eater)
44660	Red-winged Blackbird	1.1.1.2	spermivore (seed-eater)
44670	Tricolored Blackbird	1.1.1.2	spermivore (seed-eater)
44680	Western Meadowlark	1.1.1.2	spermivore (seed-eater)
44710	Brewer's Blackbird	1.1.1.2	spermivore (seed-eater)
44740	Brown-headed Cowbird	1.1.1.2	spermivore (seed-eater)

SppID	Common Name	KEFCode	KEFDescription
44870	House Finch	1.1.1.2	spermivore (seed-eater)
44920	Pine Siskin	1.1.1.2	spermivore (seed-eater)
44930	Lesser Goldfinch	1.1.1.2	spermivore (seed-eater)
44950	American Goldfinch	1.1.1.2	spermivore (seed-eater)
50610	California ground squirrel	1.1.1.2	spermivore (seed-eater)
50820	Western harvest mouse	1.1.1.2	spermivore (seed-eater)
50821	Salt marsh harvest mouse	1.1.1.2	spermivore (seed-eater)
50830	Deer mouse	1.1.1.2	spermivore (seed-eater)
50890	Dusky-footed woodrat	1.1.1.2	spermivore (seed-eater)
51220	Raccoon	1.1.1.2	spermivore (seed-eater)
40530	Greater White-fronted Goose	1.1.1.4	grazer (grass, forb eater)
40550	Snow Goose	1.1.1.4	grazer (grass, forb eater)
40570	Canada Goose	1.1.1.4	grazer (grass, forb eater)
40670	American Wigeon	1.1.1.4	grazer (grass, forb eater)
41360	Sandhill Crane	1.1.1.4	grazer (grass, forb eater)
41390	Pacific Golden-Plover	1.1.1.4	grazer (grass, forb eater)
50360	Brush rabbit	1.1.1.4	grazer (grass, forb eater)
50420	Black-tailed jackrabbit	1.1.1.4	grazer (grass, forb eater)
50610	California ground squirrel	1.1.1.4	grazer (grass, forb eater)
50730	Botta's pocket gopher	1.1.1.4	grazer (grass, forb eater)
50890	Dusky-footed woodrat	1.1.1.4	grazer (grass, forb eater)
41260	Wild Turkey	1.1.1.5	frugivore (fruit-eater)
41290	California Quail	1.1.1.5	frugivore (fruit-eater)
41360	Sandhill Crane	1.1.1.5	frugivore (fruit-eater)
41590	Whimbrel	1.1.1.5	frugivore (fruit-eater)
42390	Band-tailed Pigeon	1.1.1.5	frugivore (fruit-eater)
42730	Acorn Woodpecker	1.1.1.5	frugivore (fruit-eater)
42770	Red-breasted Sapsucker	1.1.1.5	frugivore (fruit-eater)
42890	Willow Flycatcher	1.1.1.5	frugivore (fruit-eater)
42900	Least Flycatcher	1.1.1.5	frugivore (fruit-eater)

SppID	Common Name	KEFCode	KEFDescription
42940	Pacific-slope Flycatcher	1.1.1.5	frugivore (fruit-eater)
42980	Say's Phoebe	1.1.1.5	frugivore (fruit-eater)
43000	Ash-throated Flycatcher	1.1.1.5	frugivore (fruit-eater)
43020	Western Kingbird	1.1.1.5	frugivore (fruit-eater)
43120	Cassin's Vireo	1.1.1.5	frugivore (fruit-eater)
43130	Hutton's Vireo	1.1.1.5	frugivore (fruit-eater)
43140	Warbling Vireo	1.1.1.5	frugivore (fruit-eater)
43200	Western Scrub-Jay	1.1.1.5	frugivore (fruit-eater)
43240	American Crow	1.1.1.5	frugivore (fruit-eater)
43260	Common Raven	1.1.1.5	frugivore (fruit-eater)
43380	Chestnut-backed Chickadee	1.1.1.5	frugivore (fruit-eater)
43420	Bushtit	1.1.1.5	frugivore (fruit-eater)
43540	Golden-crowned Kinglet	1.1.1.5	frugivore (fruit-eater)
43550	Ruby-crowned Kinglet	1.1.1.5	frugivore (fruit-eater)
43630	Swainson's Thrush	1.1.1.5	frugivore (fruit-eater)
43640	Hermit Thrush	1.1.1.5	frugivore (fruit-eater)
43660	American Robin	1.1.1.5	frugivore (fruit-eater)
43670	Varied Thrush	1.1.1.5	frugivore (fruit-eater)
43680	Wrentit	1.1.1.5	frugivore (fruit-eater)
43700	Northern Mockingbird	1.1.1.5	frugivore (fruit-eater)
43710	Sage Thrasher	1.1.1.5	frugivore (fruit-eater)
43800	American Pipit	1.1.1.5	frugivore (fruit-eater)
43820	Cedar Waxwing	1.1.1.5	frugivore (fruit-eater)
43870	Orange-crowned Warbler	1.1.1.5	frugivore (fruit-eater)
43970	Yellow-rumped Warbler	1.1.1.5	frugivore (fruit-eater)
44250	Western Tanager	1.1.1.5	frugivore (fruit-eater)
44270	Spotted Towhee	1.1.1.5	frugivore (fruit-eater)
44280	California Towhee	1.1.1.5	frugivore (fruit-eater)
44390	Bryant's savannah sparrow	1.1.1.5	frugivore (fruit-eater)
44430	Fox Sparrow	1.1.1.5	frugivore (fruit-eater)

SppID	Common Name	KEFCode	KEFDescription
44440	Alameda song sparrow	1.1.1.5	frugivore (fruit-eater)
44470	White-throated Sparrow	1.1.1.5	frugivore (fruit-eater)
44490	White-crowned Sparrow	1.1.1.5	frugivore (fruit-eater)
44500	Golden-crowned Sparrow	1.1.1.5	frugivore (fruit-eater)
44590	Black-headed Grosbeak	1.1.1.5	frugivore (fruit-eater)
44710	Brewer's Blackbird	1.1.1.5	frugivore (fruit-eater)
44790	Bullock's Oriole	1.1.1.5	frugivore (fruit-eater)
44870	House Finch	1.1.1.5	frugivore (fruit-eater)
44930	Lesser Goldfinch	1.1.1.5	frugivore (fruit-eater)
44950	American Goldfinch	1.1.1.5	frugivore (fruit-eater)
50820	Western harvest mouse	1.1.1.5	frugivore (fruit-eater)
50821	Salt marsh harvest mouse	1.1.1.5	frugivore (fruit-eater)
50830	Deer mouse	1.1.1.5	frugivore (fruit-eater)
51220	Raccoon	1.1.1.5	frugivore (fruit-eater)
10073	Threespine stickleback	1.1.2.3	ovivorous (egg eater)
10081	Prickly sculpin	1.1.2.3	ovivorous (egg eater)
10221	Pacific staghorn sculpin	1.1.2.3	ovivorous (egg eater)
10237	Shiner perch	1.1.2.3	ovivorous (egg eater)
10238	Tule perch	1.1.2.3	ovivorous (egg eater)
10249	Green sturgeon	1.1.2.3	ovivorous (egg eater)
10405	Brown rockfish	1.1.2.3	ovivorous (egg eater)
10537	English sole	1.1.2.3	ovivorous (egg eater)
10538	California tonguefish	1.1.2.3	ovivorous (egg eater)
10539	Diamond turbot	1.1.2.3	ovivorous (egg eater)
10561	Sand sole	1.1.2.3	ovivorous (egg eater)
10628	Longjawed mudsucker	1.1.2.3	ovivorous (egg eater)
10629	Bay goby	1.1.2.3	ovivorous (egg eater)
10633	Arrow goby	1.1.2.3	ovivorous (egg eater)
10634	Cheekspot goby	1.1.2.3	ovivorous (egg eater)
10637	Speckled sanddab	1.1.2.3	ovivorous (egg eater)

SppID	Common Name	KEFCode	KEFDescription
10641	Pacific herring	1.1.2.3	ovivorous (egg eater)
10648	Barred surfperch	1.1.2.3	ovivorous (egg eater)
10653	Surf Smelt	1.1.2.3	ovivorous (egg eater)
10686	Dwarf surfperch	1.1.2.3	ovivorous (egg eater)
10729	Plainfin midshipman	1.1.2.3	ovivorous (egg eater)
10757	Topsmelt	1.1.2.3	ovivorous (egg eater)
10758	Jack smelt	1.1.2.3	ovivorous (egg eater)
10808	Bat ray	1.1.2.3	ovivorous (egg eater)
10817	Northern anchovy	1.1.2.3	ovivorous (egg eater)
11113	White croaker	1.1.2.3	ovivorous (egg eater)
30100	Southern alligator lizard	1.1.2.3	ovivorous (egg eater)
30290	Gopher snake	1.1.2.3	ovivorous (egg eater)
30350	Western rattlesnakes	1.1.2.3	ovivorous (egg eater)
40470	Black-crowned Night-Heron	1.1.2.3	ovivorous (egg eater)
41000	Bald Eagle	1.1.2.3	ovivorous (egg eater)
41350	American Coot	1.1.2.3	ovivorous (egg eater)
41360	Sandhill Crane	1.1.2.3	ovivorous (egg eater)
41610	Long-billed Curlew	1.1.2.3	ovivorous (egg eater)
41650	Ruddy Turnstone	1.1.2.3	ovivorous (egg eater)
41950	Parasitic Jaeger	1.1.2.3	ovivorous (egg eater)
42020	Heermann's Gull	1.1.2.3	ovivorous (egg eater)
42040	Ring-billed Gull	1.1.2.3	ovivorous (egg eater)
42050	California Gull	1.1.2.3	ovivorous (egg eater)
42060	Herring Gull	1.1.2.3	ovivorous (egg eater)
42070	Thayer's Gull	1.1.2.3	ovivorous (egg eater)
42100	Western Gull	1.1.2.3	ovivorous (egg eater)
42110	Glaucous-winged Gull	1.1.2.3	ovivorous (egg eater)
42120	Glaucous Gull	1.1.2.3	ovivorous (egg eater)
43200	Western Scrub-Jay	1.1.2.3	ovivorous (egg eater)
43240	American Crow	1.1.2.3	ovivorous (egg eater)

SppID	Common Name	KEFCode	KEFDescription
43260	Common Raven	1.1.2.3	ovivorous (egg eater)
50610	California ground squirrel	1.1.2.3	ovivorous (egg eater)
51180	Gray fox	1.1.2.3	ovivorous (egg eater)
51220	Raccoon	1.1.2.3	ovivorous (egg eater)
51300	western spotted skunk	1.1.2.3	ovivorous (egg eater)
51310	Striped skunk	1.1.2.3	ovivorous (egg eater)

Appendix A-5

Shoreline Study Project Without Project Conditions Species List

[343 Fish and Wildlife Species used for Historic Functional Redundancy & Resiliency]

SPP ID	Common Name	Scientific Name	Classification
10001	Pacific lamprey	*Lampetra tridentata*	native
10071	Sacramento sucker	*Catostomus occidentalis occidentalis*	native
10073	Threespine stickleback	*Gasterosteus aculeatus*	native
10081	Prickly sculpin	*Cottus asper*	native
10173	Starry flounder	*Platichthys stellatus*	native
10221	Pacific staghorn sculpin	*Leptocottus armatus*	native
10237	Shiner perch	*Cymatogaster aggregata*	native
10238	Tule perch	*Hysterocarpus traski*	native
10245	Longfin smelt	*Spirinchus thaleichthys*	native
10249	Green sturgeon	*Acipenser medirostris*	native
10295	Steelhead	*Oncorhynchus mykiss*	native
10325	Leopard shark	*Triakis semifasciata*	native
10326	Brown smoothhound	*Mustelus henlei*	native
10329	Soupfin shark	*Galeorhinus galeus*	native
10333	Spiny dogfish	*Squalus acanthias*	native
10337	Big skate	*Raja binoculata*	native
10341	California skate	*Raja inornata*	native
10405	Brown rockfish	*Sebastes auriculatus*	native
10537	English sole	*Parophrys vetulus*	native
10538	California tonguefish	*Symphurus atricaudus*	native
10539	Diamond turbot	*Hypsopsetta guttulata*	native
10545	Pacific sanddab	*Citharichthys sordidus*	native
10561	Sand sole	*Psettichthys melanostictus*	native
10585	Chinook salmon	*Oncorhynchus tshawytscha*	native
10589	Pink salmon	*Oncorhynchus gorbuscha*	native
10593	Chum salmon	*Oncorhynchus keta*	native
10628	Longjawed mudsucker	*Gillichthys mirabilis*	native

SPP ID	Common Name	Scientific Name	Classification
10629	Bay goby	*Lepidogobius lepidus*	native
10633	Arrow goby	*Clevelandia ios*	native
10634	Cheekspot goby	*Ilypnus gilberti*	native
10637	Speckled sanddab	*Citharichthys stigmaeus*	native
10641	Pacific herring	*Clupea pallasii*	native
10648	Barred surfperch	*Amphistichus argenteus*	native
10653	Surf Smelt	*Hypomesus pretiosus*	native
10657	Whitebait smelt	*Allosmerus elongatus*	native
10669	Bay pipefish	*Syngnathus leptorhynchus*	native
10686	Dwarf surfperch	*Micrometrus minimus*	native
10729	Plainfin midshipman	*Porichthys notatus*	native
10757	Topsmelt	*Atherinops affinis*	native
10758	Jack smelt	*Atherinopsis californiensis*	native
10765	Pacific sardine	*Sardinops sagax*	native
10808	Bat ray	*Myliobatis californica*	native
10817	Northern anchovy	*Engraulis mordax*	native
11113	White croaker	*Genyonemus lineatus*	native
11197	California halibut	*Paralichthys californicus*	native
20010	California tiger salamander	*Ambystoma californiense*	native
20210	California slender salamander	*Batrachoseps attenuatus*	native
20217	Arboreal salamander	*Aneides lugubris*	native
20260	Pacific tree frog	*Pseudacris regilla*	native
30030	Western pond turtle	*Clemmys marmorata*	native
30100	Southern alligator lizard	*Elgaria multicarinata*	native
30160	Western fence lizard	*Sceloporus occidentalis*	native
30180	Western skink	*Eumeces skiltonianus*	native
30290	Gopher snake	*Pituophis melanoleuca*	native
30320	Western terrestrial garter snake	*Thamnophis elegans*	native
30340	Common garter snake	*Thamnophis sirtalis*	native
30350	Western rattlesnakes	*Crotalus oreganus*	native

SPP ID	Common Name	Scientific Name	Classification
40010	Red-throated Loon	*Gavia stellata*	native
40020	Pacific Loon	*Gavia pacifica*	native
40030	Common Loon	*Gavia immer*	native
40050	Pied-billed Grebe	*Podilymbus podiceps*	native
40060	Horned Grebe	*Podiceps auritus*	native
40070	Red-necked Grebe	*Podiceps grisegena*	native
40080	Eared Grebe	*Podiceps nigricollis*	native
40090	Western Grebe	*Aechmophorus occidentalis*	native
40100	Clark's Grebe	*Aechmophorus clarkii*	native
40300	Brown Booby	*Sula leucogaster*	native
40320	American White Pelican	*Pelecanus erythrorhynchos*	native
40330	Brown Pelican	*Pelecanus occidentalis*	native
40340	Brandt's Cormorant	*Phalacrocorax penicillatus*	native
40350	Double-crested Cormorant	*Phalacrocorax auritus*	native
40360	Pelagic Cormorant	*Phalacrocorax pelagicus*	native
40370	Magnificent Frigatebird	*Fregata magnificens*	native
40380	American Bittern	*Botaurus lentiginosus*	native
40390	Least Bittern	*Ixobrychus exilis*	native
40400	Great Blue Heron	*Ardea herodias*	native
40410	Great Egret	*Ardea alba*	native
40420	Snowy Egret	*Egretta thula*	native
40430	Little Blue Heron	*Egretta caerulea*	native
40450	Cattle Egret	*Bubulcus ibis*	native
40460	Green Heron	*Butorides virescens*	native
40470	Black-crowned Night-Heron	*Nycticorax nycticorax*	native
40490	White-faced Ibis	*Plegadis chihi*	native
40490	Glossy Ibis	*Plegadis falcinellus*	native
40500	Turkey Vulture	*Cathartes aura*	native
40530	Greater White-fronted Goose	*Anser albifrons*	native
40550	Snow Goose	*Chen hyperborea*	native

SPP ID	Common Name	Scientific Name	Classification
40560	Ross's Goose	*Chen rossii*	native
40570	Canada Goose	*Branta canadensis*	native
40575	Cackling Goose	*Branta hutchinsii*	native
40580	Brant	*Branta bernicla*	native
40610	Tundra Swan	*Cygnus columbianus*	native
40640	Gadwall	*Anas strepera*	native
40660	Eurasian Wigeon	*Anas penelope*	native
40670	American Wigeon	*Anas americana*	native
40690	Mallard	*Anas platyrhynchos*	native
40700	Blue-winged Teal	*Anas discors*	native
40710	Cinnamon Teal	*Anas cyanoptera*	native
40720	Northern Shoveler	*Anas clypeata*	native
40730	Northern Pintail	*Anas acuta*	native
40760	Green-winged Teal	*Anas crecca*	native
40770	Canvasback	*Aythya valisineria*	native
40780	Redhead	*Aythya americana*	native
40790	Ring-necked Duck	*Aythya collaris*	native
40810	Greater Scaup	*Aythya marila*	native
40820	Lesser Scaup	*Aythya affinis*	native
40860	Surf Scoter	*Melanitta perspicillata*	native
40870	White-winged Scoter	*Melanitta fusca*	native
40880	Black Scoter	*Melanitta nigra*	native
40890	Long-tailed Duck	*Clangula hyemalis*	native
40900	Bufflehead	*Bucephala albeola*	native
40910	Common Goldeneye	*Bucephala clangula*	native
40940	Hooded Merganser	*Lophodytes cucullata*	native
40950	Common Merganser	*Mergus merganser*	native
40960	Red-breasted Merganser	*Mergus serrator*	native
40970	Ruddy Duck	*Oxyura jamaicensis*	native
40980	Osprey	*Pandion haliaetus*	native

SPP ID	Common Name	Scientific Name	Classification
40990	White-tailed Kite	*Elanus coeruleus*	native
41000	Bald Eagle	*Haliaeetus leucocephalus*	native
41010	Northern Harrier	*Circus cyaneus*	native
41020	Sharp-shinned Hawk	*Accipiter striatus*	native
41030	Cooper's Hawk	*Accipiter cooperii*	native
41050	Red-shouldered Hawk	*Buteo lineatus*	native
41080	Red-tailed Hawk	*Buteo jamaicensis*	native
41090	Ferruginous Hawk	*Buteo regalis*	native
41100	Rough-legged Hawk	*Buteo lagopus*	native
41110	Golden Eagle	*Aquila chrysaetos*	native
41120	American Kestrel	*Falco sparverius*	native
41130	Merlin	*Falco columbarius*	native
41150	Peregrine Falcon	*Falco peregrinus*	native
41160	Prairie Falcon	*Falco mexicanus*	native
41260	Wild Turkey	*Meleagris gallopavo*	native
41290	California Quail	*Callipepla californica*	native
41311	California Black Rail	*Rallus longirostris obsoletus*	native
41320	Virginia Rail	*Laterallus jamaicensis coturniculus*	native
41321	California Clapper Rail	*Rallus limicola*	native
41330	Sora	*Porzana carolina*	native
41340	Common Moorhen	*Gallinula chloropus*	native
41350	American Coot	*Fulica americana*	native
41360	Sandhill Crane	*Grus canadensis*	native
41370	Black-bellied Plover	*Pluvialis squatarola*	native
41380	American Golden-Plover	*Pluvialis dominica*	native
41390	Pacific Golden-Plover	*Pluvialis fulva*	native
41410	Western Snowy Plover	*Charadrius alexandrinus nivosus*	native
41420	Semipalmated Plover	*Charadrius semipalmata*	native
41440	Killdeer	*Charadrius vociferus*	native
41470	Black Oystercatcher	*Haematopus bachmani*	native

SPP ID	Common Name	Scientific Name	Classification
41480	Black-necked Stilt	*Himantopus mexicanus*	native
41490	American Avocet	*Recurvirostra americana*	native
41500	Greater Yellowlegs	*Tringa melanoleuca*	native
41510	Lesser Yellowlegs	*Tringa flavipes*	native
41530	Solitary Sandpiper	*Tringa solitaria*	native
41540	Willet	*Catoptrophorus semipalmatus*	native
41550	Wandering Tattler	*Heteroscelus incanus*	native
41570	Spotted Sandpiper	*Actitis macularia*	native
41590	Whimbrel	*Numenius phaeopus*	native
41610	Long-billed Curlew	*Numenius americanus*	native
41620	Hudsonian Godwit	*Limosa haemastica*	native
41630	Bar-tailed Godwit	*Limosa lapponica*	native
41640	Marbled Godwit	*Limosa fedoa*	native
41650	Ruddy Turnstone	*Arenaria interpres*	native
41660	Black Turnstone	*Arenaria melanocephala*	native
41670	Surfbird	*Aphriza virgata*	native
41690	Red Knot	*Calidris canutus*	native
41700	Sanderling	*Calidris alba*	native
41710	Semipalmated Sandpiper	*Calidris pusilla*	native
41720	Western Sandpiper	*Calidris mauri*	native
41740	Little Stint	*Calidris minuta*	native
41760	Least Sandpiper	*Calidris minutilla*	native
41780	Baird's Sandpiper	*Calidris bairdii*	native
41790	Pectoral Sandpiper	*Calidris melanotos*	native
41800	Sharp-tailed Sandpiper	*Calidris acuminata*	native
41820	Dunlin	*Calidris alpina*	native
41830	Curlew Sandpiper	*Calidris ferruginea*	native
41840	Stilt Sandpiper	*Calidris himantopus*	native
41850	Buff-breasted Sandpiper	*Tryngites subruficollis*	native
41860	Ruff	*Philomachus pugnax*	native

SPP ID	Common Name	Scientific Name	Classification
41870	Short-billed Dowitcher	*Limnodromus griseus*	native
41880	Long-billed Dowitcher	*Limnodromus scolopaceus*	native
41890	Wilson's Snipe	*Gallinago delicata*	native
41900	Wilson's Phalarope	*Phalaropus tricolor*	native
41910	Red-necked Phalarope	*Phalaropus lobatus*	native
41920	Red Phalarope	*Phalaropus fulicaria*	native
41950	Parasitic Jaeger	*Stercorarius parasiticus*	native
41980	Franklin's Gull	*Larus pipixcan*	native
41990	Little Gull	*Larus minutus*	native
42000	Black-headed Gull	*Larus ridibundus*	native
42010	Bonaparte's Gull	*Larus Philadelphia*	native
42020	Heermann's Gull	*Larus heermanni*	native
42030	Mew Gull	*Larus canus*	native
42040	Ring-billed Gull	*Larus delawarensis*	native
42050	California Gull	*Larus californicus*	native
42060	Herring Gull	*Larus argentatus*	native
42070	Thayer's Gull	*Larus thayeri*	native
42090	Slaty-backed Gull	*Larus schistisagus*	native
42100	Western Gull	*Larus occidentalis*	native
42110	Glaucous-winged Gull	*Larus glaucescens*	native
42120	Glaucous Gull	*Larus hyperboreus*	native
42130	Sabine's Gull	*Xena sabini*	native
42180	Caspian Tern	*Sterna caspia*	native
42190	Elegant Tern	*Sterna elegans*	native
42200	Common Tern	*Sterna hirundo*	native
42201	Black Skimmer	*Rynchops niger*	native
42210	Arctic Tern	*Sterna paradisaea*	native
42220	Forster's Tern	*Sterna forsteri*	native
42230	California Least Tern	*Sterna antillarum browni*	native
42240	Black Tern	*Chlidonias niger*	native

SPP ID	Common Name	Scientific Name	Classification
42250	Common Murre	*Uria aalge*	native
42270	Pigeon Guillemot	*Cepphus columba*	native
42320	Ancient Murrelet	*Synthliboramphus antiquus*	native
42390	Band-tailed Pigeon	*Columba fasciata*	native
42410	Mourning Dove	*Zenaida macroura*	native
42440	Barn Owl	*Tyto alba*	native
42470	Great Horned Owl	*Bubo virginianus*	native
42510	Burrowing Owl	*Athene cunicularia*	native
42560	Short-eared Owl	*Asio flammeus*	native
42620	Vaux's Swift	*Chaetura vauxi*	native
42630	White-throated Swift	*Aeronautes saxatalis*	native
42640	Black-chinned Hummingbird	*Archilochus alexandri*	native
42650	Anna's Hummingbird	*Calypte anna*	native
42690	Rufous Hummingbird	*Selasphorus rufus*	native
42700	Allen's Hummingbird	*Selasphorus sasin*	native
42710	Belted Kingfisher	*Ceryle alcyon*	native
42730	Acorn Woodpecker	*Melanerpes formicivorus*	native
42770	Red-breasted Sapsucker	*Sphyrapicus ruber*	native
42780	Nuttall's Woodpecker	*Picoides nuttallii*	native
42790	Downy Woodpecker	*Picoides pubescens*	native
42840	Northern Flicker	*Colaptes auratus*	native
42870	Western Wood-Pewee	*Contopus sordidulus*	native
42890	Willow Flycatcher	*Empidonax traillii*	native
42900	Least Flycatcher	*Empidonax minimus*	native
42910	Hammond's Flycatcher	*Empidonax hammondii*	native
42930	Dusky Flycatcher	*Empidonax oberholseri*	native
42940	Pacific-slope Flycatcher	*Empidonax difficilis*	native
42960	Black Phoebe	*Sayornis nigricans*	native
42980	Say's Phoebe	*Sayornis saya*	native
43000	Ash-throated Flycatcher	*Myiarchus cinerascens*	native

SPP ID	Common Name	Scientific Name	Classification
43010	Tropical Kingbird	*Tyrannus melancholicus*	native
43020	Western Kingbird	*Tyrannus verticalis*	native
43060	Loggerhead Shrike	*Lanius ludovicianus*	native
43120	Cassin's Vireo	*Vireo cassinii*	native
43130	Hutton's Vireo	*Vireo huttoni*	native
43140	Warbling Vireo	*Vireo gilvus*	native
43200	Western Scrub-Jay	*Aphelocoma californica*	native
43240	American Crow	*Corvus brachyrhynchos*	native
43260	Common Raven	*Corvus corax*	native
43280	Horned Lark	*Eremophila alpestris*	native
43290	Purple Martin	*Progne subis*	native
43300	Tree Swallow	*Tachycineta bicolor*	native
43310	Violet-green Swallow	*Tachycineta thalassina*	native
43320	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	native
43330	Bank Swallow	*Riparia riparia*	native
43340	Cliff Swallow	*Petrochelidon pyrrhonota*	native
43350	Barn Swallow	*Hirundo rustica*	native
43380	Chestnut-backed Chickadee	*Poecile rufescens*	native
43420	Bushtit	*Psaltriparus minimus*	native
43470	Rock Wren	*Salpinctes obsoletus*	native
43490	Bewick's Wren	*Thryomanes bewickii*	native
43500	House Wren	*Troglodytes aedon*	native
43520	Marsh Wren	*Cistothorus palustris*	native
43540	Golden-crowned Kinglet	*Regulus satrapa*	native
43530	American Dipper	*Cinclus mexicanus*	native
43550	Ruby-crowned Kinglet	*Regulus calendula*	native
43560	Blue-gray Gnatcatcher	*Polioptila caerulea*	native
43630	Swainson's Thrush	*Catharus ustulatus*	native
43640	Hermit Thrush	*Catharus guttatus*	native
43660	American Robin	*Turdus migratorius*	native

SPP ID	Common Name	Scientific Name	Classification
43670	Varied Thrush	*Ixoreus naevius*	native
43680	Wrentit	*Chamaea fasciata*	native
43700	Northern Mockingbird	*Mimus polyglottos*	native
43710	Sage Thrasher	*Oreoscoptes montanus*	native
43770	White Wagtail	*Motacilla alba*	native
43800	American Pipit	*Anthus rubescens*	native
43820	Cedar Waxwing	*Bombycilla cedrorum*	native
43870	Orange-crowned Warbler	*Vermivora celata*	native
43880	Nashville Warbler	*Vermivora ruficapilla*	native
43920	Yellow Warbler	*Dendroica petechia*	native
43940	Magnolia Warbler	*Dendroica magnolia*	native
43970	Yellow-rumped Warbler	*Dendroica coronata*	native
44000	Townsend's Warbler	*Dendroica townsendi*	native
44060	Palm Warbler	*Dendroica palmarum*	native
44080	Blackpoll Warbler	*Dendroica striata*	native
44100	American Redstart	*Setophaga ruticilla*	native
44140	Northern Waterthrush	*Seiurus noveboracensis*	native
44180	San Francisco common yellowthroat	*Geothlypis trichas sinuosa*	native
44200	Wilson's Warbler	*Wilsonia pusilla*	native
44220	Yellow-breasted Chat	*Icteria virens*	native
44250	Western Tanager	*Piranga ludoviciana*	native
44270	Spotted Towhee	*Pipilo maculatus*	native
44280	California Towhee	*Pipilo crissalis*	native
44300	Chipping Sparrow	*Spizella passerina*	native
44310	Clay-colored Sparrow	*Spizella pallida*	native
44320	Brewer's Sparrow	*Spizella breweri*	native
44340	Vesper Sparrow	*Pooecetes gramineus*	native
44350	Lark Sparrow	*Chondestes grammacus*	native
44370	Sage Sparrow	*Amphispiza belli*	native

SPP ID	Common Name	Scientific Name	Classification
44390	Bryant's savannah sparrow	*Passerculus sandwichensis alaudinus*	native
44420	Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	native
44430	Fox Sparrow	*Passerella iliaca*	native
44440	Alameda song sparrow	*Melospiza melodia pusillula*	native
44450	Lincoln's Sparrow	*Melospiza lincolnii*	native
44460	Swamp Sparrow	*Melospiza georgiana*	native
44470	White-throated Sparrow	*Zonotrichia leucophrys*	native
44490	White-crowned Sparrow	*Zonotrichia atricapilla*	native
44500	Golden-crowned Sparrow	*Zonotrichia atricapilla*	native
44510	Dark-eyed Junco	*Junco hyemalis*	native
44540	Chestnut-collared Longspur	*Calcarius ornatus*	native
44590	Black-headed Grosbeak	*Pheucticus melanocephalus*	native
44610	Lazuli Bunting	*Passerina amoena*	native
44660	Red-winged Blackbird	*Agelaius phoeniceus*	native
44670	Tricolored Blackbird	*Agelaius tricolor*	native
44680	Western Meadowlark	*Sturnella neglecta*	native
44710	Brewer's Blackbird	*Euphagus cyanocephalus*	native
44740	Brown-headed Cowbird	*Molothrus ater*	native
44760	Hooded Oriole	*Icterus cucullatus*	native
44790	Bullock's Oriole	*Icterus bullockii*	native
44870	House Finch	*Carpodacus mexicanus*	native
44920	Pine Siskin	*Spinus pinus*	native
44930	Lesser Goldfinch	*Carduelis psaltria*	native
44950	American Goldfinch	*Carduelis tristis*	native
50040	Salt marsh wandering shrew	*Sorex vagrans halicoetes*	native
50180	California myotis	*Myotis californicus*	native
50200	Yuma myotis	*Myotis yumanensis*	native
50220	Long-legged myotis	*Myotis volans*	native
50250	Long-eared myotis	*Myotis septentrionalis*	native
50280	Big brown bat	*Eptesicus fuscus*	native

SPP ID	Common Name	Scientific Name	Classification
50285	Western red bat	*Lasirurs blossevillii*	native
50290	Hoary bat	*Lasiurus cinereus*	native
50310	Townsend's big-eared bat	*Corynorhinus townsendii*	native
50320	Northern river otter	*Lontra canadensis*	native
50330	Mexican free-tailed bat	*Tadarida brasiliensis*	native
50360	Brush rabbit	*Sylvilagus bachmani*	native
50381	Desert cottontail	*Sylvilagus audubonii*	native
50420	Black-tailed jackrabbit	*Lepus californicus*	native
50610	California ground squirrel	*Spermophilus beecheyi*	native
50730	Botta's pocket gopher	*Thomomys bottae*	native
50820	Western harvest mouse	*Reithrodontomys megalotis*	native
50821	Salt marsh harvest mouse	*Reithrodontomys raviventris raviventris*	native
50830	Deer mouse	*Peromyscus maniculatus*	native
50890	Dusky-footed woodrat	*Neotoma fuscipes*	native
50990	California vole	*Microtus californicus*	native
51050	Muskrat	*Ondatra zibethicus*	native
51180	Gray fox	*Urocyon cinereoargenteus*	native
51220	Raccoon	*Procyon lotor*	native
51260	Long-tailed weasel	*Mustela frenata*	native
51300	Western spotted skunk	*Spilogale gracilis*	native
51310	Striped skunk	*Mephitis mephitis*	native
51330	Mountain lion	*Felis concolor*	native
60030	California sea lion	Zalophus californianus	native
60040	Pacific harbor seal	*Phoca vitulina richardsi*	native

Appendix A-6

Species Associations with Historic Habitats for Without Project Assessment

[Total species listed 205 used to determine higher habitat value level // 171 species used to determine the lower habitat value level (indicates which species were removed)]

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
10001	Pacific lamprey	1				1		1	1	1	1	
10071	Sacramento sucker					1					1	
10073	Threespine stickleback	1				1		1	1	1	1	
10081	Prickly sculpin	1				1		1	1	1	1	
10173	Starry flounder	1				1			1	1	1	
10221	Pacific staghorn sculpin	1			1	1	1	1	1	1	1	
10237	Shiner perch	1			1	1		1	1	1	1	
10238	Tule perch	1			1	1		1	1	1	1	
10245	Longfin smelt	1				1		1	1	1	1	
10249	Green sturgeon	1						1	1	1	1	
10295	Steelhead	1						1	1	1	1	
10325	Leopard shark	1						1	1	1	1	
10326	Brown smoothhound	1						1	1	1	1	
10329	Soupfin shark								1	1	1	
10333	Spiny dogfish	1						1	1	1	1	
10337	Big skate	1						1	1	1	1	
10341	California skate	1						1	1	1	1	
10405	Brown rockfish	1			1			1	1	1	1	
10537	English sole	1						1	1	1	1	
10538	California tonguefish	1						1	1	1	1	
10539	Diamond turbot	1						1	1	1	1	
10545	Pacific sanddab								1	1	1	

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
10561	Sand sole	1						1	1	1	1	
10585	Chinook salmon	1				1		1	1	1	1	
10589	Pink salmon	1				1		1	1	1	1	
10593	Chum salmon	1				1		1	1	1	1	
10628	Longjawed mudsucker	1				1		1			1	
10629	Bay goby	1						1			1	
10633	Arrow goby	1						1			1	
10634	Cheekspot goby	1						1			1	
10637	Speckled sanddab				1				1	1	1	
10641	Pacific herring				1	1			1	1	1	
10648	Barred surfperch	1			1			1	1	1	1	
10653	Surf Smelt					1			1	1	1	
10657	Whitebait smelt	1						1	1	1	1	
10669	Bay pipefish	1				1		1	1	1	1	
10686	Dwarf surfperch	1			1			1	1	1	1	
10729	Plainfin midshipman	1						1	1	1	1	
10757	Topsmelt	1				1		1	1	1	1	
10758	Jack smelt	1				1		1	1	1	1	
10765	Pacific sardine	1						1	1	1	1	
10808	Bat ray	1				1			1	1	1	
10817	Northern anchovy	1				1		1	1	1	1	
11113	White croaker	1						1	1	1	1	
11197	California halibut	1						1	1	1	1	
30100	Southern alligator lizard											1
30160	Western fence lizard											1
30290	Gopher snake										1	1
30320	Western terrestrial garter snake							1			1	1

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
30340	Common garter snake										1	1
30350	Western rattlesnakes											1
40010	Red-throated Loon	1							1			
40020	Pacific Loon	1							1			
40030	Common Loon	1							1			
40050	Pied-billed Grebe	1			1	1		1	1		1	
40060	Horned Grebe	1				1			1		1	
40070	Red-necked Grebe	1							1			
40080	Eared Grebe	1				1		1	1		1	
40090	Western Grebe	1							1		1	
40100	Clark's Grebe	1							1		1	
40320	American White Pelican			1	1	1			1		1	
40330	Brown Pelican	1			1	1	1		1			
40350	Double-crested Cormorant	1		1		1		1	1	1	1	
40380	American Bittern				1						1	
40390	Least Bittern				1						1	
40400	Great Blue Heron			1	1	1				1	1	1
40410	Great Egret			1	1	1				1	1	
40420	Snowy Egret			1	1	1					1	
40460	Green Heron				1						1	
40470	Black-crowned Night-Heron			1							1	1
40500	Turkey Vulture											1
40530	Greater White-fronted Goose							1			1	
40570	Canada Goose			1	1	1		1			1	
40640	Gadwall				1	1		1			1	
40660	Eurasian Wigeon				1	1		1	1		1	

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
40670	American Wigeon				1	1		1	1		1	
40690	Mallard			1	1	1		1			1	
40700	Blue-winged Teal				1			1			1	
40710	Cinnamon Teal				1			1			1	
40720	Northern Shoveler				1	1		1			1	
40730	Northern Pintail				1	1		1	1		1	
40760	Green-winged Teal				1	1		1	1		1	
40770	Canvasback	1			1	1		1	1	1	1	
40780	Redhead	1			1	1		1	1	1	1	
40790	Ring-necked Duck	1			1	1		1	1	1	1	
40810	Greater Scaup	1			1	1			1	1	1	
40820	Lesser Scaup	1			1	1			1	1	1	
40860	Surf Scoter	1							1	1	1	
40870	White-winged Scoter	1							1	1	1	
40880	Black Scoter	1							1	1	1	
40890	Long-tailed Duck	1							1	1	1	
40900	Bufflehead	1			1	1			1	1	1	
40910	Common Goldeneye	1			1	1			1	1	1	
40920	Barrow's Goldeneye					1					1	
40940	Hooded Merganser				1				1	1	1	
40950	Common Merganser	1			1				1	1	1	
40960	Red-breasted Merganser				1						1	
40970	Ruddy Duck	1			1	1			1	1	1	
40980	Osprey	1							1	1	1	
40990	White-tailed Kite										1	
41000	Bald Eagle	1		1	1		1				1	1
41010	Northern Harrier					1					1	
41030	Cooper's Hawk										1	1

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
41050	Red-shouldered Hawk										1	1
41080	Red-tailed Hawk										1	1
41090	Ferruginous Hawk										1	1
41110	Golden Eagle										1	1
41120	American Kestrel										1	
41130	Merlin										1	
41150	Peregrine Falcon				1		1	1			1	1
41311	California Black Rail										1	
41320	Virginia Rail										1	
41321	California Clapper Rail										1	
41330	Sora				1						1	
41340	Common Moorhen				1						1	
41350	American Coot				1	1		1		1	1	
41370	Black-bellied Plover				1	1	1		1	1		
41380	American Golden-Plover		1		1	1	1		1	1		
41390	Pacific Golden-Plover		1		1	1	1		1	1		
41410	Western Snowy Plover				1	1	1		1	1		
41420	Semipalmated Plover		1	1	1	1	1		1	1		
41440	Killdeer		1	1	1	1	1		1	1	1	
41470	Black Oystercatcher					1	1		1	1		
41480	Black-necked Stilt			1	1	1			1	1	1	
41490	American Avocet			1	1	1			1	1	1	
41500	Greater Yellowlegs		1	1	1	1			1	1	1	
41510	Lesser Yellowlegs		1	1	1	1			1	1	1	
41540	Willet			1	1	1	1		1	1	1	
41550	Wandering Tattler					1	1		1	1		
41570	Spotted Sandpiper			1	1	1			1	1	1	
41590	Whimbrel				1	1			1	1	1	

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
41610	Long-billed Curlew			1		1	1		1	1	1	
41640	Marbled Godwit				1	1	1		1	1	1	
41650	Ruddy Turnstone		1		1	1	1		1	1	1	
41660	Black Turnstone				1	1	1		1	1	1	
41670	Surfbird					1			1	1	1	
41690	Red Knot				1	1	1		1	1	1	
41700	Sanderling		1			1	1		1	1	1	
41710	Semipalmated Sandpiper			1	1	1	1		1	1		
41720	Western Sandpiper			1	1	1	1		1	1	1	
41760	Least Sandpiper		1		1	1	1		1	1	1	
41780	Baird's Sandpiper		1	1	1	1	1		1	1	1	
41790	Pectoral Sandpiper			1	1	1			1	1	1	
41800	Sharp-tailed Sandpiper			1	1	1			1	1		
41820	Dunlin			1	1	1	1		1	1	1	
41840	Stilt Sandpiper			1		1			1	1		
41850	Buff-breasted Sandpiper					1	1		1	1		
41860	Ruff				1	1			1	1		
41870	Short-billed Dowitcher			1	1	1	1		1	1	1	
41880	Long-billed Dowitcher			1	1	1	1		1	1	1	
41890	Wilson's Snipe			1					1		1	
41900	Wilson's Phalarope	1		1		1		1				
41910	Red-necked Phalarope			1	1	1		1			1	
41980	Franklin's Gull			1			1					
42010	Bonaparte's Gull	1	1	1	1		1	1	1	1	1	1
42020	Heermann's Gull		1		1		1		1	1		
42030	Mew Gull	1		1	1		1	1			1	1
42040	Ring-billed Gull	1		1	1		1	1			1	1
42050	California Gull	1		1	1		1	1			1	1

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
42060	Herring Gull	1		1	1		1	1			1	1
42070	Thayer's Gull	1	1	1	1		1	1			1	1
42100	Western Gull	1	1	1	1		1	1	1	1	1	1
42110	Glaucous-winged Gull	1	1	1	1		1	1	1	1	1	1
42120	Glaucous Gull		1	1	1		1		1	1	1	1
42180	Caspian Tern	1		1	1		1	1	1	1	1	
42190	Elegant Tern						1					
42200	Common Tern	1						1			1	
42210	Arctic Tern						1					
42220	Forster's Tern			1	1			1	1	1	1	
42230	California Least Tern								1	1		
42390	Band-tailed Pigeon						1				1	
42410	Mourning Dove										1	1
42440	Barn Owl					1					1	
42560	Short-eared Owl		1								1	
42710	Belted Kingfisher				1						1	
43200	Western Scrub-Jay										1	1
43280	Horned Lark		1				1					
43300	Tree Swallow										1	
43310	Violet-Green Swallow										1	
43320	Northern Rough-winged Swallow										1	
43350	Barn Swallow		1		1						1	
43520	Marsh Wren										1	
43700	Northern Mockingbird											1
43800	American Pipit										1	
44180	San Francisco common yellowthroat					1					1	

Spp ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Island	Lagoon	Salt Pond	Sandy Beach	Shallow Bay / Channel (intertidal)	Shellflat	Tidal Flat	Tidal Marsh	Shell Mounds
44390	Savannah Sparrow										1	
44440	Alameda song sparrow										1	
44490	White-crowned Sparrow										1	
44660	Red-winged Blackbird										1	
44680	Western Meadowlark										1	
44710	Brewer's Blackbird											1
50040	Salt marsh wandering shrew										1	
50200	Yuma myotis				1	1		1			1	
50285	Western red bat				1	1						
50290	Hoary Bat					1					1	
50820	Western harvest mouse										1	
50821	Salt marsh harvest mouse										1	
50830	Deer mouse										1	1
50990	California vole										1	1
51050	Muskrat					1					1	
51220	Raccoon		1	1		1	1				1	1
51260	Long-tailed weasel					1					1	
51310	Striped skunk					1					1	1
60030	California sea Lion	1						1				
60040	Pacific harbor seal	1					1	1		1	1	

Appendix A-7

Species Associations with Modern Habitats for Without Project Assessment [240 species]

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
10001	Pacific lamprey	1				1				
10071	Sacramento sucker									
10073	Threespine stickleback	1			1	1	1	1		
10081	Prickly sculpin	1			1	1	1	1		
10121	Striped bass	1			1	1	1	1		
10149	Common carp				1					
10173	Starry flounder	1						1		
10177	Goldfish				1					
10189	Western mosquito fish				1					
10221	Pacific staghorn sculpin	1		1	1	1	1	1		
10233	American shad	1				1	1			
10234	Threadfin shad	1				1	1			
10237	Shiner perch	1		1	1	1	1	1		
10238	Tule perch	1		1		1	1	1		
10245	Longfin smelt	1				1	1			
10249	Green sturgeon	1				1				
10295	Steelhead	1				1				
10325	Leopard shark	1			1	1	1	1		
10326	Brown smoothhound	1			1	1				
10329	Soupfin shark	1								
10333	Spiny dogfish	1				1				
10337	Big skate	1				1				
10341	California skate	1				1				
10361	Cabezon	1				1				
10405	Brown rockfish	1		1		1	1			

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
10537	English sole	1				1		1		
10538	California tonguefish	1				1				
10539	Diamond turbot	1			1	1				
10545	Pacific sanddab	1								
10561	Sand sole	1				1				
10585	Chinook salmon	1				1		1		
10589	Pink salmon	1				1				
10593	Chum salmon	1				1				
10628	Longjawed mudsucker				1	1	1	1		
10629	Bay goby					1	1			
10633	Arrow goby					1	1	1		
10634	Cheekspot goby					1				
10637	Speckled sanddab	1		1	1					
10641	Pacific herring	1		1			1	1		
10648	Barred surfperch	1		1	1	1	1	1		
10653	Surf Smelt	1								
10657	Whitebait smelt	1				1				
10669	Bay pipefish	1			1	1		1		
10686	Dwarf surfperch	1		1		1				
10729	Plainfin midshipman	1				1	1			
10757	Topsmelt	1			1	1	1	1		
10758	Jack smelt	1				1	1	1		
10765	Pacific sardine	1				1				
10808	Bat ray	1			1		1	1		
10817	Northern anchovy	1			1	1	1	1		
11113	White croaker	1				1				
11197	California halibut	1				1				
30100	Southern alligator lizard									1

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
30160	Western fence lizard							1		1
30290	Gopher snake									1
30320	Western terrestrial garter snake							1		1
30340	Common garter snake									1
40010	Red-throated Loon	1								
40020	Pacific Loon	1								
40030	Common Loon	1								
40050	Pied-billed Grebe	1		1	1			1		
40060	Horned Grebe	1			1			1		
40080	Eared Grebe	1			1			1		
40090	Western Grebe	1			1			1		
40100	Clark's Grebe	1			1			1		
40320	American White Pelican	1		1	1			1		
40330	Brown Pelican	1		1	1					
40350	Double-crested Cormorant	1			1			1		
40380	American Bittern					1		1		
40390	Least Bittern					1		1		
40400	Great Blue Heron			1	1	1	1	1		1
40410	Great Egret			1	1	1	1	1		1
40420	Snowy Egret				1	1	1	1		1
40450	Cattle Egret							1		1
40460	Green Heron			1				1		
40470	Black-crowned Night-Heron							1	1	1
40500	Turkey Vulture									1
40530	Greater White-fronted Goose					1		1		1
40570	Canada Goose			1	1	1		1	1	1

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
40640	Gadwall			1	1	1		1		1
40660	Eurasian Wigeon			1	1	1		1		
40670	American Wigeon			1	1	1		1		1
40690	Mallard			1	1	1		1		1
40700	Blue-winged Teal			1		1		1		1
40710	Cinnamon Teal			1		1		1		
40720	Northern Shoveler			1	1	1		1		
40730	Northern Pintail			1	1	1		1		
40760	Green-winged Teal			1	1	1		1		
40770	Canvasback	1		1	1	1		1		
40780	Redhead	1		1	1			1		
40790	Ring-necked Duck	1			1			1		
40810	Greater Scaup	1			1					
40820	Lesser Scaup	1		1	1					
40860	Surf Scoter	1			1					
40870	White-winged Scoter	1			1					
40880	Black Scoter	1			1					
40890	Long-tailed Duck	1			1					
40900	Bufflehead	1		1	1					
40910	Common Goldeneye	1		1	1					
40920	Barrow's Goldeneye	1			1					
40940	Hooded Merganser	1		1	1			1		
40950	Common Merganser	1		1	1			1		
40970	Ruddy Duck	1		1	1			1		
40980	Osprey	1						1		
40990	White-tailed Kite							1		
41010	Northern Harrier				1			1		1
41020	Sharp-shinned Hawk								1	

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
41030	Cooper's Hawk								1	
41050	Red-shouldered Hawk									1
41080	Red-tailed Hawk									1
41090	Ferruginous Hawk									1
41110	Golden Eagle									1
41120	American Kestrel									1
41130	Merlin									1
41150	Peregrine Falcon			1	1	1		1	1	1
41190	Ring-necked Pheasant									1
41290	California Quail									1
41311	California Black Rail							1		
41320	Virginia Rail							1		
41321	California Clapper rail							1		
41330	Sora			1				1		
41340	Common Moorhen			1				1		
41350	American Coot			1	1	1	1	1		
41370	Black-bellied Plover			1	1		1	1		
41380	American Golden-Plover		1	1	1		1	1		
41410	Western Snowy Plover			1	1		1	1		
41420	Semipalmated Plover		1	1	1		1	1		
41440	Killdeer			1	1		1	1	1	1
41480	Black-necked Stilt			1	1		1	1		
41490	American Avocet			1	1		1	1		
41500	Greater Yellowlegs		1	1	1		1	1		
41510	Lesser Yellowlegs		1	1	1		1	1		
41540	Willet			1	1		1	1		
41570	Spotted Sandpiper			1			1	1		
41590	Whimbrel			1	1		1			

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
41610	Long-billed Curlew			1	1		1	1		1
41640	Marbled Godwit			1	1		1	1		
41650	Ruddy Turnstone		1	1	1		1	1		
41700	Sanderling		1		1		1			
41710	Semipalmated Sandpiper			1	1		1			
41720	Western Sandpiper			1	1		1	1		
41760	Least Sandpiper		1	1	1		1	1		
41820	Dunlin			1	1		1	1		
41860	Ruff						1	1		
41870	Short-billed Dowitcher			1	1		1	1		
41880	Long-billed Dowitcher			1	1		1	1		
41900	Wilson's Phalarope	1			1	1				
41910	Red-necked Phalarope	1			1	1				
42010	Bonaparte's Gull	1	1	1	1			1		
42020	Heermann's Gull	1	1	1	1			1		
42030	Mew Gull			1	1			1		
42040	Ring-billed Gull			1	1	1		1	1	
42050	California Gull			1	1	1		1	1	
42060	Herring Gull			1	1	1		1		
42070	Thayer's Gull		1	1	1	1		1		
42100	Western Gull	1	1	1	1	1		1	1	
42110	Glaucous-winged Gull	1	1	1	1			1		
42120	Glaucous Gull	1	1	1	1			1		
42130	Sabine's Gull				1			1		
42180	Caspian Tern	1			1	1		1		
42201	Black Skimmer	1			1					
42220	Forster's Tern	1		1	1	1		1		
42230	California Least Tern	1			1	1				

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
42380	Rock Pigeon								1	1
42390	Band-tailed Pigeon								1	
42410	Mourning Dove								1	1
42440	Barn Owl				1			1		1
42470	Great Horned Owl				1			1		1
42510	Burrowing Owl				1			1		
42560	Short-eared Owl							1		1
42650	Anna's Hummingbird								1	
42700	Allen's Hummingbird								1	
42710	Belted Kingfisher							1		
42840	Northern Flicker								1	
42960	Black Phoebe							1	1	
43060	Loggerhead Shrike									1
43200	Western Scrub-Jay								1	
43240	American Crow								1	1
43260	Common Raven								1	1
43280	Horned Lark		1							1
43300	Tree Swallow							1		
43310	Violet-green Swallow							1		
43320	Northern Rough-winged Swallow							1		
43330	Bank Swallow							1		
43340	Cliff Swallow							1		
43350	Barn Swallow		1	1				1		1
43380	Chestnut-backed Chickadee								1	
43420	Bushtit								1	
43490	Bewick's Wren							1		
43500	House Wren								1	

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
43520	Marsh Wren							1		
43550	Ruby-crowned Kinglet								1	
43660	American Robin								1	1
43700	Northern Mockingbird								1	
43740	European Starling								1	1
43820	Cedar Waxwing								1	
43970	Yellow-rumped Warbler								1	
44000	Townsend's Warbler								1	
44180	San Francisco common yellowthroat							1		
44270	Spotted Towhee								1	
44280	California Towhee							1	1	
44390	Bryant's savannah sparrow							1		1
44440	Alameda song sparrow							1		
44490	White-crowned Sparrow							1	1	
44500	Golden-crowned Sparrow							1	1	
44510	Dark-eyed Junco								1	
44660	Red-winged Blackbird							1		1
44670	Tricolored Blackbird							1		1
44680	Western Meadowlark							1		1
44710	Brewer's Blackbird								1	1
44740	Brown-headed Cowbird									1
44790	Bullock's Oriole								1	
44870	House Finch								1	1
44970	House Sparrow								1	1
50010	Virginia opossum				1			1	1	1
50035	Ornate Shrew							1		
50040	Salt marsh wandering shrew							1		

SPP ID	Common Name	Deep Bay / Channel (subtidal)	Dune	Lagoon	Salt Pond	Shallow Bay / Channel (intertidal)	Tidal Flat	Tidal Marsh	Developed	Agriculture
50110	Trowbridge's Shrew							1		
50200	Yuma myotis			1	1					
50285	Western red bat			1	1					1
50290	Hoary bat				1					
50330	Mexican free-tailed bat				1					
50420	Black-tailed jackrabbit				1					
50610	California ground squirrel				1					1
50730	Botta's pocket gopher									1
50820	Western harvest mouse							1		1
50821	Salt marsh harvest mouse							1		
50830	Deer mouse									1
50990	California vole							1		1
51050	Common muskrat				1			1		
51070	Black rat								1	
51080	Norway rat				1			1	1	1
51090	House mouse							1	1	1
51160	Red fox				1			1		1
51180	Gray fox				1			1		1
51220	Raccoon		1		1			1	1	1
51260	Long-tailed weasel				1					
51310	Striped skunk				1			1	1	1
60040	Pacific harbor seal	1				1	1	1		

Relationship Matrix Descriptions

MATRIX 1: Potential Species by Function Matrix

The potential species list generated by IBIS (see Appendix A) is aligned with Key Ecological Functions (KEFs) that could potentially be performed in the habitat type and structural condition represented by the polygon. For example, if the polygon represents a "shrub-steppe" habitat type, the KEFs thought to be performed in that habitat type by the potential species are included in the relationship matrix. This information is generated from IBIS. The result of this matrix is the number of potential species performing key functions in that habitat type. Example follows:

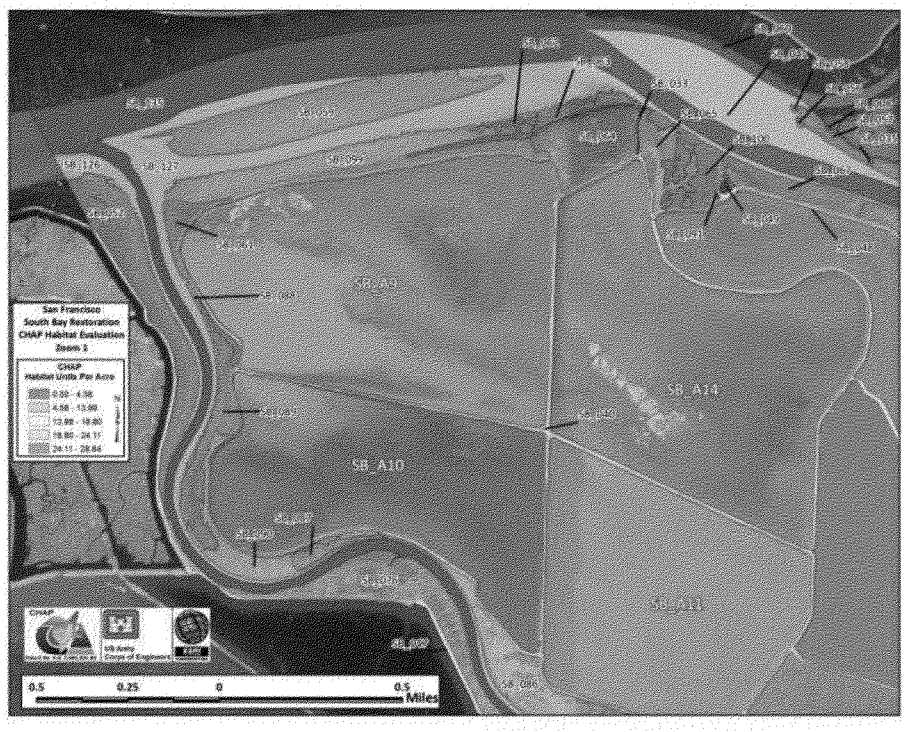
Lowland Mixed Conifer Habitat Type *Species Value (Potential)*	**Function 1** ***Secondary Consumer***	**Function 2** ***Breaks up Down Wood***	**Function 3** ***Primary Excavator***	**Function 4** ***Eats Terrestrial Insects***
Downey Woodpecker	**0**	**1**	**1 (tree)**	**1**
Bobcat	**1**	**0**	**0**	**0**
Belted Kingfisher	**1**	**0**	**1 (burrows)**	**1**
Great Blue Heron	**1**	**0**	**0**	**1**

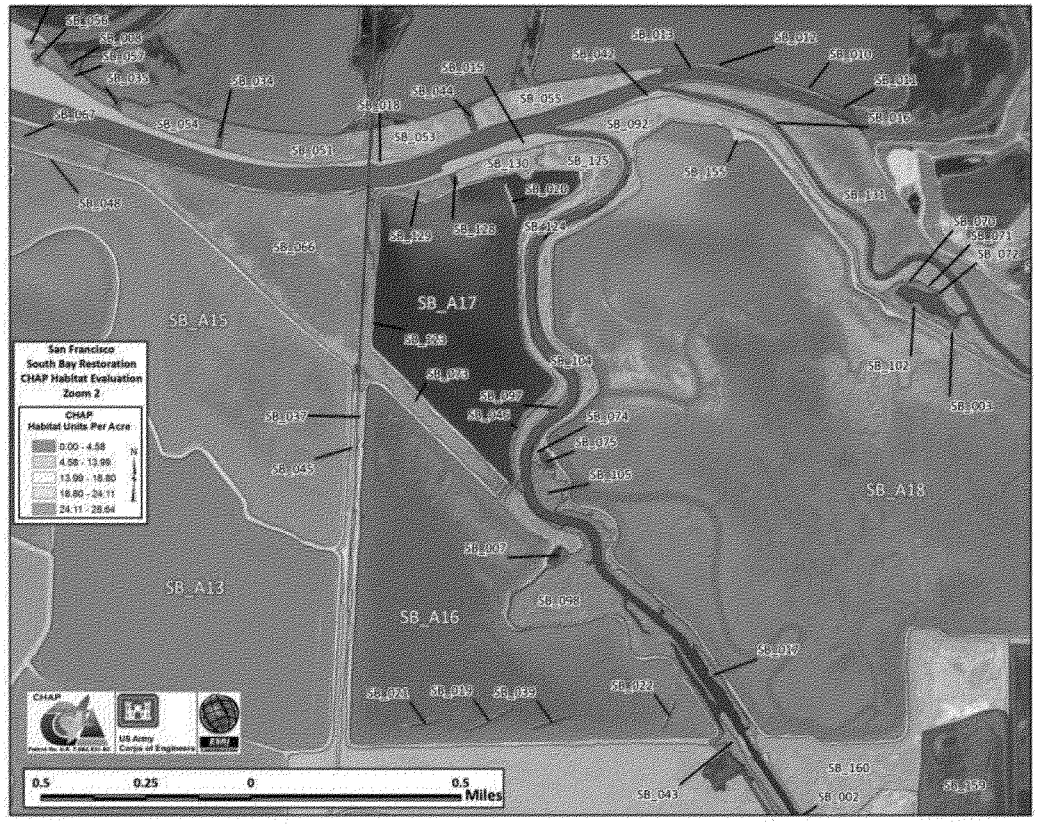
MATRIX 2: Actual KEC by Function Matrix

In this matrix, the functions, or KEFs, are again related to Key Environmental Correlates (KECs), but this time the KECs are actually present at the site (based on field data inventory). Because this is an actual account, those KEFs not correlated to an actual KEC are then removed. The result of this matrix is the number of KEFs characterized by KECs specific to that polygon. Example follows:

Lowland Mixed Conifer Habitat Type *KEC Value (Potential)*	**Function 1** ***Creates Snags***	**Function 2** ***Breaks up Down Wood***	**Function 3** ***Primary Excavator***	**Function 4** ***Eats Terrestrial Insects***	**Function 5** ***Eats Aquatic MacroInvertebrates***
KEC 1 down wood	**0**	**1**	**0**	**1**	**0**
KEC 2 snags	**1**	**0**	**1**	**1**	**0**
KEC 3 tree cavities	**1**	**1**	**1**	**1**	**0**
KEC 4 intertidal	**0**	**0**	**0**	**1**	**1**
KEC 5 Aquatic substrate cobble	**0**	**0**	**0**	**0**	**1**

Appendix C
Zoom-in maps of corrected per-acre values by polygon




San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 2
CHAP
Habitat Units Per Acre
0.00 - 4.58
4.58 - 13.99
13.99 - 18.80
18.80 - 24.11
24.11 - 28.64
SB_A15
SB_A17
SB_A18
SB_A13
SB_A16
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0.25
0
0.5
Miles

0.5
0.25
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Miles
SB_070
SB_071
SB_072
SB_014
SB_093
SB_069
SB_101
SB_094
SB_030
SB_096
SB_026
SB_025
SB_056
SB_147
SB_102
SB_032
SB_141
SB_003
SB_095
SB_068
SB_103
SB_029
SB_027
SB_A18
SB_164
SB_028
SB_017
SB_143
SB_160
SB_161
SB_159
SB_002
SB_005
SB_156
SB_163
SB_148
SB_162
SB_149
SB_158
SB_145
San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 3
CHAP
Habitat Units Per Acre
0.00 - 4.58
4.58 - 13.99
13.99 - 18.80
18.80 - 24.11
24.11 - 28.64
N
CHAP
US Army
Corps of Engineers

SB_A16
SB_017
SB_021
SB_019
SB_039
SB_022
SB_143
SB_160
SB_161
SB_159
SB_043
SB_002
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SB_078
SB_114
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SB_082
SB_140
SB_109
SB_113
SB_112
SB_111
SB_107
SB_106
SB_124
SB_110
0.5
0.25
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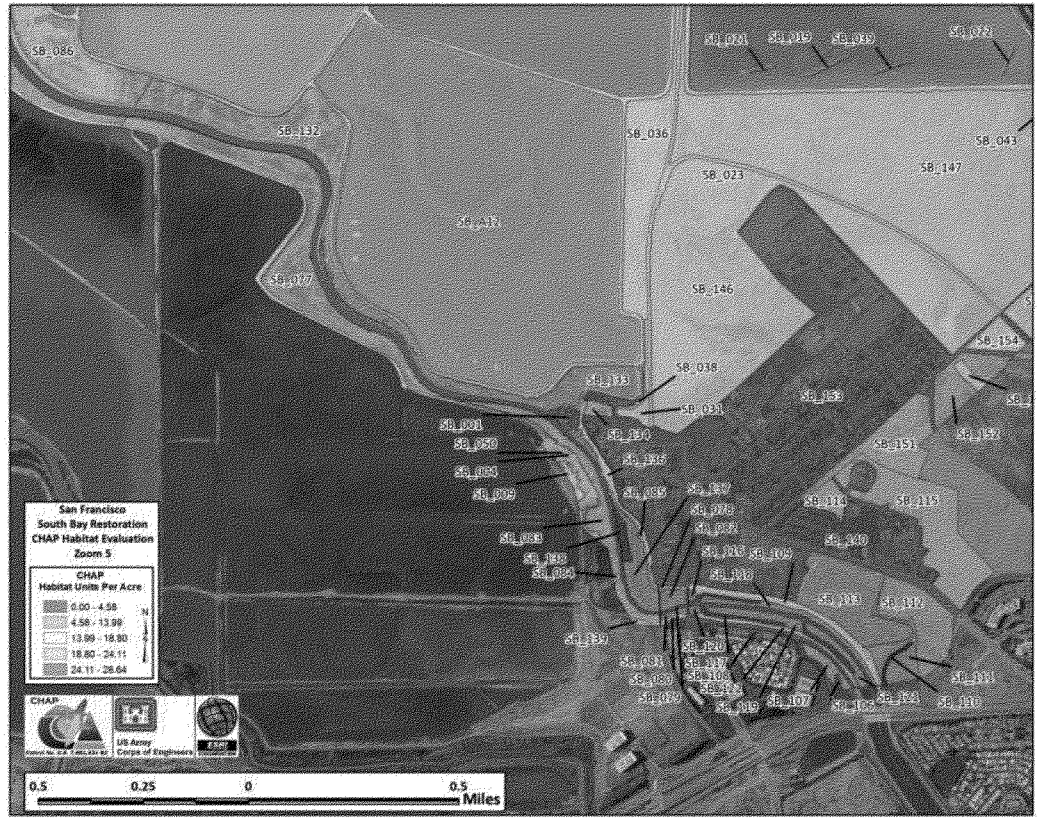
Miles
San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 4
CHAP
Habitat Units Per Acre
0.00 - 4.58
4.58 - 13.99
13.99 - 18.80
18.80 - 24.11
24.11 - 28.64
CHAP
US Army
Corps of Engineers


San Francisco
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CHAP Habitat Evaluation
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13.99 - 18.80
18.80 - 24.11
24.11 - 28.64
N
CHAP
US Army
Corps of Engineers
0.5
0.25
0
0.5
Miles
SB_086
SB_132
SB_036
SB_023
SB_147
SB_043
SB_146
SB_154
SB_038
SB_031
SB_133
SB_001
SB_050
SB_004
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SB_120
SB_117
SB_108
SB_119
SB_077
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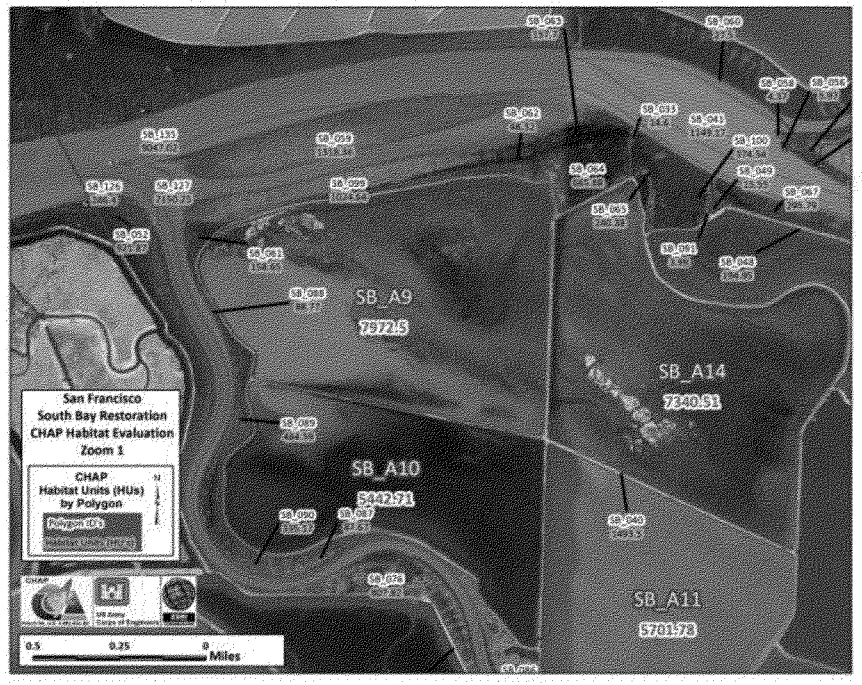
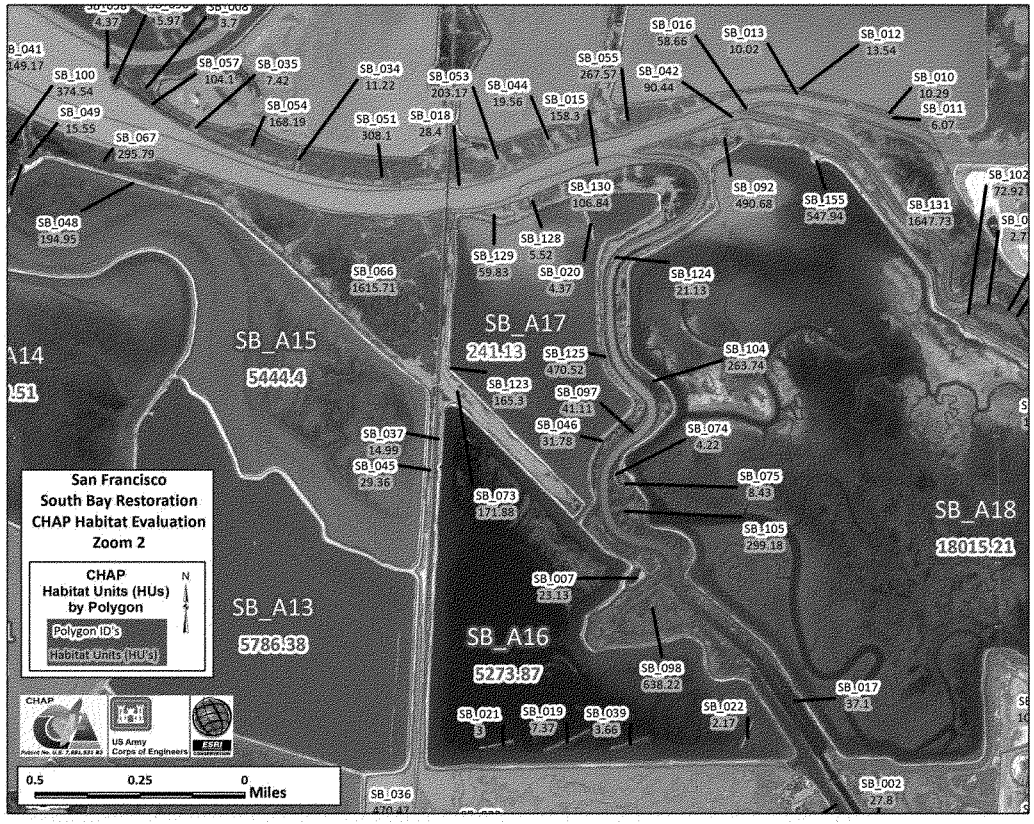
SB_082
SB_016
SB_019
SB_039
SB_022

Appendix D
Zoom-in maps of habitat unit values by polygon




San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 2
CHAP
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by Polygon
Polygon ID's
Habitat Units (HU's)
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CHAP
US Army
Corps of Engineers
ESRI
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0.25
0
Miles
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SB_A13
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SB_A16
5273.87
SB_A17
241.13
SB_A18
18015.21
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SB_049
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SB_048
194.95
SB_067
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SB_057
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SB_035
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SB_034
11.22
SB_051
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SB_018
28.4
SB_053
203.17
SB_044
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SB_015
158.3
SB_055
267.57
SB_042
90.44
SB_016
58.66
SB_013
10.02
SB_012
13.54
SB_010
10.29
SB_011
6.07
SB_092
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SB_155
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SB_131
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SB_130
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SB_128
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SB_129
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SB_020
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SB_124
21.13
SB_066
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SB_123
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SB_074
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SB_075
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SB_073
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299.18
SB_007
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SB_098
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SB_017
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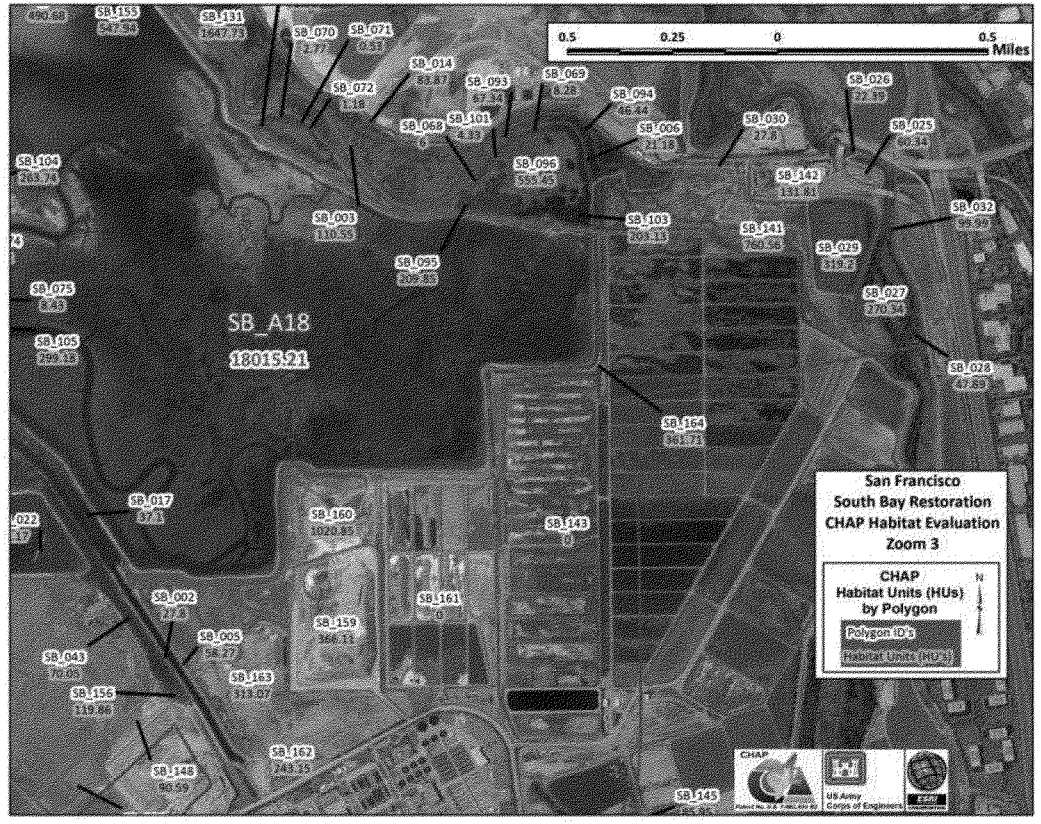
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Miles
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San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 3
CHAP
Habitat Units (HUs)
by Polygon
Polygon ID's
Habitat Units (HU's)
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SB_155
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SB_131
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SB_070
SB_071
SB_014
SB_093
SB_069
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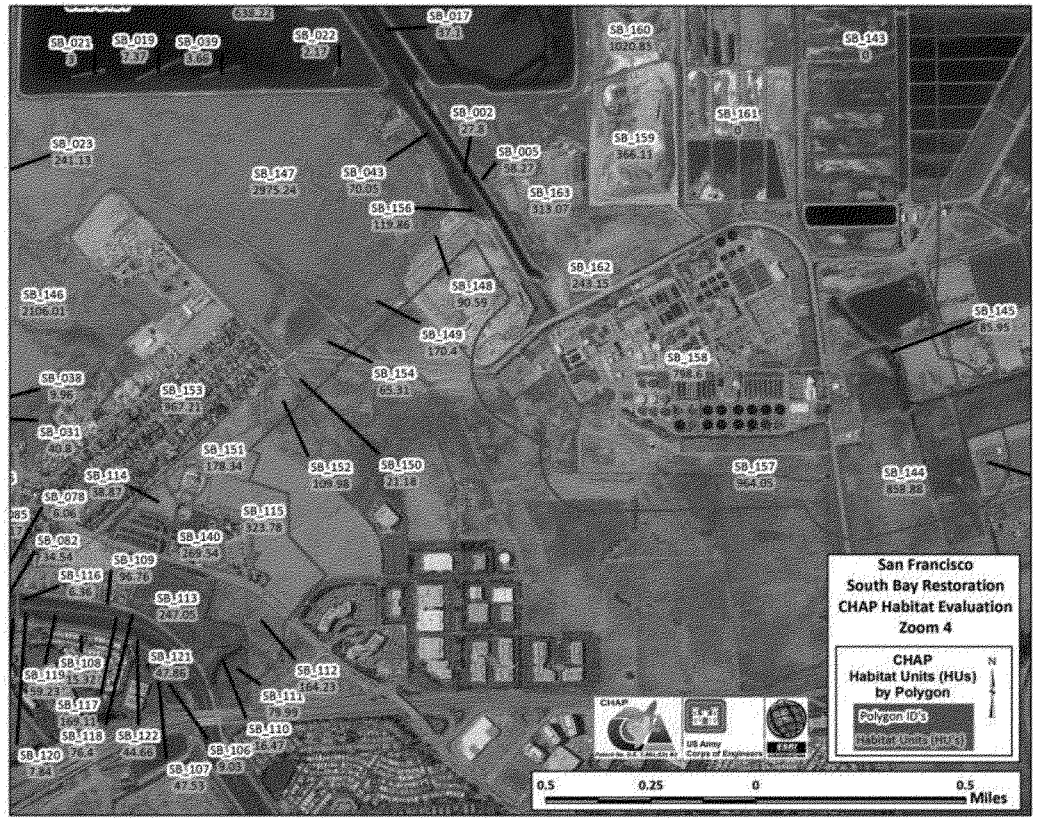
US Army
Corps of Engineers
ESRI


San Francisco
South Bay Restoration
CHAP Habitat Evaluation
Zoom 4
CHAP
Habitat Units (HUs)
by Polygon
Polygon ID's
Habitat Units (HUs)
N
US Army
Corps of Engineers
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0.25
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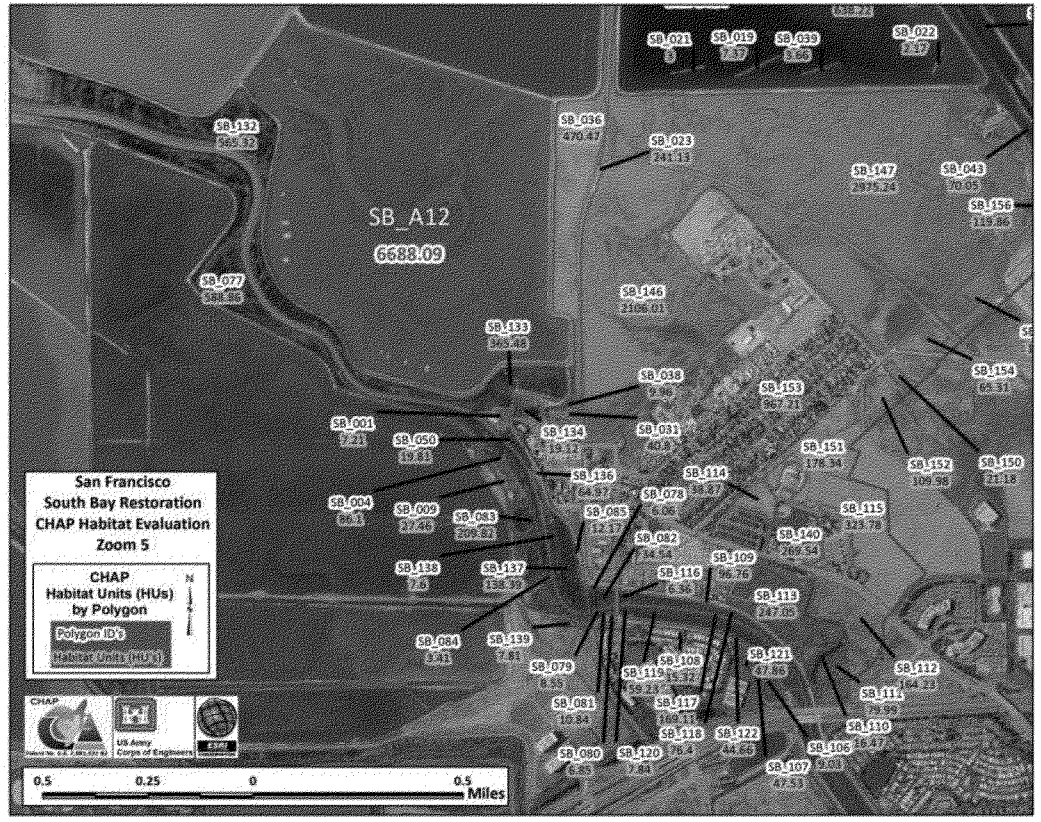
Miles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San Francisco
South Bay Restoration
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Zoom 5
CHAP
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by Polygon
Polygon ID's
Habitat Units (HU's)
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0.5
Miles
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SB_019
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SB_022
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SB_036
470.47
SB_023
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SB_121
SB_112
SB_111
SB_081
SB_117
SB_110
SB_118
SB_122
SB_106
SB_080
SB_120
SB_107

Appendix B3

Flood Risk Management Coordination with the USFWS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
1 Marshlands Road
Fremont, California 94555

September 10, 2015

LTC John Morrow, District Commander
Attn: Caleb Conn, Project Manager U.S. Army Corps of Engineers
San Francisco District
1455 Market Street, 17th Floor
San Francisco, California 94103

Dear LTC Morrow,

The purpose of this letter is to clarify what is intended by our Compatibility Determination (CD) for the South San Francisco Bay Shoreline Phase I Study, dated September 4, 2015. First and foremost, nothing in the CD is intended to be inconsistent with the roles and responsibilities outlined in the recommended plan set out in the Final Integrated Document (Final Interim Feasibility Study With Environmental Impact Statement/Environmental Impact Report) and in the Draft Memorandum of Understanding (MOU) between the United States Fish and Wildlife Service (FWS), the Santa Clara Valley Water District (SCVWD), and the California State Coastal Conservancy (SCC).

As such, it is understood that the flood risk management, ecosystem restoration and recreational features in the recommended plan, to be constructed by the Corps, will be operated, maintained, repaired, replaced and rehabilitated by the SCVWD and SCC, the non-Federal Sponsors (NFS) for the South San Francisco Bay Shoreline Phase I Study Project, under sections 103(i) and 103(j) of the Water Resources Development Act of 1986, 33 U.S.C. § 2213(i)(j), and USACE regulations and policies. Please refer to Chapter 9 of the Integrated Document and paragraphs 2 and 3.B. of the draft MOU, attached, that discusses the operations, maintenance, repair, replacement and rehabilitation of the project .

The FWS recognizes that the subsequent restoration activities, i.e., the conversion of Refuge Ponds A9-15 to tidal marsh habitat and the enhancement of recreational features (replacing trails and interpretive signs along levee), that will follow the levee construction are Refuge Management Activities and therefore from our perspective do not require a CD.

The term "Refuge Management Activities" is from our own policy and is not a reference to the specific activities of the Shoreline project but rather refers to a category of "refuge uses." A "Refuge Management Activity" is a specific term defined by our policy as: "An activity conducted by the Service or a Service-authorized agent to fulfill one or more purposes of the national wildlife refuge, or the National Wildlife Refuge System mission. Service-authorized agents include contractors, cooperating agencies, cooperating associations, refuge support groups, and volunteers." Even though USACE and the sponsors are funding the ecosystem restoration and recreation features and have control over the project features, including mitigation, monitoring, and adaptive management activities, those activities fulfill one or more purposes of the refuge; therefore, we consider those to be "Refuge Management Activities." Fortunately for all involved, those "general" (not specific) uses have already been evaluated in prior planning documents and have been determined to be compatible.

Also note that although the "Description of Use" section of the CD refers to USACE being responsible for levee construction and the NFS as being responsible for levee operation and maintenance, it was not intended to limit any other responsibilities or authorities in any manner, shape or form. The other components of the South San Francisco Bay Shoreline Phase I Study Project, i.e., ecosystem restoration and recreation, have already been deemed to be compatible and thus were not included in the CD. As described in the MOU, access for the design and construction of the levee, ecosystem restoration, and recreation features will be granted to USACE through issuance of a Special Use Permit and access for operation and maintenance of the features will be granted to the NFS in the form of a Right of Way without term limitations.

To ensure that there is no doubt of the FWS intentions, we will ensure that our Record of Decision is sufficiently robust to include all three major project elements of flood control, ecosystem restoration, and recreation. Additionally, we will discuss the OMRR&R responsibilities of the NFSs. Should you have any further questions, please do not hesitate to contact me by telephone on (510) 792-0222 extension 123 or by email at anne_morkill@fws.gov.

Sincerely,

Anne E. Morkill
Refuge Complex Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
1 Marshlands Road
Fremont, California 94555

Compatibility Determination
for the South San Francisco Bay Shoreline Phase I Study,
Don Edwards San Francisco Bay National Wildlife Refuge, California

Use: Issuance of a Special Use Permit to the U.S. Corps of Engineers and a Right of Way to the Santa Clara Valley Water District for the construction and operation of an engineered flood risk management levee as a component of the South San Francisco Bay Shoreline Phase I Study.

Refuge Name: Don Edwards San Francisco Bay National Wildlife Refuge, Alameda, Santa Clara and San Mateo Counties, California (see Figure 1).

Date Established: June 30, 1972

Establishing and Acquisition Authorities: 86 Stat. 399, dated June 30, 1972, An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes (16 U.S.C. 667b); Endangered Species Act of 1973 (16 U.S.C. 1534); Fish and Wildlife Act of 1956 (16 U.S.C. 742f)

Refuge Purpose(s):

"...for the preservation and enhancement of highly significant wildlife habitat...for the protection of migratory waterfowl and other wildlife, including species known to be threatened with extinction, and to provide an opportunity for wildlife-oriented recreation and nature study..." (86 Stat. 399, dated June 30, 1972).

"...particular value in carrying out the national migratory bird management program" 16 U.S.C. 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes).

"...to conserve (A) fish or wildlife which are listed as endangered species or threatened species....or (B) plants ..." 16 U.S.C. 1534 (Endangered Species Act of 1973).

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f(a)(4) "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. 742f (b) (1) (Fish and Wildlife Act of 1956).

National Wildlife Refuge System Mission: The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd- 668ee]).

Description of Use: The proposed use is the issuance of permits to grant access for the construction and operation of an engineered flood risk management levee on the Don Edwards San Francisco Bay NWR, including pre-construction engineering and design activities, geotechnical and hydrological analyses, equipment staging, construction of project features, and the long-term operations, maintenance, repair, replacement, and rehabilitation of the levee. The levee is part of the South San Francisco Bay Shoreline Study (Study), a multi-purpose flood risk management, ecosystem restoration, and recreation enhancement project led by the U.S. Corps of Engineers (USACE) in coordination with California State Coastal Conservancy (SCC), Santa Clara Valley Water District (SCVWD), U.S. Fish and Wildlife Service (USFWS), and City of San Jose. Access for the proposed use would be granted through issuance of a Special Use Permit to the USACE (levee design and construction) and a Right Of Way to the SCVWD (levee operation and maintenance).

The engineered levee would be constructed on an existing pond dike alignment along the eastern border of Refuge Ponds A12-13 and the southern border of Refuge Pond A16 and cross Artesian Slough onto city property where it would continue along the southern border of the city's Pond A18. The engineered levee would be built to 15.2 feet high (approximately 6-8 feet higher than existing pond dikes) to provide protection against a 100- year storm event, meet local requirements for flood risk management within Santa Clara County, and allow for continued Federal Emergency Management Agency (FEMA) accreditation at the end of the Study's period of analysis (the year 2067). The proposed use also includes construction of a 30:1 (1 foot of elevation rise for each 30 feet of horizontal distance) broad-sloping ecotone along the levee alignment adjacent to Refuge Ponds A12-13 (Figure 2).

The subsequent restoration activities (conversion of Refuge Ponds A9-15 to tidal marsh habitat) and enhancement of recreational features (replacing trails and interpretive signs along levee) that will follow the levee construction are Refuge Management Activities, and therefore do not require a compatibility determination.

Availability of Resources:

Adequacy of existing resources: Existing resources are adequate to administer the special use permit and the right of way. The primary staff responsible is the Refuge Manager (and other staff as appropriate) of the Don Edwards San Francisco Bay NWR, with support as necessary from the Project Leader for the San Francisco Bay National Wildlife Refuge Complex, headquartered in Fremont, California.

Needed resources: No additional fiscal resources are needed to manage this use. The Refuge Manager will be using regular base allocations for the long-term operations and maintenance of the ecosystem restoration features and associated recreational features on Refuge lands (Ponds A9- 16). Operations and maintenance costs will be reduced significantly once Ponds A9-15 are restored to tidal marsh, negating the need to maintain the system of earthen dikes and water control structures that currently exist. Further, the USFWS will no longer be responsible for maintaining the levee along Refuge Ponds A12-13 and A16 as they will be placed under a right-of-way permit for the SCVWD to operate and maintain once it is re-constructed to the proposed engineered flood risk management levee height of 15.2 feet.

Anticipated Impacts of the Use:

Water Quality: Negative short-term impacts from temporary increase in salinity in sloughs and remobilization of mercury in ponds and sloughs. Potential positive long-term benefits to surface water and sediment quality. Restoration of the ponds would reduce turbidity of waters flowing into the bay, provide energy dissipation that will reduce erosion and flooding, provide higher levels of dissolved oxygen in some ponds in the short term, and sequester water pollutants in the South San Francisco Bay.

Air Quality/Greenhouse Gases: Moderate but short-term negative construction-related impacts.

Subtidal Marsh and Mudflat Habitat Values: Minor negative construction-related impacts; potential positive long-term effects. Proposed use would not have a substantial adverse effect on or cause a substantial decrease in the abundance or distribution of steelhead, Chinook salmon, green sturgeon, longfin smelt, estuarine species, or bay shrimp populations, nor result in the substantial loss or degradation of designated essential fish habitat. The proposed use would not interfere substantially with the movement of any native or migratory fish or impede the use of aquatic nursery sites.

Tidal Marsh Habitat Value: Substantial positive mid- and long-term effects; additional ecotone provides for early evolution of marsh communities in former ponds and provides high-tide refugia for marsh-dependent species during high tide events, storm events, and accelerating rates of sea level rise.

Upland Habitat Value: Minor negative temporary construction-related impacts. Minor permanent increases from levee construction.

Threatened and Endangered Species: Substantial positive mid- and long-term effects; potential for minor and temporary negative effects during construction. Restoration of the ponds, which will be facilitated by the construction of the flood risk management levee, and the additional ecotone will provide for early evolution of marsh communities in former ponds and provide high-tide refugia for marsh-dependent listed species during high tide events, storm events, and accelerating rates of sea level rise.

Cultural Resources: No documented sites in the project area. Potential disturbance to unknown sites; however, any previously unknown sites that are discovered during construction activities will be handled in compliance with cultural resources consultation process.

Aesthetics: Minor negative temporary construction-related impacts. The expanded ecotone would provide shallow slopes along certain segments bayside of the levee, would include vegetation on these slopes, and would soften the contrast in form in contrast to a more traditional sharp-sloped concrete or rocked sterile-like engineered levee. The project could also result in long-term impacts to the viewshed from the Refuge's Environmental Education Center; but those impacts would be ameliorated by the addition of new trails leading up to and along the crest of the levee to provide new opportunities for views.

Land Use: Project would benefit adjacent land use by providing high level of flood risk management. There is potential for temporary construction nuisance impacts— such as noise, dust, and visual impacts—on Refuge visitors, Alviso residents, and the use of the Alviso County Marina. Construction activities may require temporary closure of public trails and the Refuge's Environmental Education Center.

Recreation: The ecosystem restoration component will result in a net loss of approximately 2.2 miles of Refuge trails once levees are breached to facilitate tidal marsh restoration, but would still support a useful Refuge trail system and a connection to other regional trails such as the San Francisco Bay Trail system. The project would result in long-term enhancements for Refuge visitors by providing providing benches, interpretive displays, and observation platforms, and facilitating connections to other trail systems with the addition of new pedestrian crossings of Artesian Slough and the Union Pacific Railroad tracks.

Public Review and Comment:

Public review and comment was solicited on the draft CD for 30 days. The draft CD was available to the public for review during June 8-July 10, 2015 while posted on the Refuge website and as hard copy at the Refuge headquarters on 1 Marshlands Road, Fremont, California. No public comment was received on the draft CD.

For additional consideration, public comment received on the Draft EIS was also evaluated. The USACE and USFWS are acting as the co–lead agencies under the National Environmental Policy Act (NEPA), and the SCVWD is acting as the lead agency under the California Environmental Quality Act (CEQA). Additionally, the SCC serves as a non-Federal cost-share partner and CEQA responsible agency for this project. The interagency project team commenced the South San Francisco Bay Shoreline Study's Phase 1 Interim Feasibility Study and Environmental Impact Statement/Environmental Impact Report (EIS/EIR) process in January 2006. The public involvement program for the project included a formal pubic scoping meeting on January 25, 2006 in Milpitas, CA, as well as ongoing stakeholder coordination and opportunities to comment on the scope and content of the proposed project through a stakeholder forum originally convened for the South Bay Salt Pond Restoration Project (SBSPRP). Forum

meetings occurred once a year and were open to the public. The Draft Interim Feasibility Study and EIS/EIR (Integrated Document) was released for public review and comment from December 19, 2014 through February 2, 2015. A public meeting on the Draft Integrated Document was held on January 14, 2015 in Alviso, CA. The comment period was subsequently extended until February 23, 2015. A total of 40 comment letters were received, including 9 letters requesting a time extension for the public comment period. The comments represented a variety of stakeholder groups as follows: Fed/State/County/City Agencies – 17, for-profit business – 2 (PG&E, Cargill), non-profit business – 12, private citizens - 9. A full description of the previous public review and comment process can be found in Chapter 6.0, Public Involvement, Review, and Consultation in the Draft Integrated Document (December 2014); and the response to comments will be included in the Final Integrated Document (December 21015).

Determination:

___ Use is Not Compatible

XX Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

The general conservation measures that will be implemented during project activities to avoid and minimize adverse effects on sensitive species and habitats are listed in the South San Francisco Bay Shoreline Study's Draft Interim Feasibility Study and Environmental Impact Statement/Environmental Impact Report (December 18, 2014) and Intra-Service Section 7 Endangered Species Act Final Biological Opinion/Conference Opinion (April 27, 2015), and incorporated herein by reference.

Justification:

With the acquisition of some 11,000 acres for former commercial solar salt ponds (including new fee title and salt-making rights on existing fee title) from Cargill, Inc. in 2003, the Don Edwards San Francisco Bay NWR gained responsibility for more than 70 miles of non- engineered dikes (earthen berms) and associated water control structures that were originally designed and constructed for commercial salt ponds. The dikes, which were created as early as the 1920s, were generally maintained to protect the salt pond production from tidal flooding, but were not meant to prevent flooding of adjacent communities. To date, the USFWS has received insufficient funds to adequately maintain the non-engineered dike system, resulting in an extremely degraded condition of many of the dikes with capability of only periodic spot-repairs as needed. Currently, much of the land south of the ponds is urbanized, including the residential and historic community of Alviso (within the limits of the City of San Jose), Silicon Valley tech business parks, transportation corridors, landfills, the City of San Jose's wastewater treatment plant, and other critical infrastructure. Much of this area has subsided as much as 13 feet below sea level due to extensive groundwater withdrawal for agricultural uses. There is considerable risk for tidal flooding caused by having large areas of low-lying terrain that are bordered by severely degraded non-engineered dikes, which are inadequate to provide reliable flood risk management for the urbanized areas south of the ponds. Sea level rise will further exacerbate risks from tidal

flooding caused by higher waters stressing the dikes. Flood benefits (damages reduced) from the project will be fully realized simply as a function of levee height and engineered design features, replacing the non-engineered dikes that currently exist.

Addressing flood risk in the Alviso area would also allow for the restoration of some 3,000 acres of former salt-production ponds to tidal marsh habitats along with associated ecological functions and habitat for threatened and endangered species. San Francisco Bay is one of the most extensive wetland ecosystems along the Pacific Coast, providing habitat for millions of migratory waterfowl and shorebirds along the Pacific Flyway as well as resident fish and wildlife. Since the area was settled in the 1880s, more than 85% of the tidal marshes have been filled, diked, or drained to support development, agricultural, and commercial solar salt-making. Since the 1960s, the trend shifted towards protection and restoration of the estuary, including the establishment of the Don Edwards San Francisco Bay NWR for the purposes of conserving and restoring tidal marsh habitats and supporting the recovery of endangered species, including the salt marsh harvest mouse (*Reithrodontomys r. raviventris*) and California Ridgway's rail (*Rallus obsoletus*, formerly *Rallus longirostris obsoletus*). The USFWS is consequently an active partner in the South Bay Salt Pond Restoration Project, the largest wetland restoration program on the West Coast that seeks to restore and enhance a mix of wetland habitats, provide wildlife-oriented public access and recreation, and provide for flood risk management in the South Bay. The proposed use described herein meets all of these goals in addition to the goals and objectives of the Don Edwards San Francisco Bay NWR Comprehensive Conservation Plan (2012) and the USFWS's Recovery Plan for Tidal Marsh Ecosystems in Northern and Central California (2014).

Reevaluation Date: In accordance with Compatibility Policy (603 FW 2.11 H), we will reevaluate compatibility when the conditions under which the special use permit or right of way permit are authorized change significantly, if there is significant new information regarding the effects of the use, and/or upon extension or termination of the permits. In addition, we will periodically monitor and review for compliance with permit terms and conditions.

NEPA Compliance for Refuge Use Decision:

____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

__X__ Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by:

Sept 3, 2015

Project Leader (Signature) (Date)

Concurrence:

9/4/2015

Refuge Supervisor (Signature) (Date)

9.4.2015

Assistant Regional Director, Refuges (Signature) (Date)

Figure 1. Don Edwards San Francisco Bay National Wildlife Refuge (location of proposed use indicated by yellow arrow)

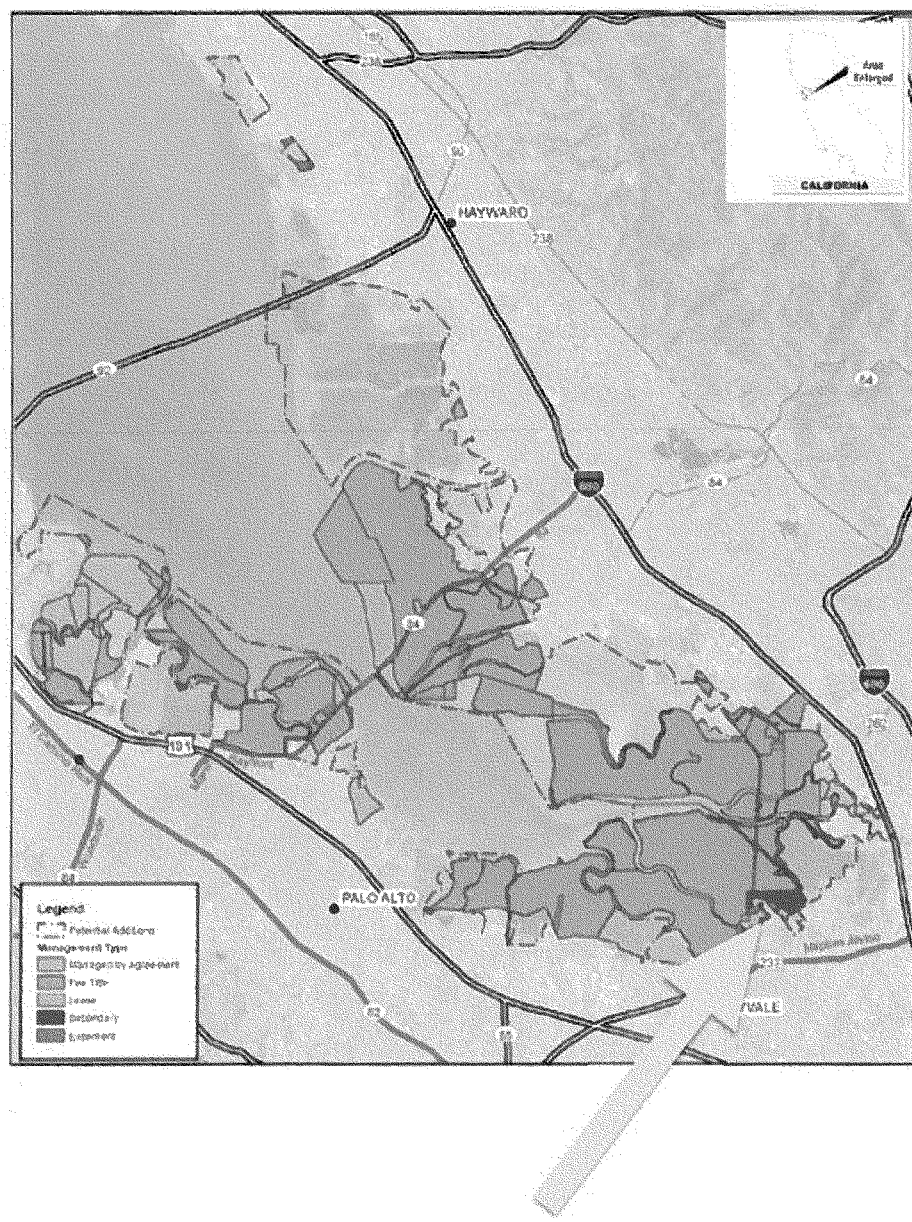

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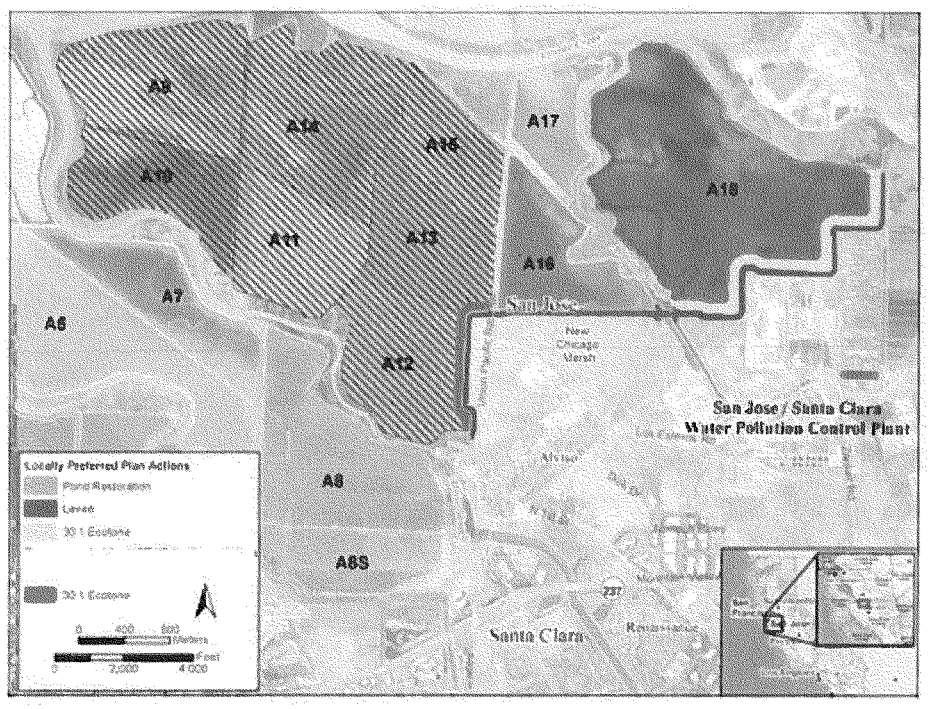
Figure 2. Proposed alignment for engineered flood risk management levee and associated ecosystem restoration features (Tentatively Selected Plan/Locally Preferred Plan for South San Francisco Bay Shoreline Study). The levee alignment and associated ecotone along Ponds A12-13 and A-16 are on Service property. The remaining levee alignment and ecotone along Pond A-18 ares on city property.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08ESMF00-
2013-CPA-0002

MAR 31 2015

Lt. Col. John C. Morrow
Commander
Attn: William DeJager
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, California 94103-1398

Dear Lt. Colonel Morrow:

This letter revises and supersedes the U.S. Fish and Wildlife Service's (Service) letter dated October 21, 2014, which described the Service's position and recommendations regarding the U.S. Army Corps of Engineers' (Corps) South San Francisco Bay Shoreline Phase I Study.

The Service has participated in planning efforts associated with the South San Francisco Bay Shoreline Phase I study for a number of years. The Service has also participated as a federal co-lead agency on this study pursuant to the National Environmental Policy Act since the project is proposed to occur on a portion of Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). In addition, the Service's Sacramento and Bay Delta Fish and Wildlife Offices provide guidance and support regarding federally listed species pursuant to the Endangered Species Act and on proposed water resource development projects pursuant to the Fish and Wildlife Coordination Act (FWCA).

The Service's efforts under FWCA are supported by transfer funding from the Corps. Transfer funding to date has been inadequate to support the type of detailed evaluation and develop recommendations such as would be in a Coordination Act Report (CAR) for a project of this scope. The Corps recently informed us that such funds will soon be provided for continued coordination including development of a CAR. Up to the time of our October 21, 2014, letter, we used the limited funds available for initial document review and informal coordination. Since our October 21, 2014, letter, we have had further opportunity to coordinate with Refuge and Corps staff and to review the alternative levee alignments and other information discussed in the Corps' December 2014 draft interim Feasibility Study/Environmental Impact Statement (FS/EIS) (Corps 2014). Based on this review, we have developed the following revised comments and recommendations. The content of this letter is still to be considered preliminary and subject to confirmation or further revision as needed pending the completion of a CAR.

Comments and recommendations

In our October 21, 2014, letter, we expressed concern that the Alviso North levee alignment, now a component of the Corps' tentatively selected plan and proposed project (FS/EIS Alternative 3), would permanently isolate New Chicago Marsh (NCM) from the San Francisco Bay, limiting the extent to which the project could restore full tidal marsh. At that time, we supported a project similar to that shown in FS/EIS Alternative 4 involving the more southerly Alviso Railroad Spur alignment for levee improvements to the west, which would expose part of NCM to tidal action, in combination with the Water Pollution Control Plant (WPCP) south alignment to the east. Among other reasons, we believed then that this alternative would result in a more comprehensive restoration and would incur reduced long term management costs. Our recommendations also differed from the earlier locally-preferred alternative that included a WPCP north alignment which would have reduced the extent of tidal restoration. These recommendations were previously discussed in our earlier letter of December 26, 2012, which is included in the FS/EIS (Appendix H *in* Corps 2014). We acknowledge that the WPCP North levee alignment has since been eliminated from the proposed project and locally preferred alternative and was not included in the final alternatives analysis in the FS/EIS.

Like many parts of the study area, NCM has experienced significant subsidence. Based on reasonable estimates of suspended sediment concentration, modeling of areas adjacent to NCM indicate that it would take several decades or more after initial exposure to tidal action for accretion to raise elevations to the point where vegetation could colonize the surface (ESA PWA 2012). This modeling indicates that the interior, more deeply subsided areas such as pond A12, would need to be restored first in order to maximize the rate of sediment accretion in these locations; otherwise, they would remain subtidal habitat. The NCM was not included in the area modeled by ESA PWA (2012) and is not under consideration for any of the alternatives. Nevertheless, it is reasonable to suggest that if tidal restoration of NCM were modeled, it would probably indicate a need for treatment sequence and marsh plain evolution similar to pond A12 (i.e., early breaching; decades needed for restoration). Inclusion of NCM, while maximizing the overall extent of tidal restoration, could affect or delay restoration of other areas.

Additionally, we have reconsidered the effect of retaining NCM versus opening it to full tidal action on fish and wildlife resources. Currently, NCM is a muted tidal marsh with water control structures that limit the amount of Bay water that enters and exits the marsh. Because of the reduction in tidal level and range, muted tidal marsh of this type generally has a lower diversity of vegetation and habitat types than full tidal marsh. Nevertheless, NCM in its present form constitutes one of the largest intact blocks of tidal marsh vegetation in the project vicinity and provides habitat that supports a number of rare species, including the federally listed salt marsh harvest mouse and western snowy plover, and others such as Forster's tern, black-necked stilt, and American avocet (Appendix Q *in* Corps 2014). If NCM were to be exposed to full tidal action under the levee configuration we had recommended, it would become open water at the expense of the marsh vegetation and the populations of these important wildlife species and would likely remain open water for a considerable time (decades).

Conversely, if NCM were retained in its present form or enhanced, it would provide continued habitat for these species. The populations in NCM, if preserved and protected, could then serve as a nearby source to expand onto the tidally restored habitat as it becomes available. Although the majority of the tidal restoration would occur over the long term, the proposed project does include a

significant component of 30:1 ecotone created by gently sloping fill placed on the outboard side of significant portions of the levee. We expect this ecotone to be rapidly colonized once exposed to full tidal action and provide more immediate additional tidal marsh and upland habitat adjacent to NCM. The proposed project, while perpetuating the muted tidal condition of NCM, provides protection from flood risks (including sea level rise) to that habitat which does not exist currently. Finally, the proposed project (also the locally preferred project) now includes the WPCP south alignment, which would maximize tidal restoration of pond A18. Both the ecotone and WPCP south components of the proposed project remain consistent with our October 21, 2014, recommendations regarding those elements.

The Service is sensitive to the need to adequately inspect and maintain the proposed levee improvements, which would also protect habitat in NCM and incorporate habitat enhancement in the form of the ecotone element in this case. Based on recent information provided by the Corps (February 20, 2015 email from Bill DeJager, San Francisco District), we now understand that most of the 30:1 ecotone element, to be composed of non-engineered fill, would be allowed to have maintenance-free marsh vegetation for nearly its entire length. As described to us, only the first 15 feet of that fill from the point it meets the levee would be maintained as a vegetation-free zone under current Corps policy (Engineering Technical Letter 1110-2-583). We expect this allowance to preserve most of the potential value of the ecotone as transitional habitat. We anticipate further coordination with the Corps and Service Refuge staff to understand and make further recommendations on maintenance needs as well as to formulate measures to minimize the effect of maintenance on listed species.

As we discussed initially in our October 21, 2014, letter, there are inherent difficulties in the application and interpretation of the Combined Habitat Assessment Protocol (CHAP) habitat evaluation methodology for this project. In principle, CHAP is based on biodiversity and places a higher value on those habitats which support greater species numbers and functions. This principle may not be appropriate to this project. Additionally, the CHAP study as provided in the FS/EIS appears to be incomplete and inadequate for present evaluation. Specifically, the FS/EIS includes only a baseline condition report and not evaluation of the alternatives (Appendix J *in* Corps 2014). Elsewhere, the FS/EIS (e.g., main report p. 3-39 and Appendix D pp. 4-5 *in* Corps 2014) makes inferences regarding evaluation of the alternatives, but the documentation of this alternative evaluation does not appear to be included in the FS/EIS. The Service would need full documentation as well as additional time and transfer funding to better evaluate the results of the CHAP effort. However, independent of the habitat evaluation, we believe that the project as proposed will result in near term protection of existing habitat on NCM from flood risks, an increment of additional enhanced habitat in the intermediate term on the ecotone, and a much more significant amount of habitat over the long term as the restored areas attain elevations needed for vegetation establishment.

Based on all of these considerations, it is the Service's preliminary finding to withdraw our previous support of the Alviso Railroad Spur and WPCP south alignment, and instead recommend Alternative 3 with its Alviso Slough North and WPCP south alignment, the Corps' tentatively selected plan and locally-preferred alternative. We now believe that Alternative 3 represents a reasonable and supportable combination of tidal restoration for the majority of the study area together with maintenance and protection of current habitat within NCM.

If you have any further questions on the Service's revised position and recommendations regarding the South San Francisco Bay Shoreline Phase I Study as described in this letter, please contact Steven Schoenberg of my staff at (916) 414-6564.

Sincerely,

Larry Rabin
Acting Field Supervisor

cc:
Joseph Terry, Sacramento Fish and Wildlife Office, Sacramento, California
Melisa Amato, Refuge Manager, Don Edwards NWR, Fremont, California
William DeJager, San Francisco Corps of Engineers, San Francisco, California
Judy McCrea, San Francisco Corps of Engineers, San Francisco, California
Brenda Buxton, California Coastal Conservancy, Oakland, California

REFERENCES

ESA PWA. 2012. Shoreline Study Preliminary Alternatives and Landscape Evolution. Memorandum prepared for the U.S. Army Corps of Engineers San Francisco District. ESA PWA. San Francisco, California. February 10, 2012. 16 pp + appendix + figures.

U.S. Army Corps of Engineers (Corps). 2014. Draft Interim Feasibility Study and Environmental Impact Statement/Report. South San Francisco Bay Shoreline Study Phase 1 Project. Santa Clara County, CA. December, 2014. U.S. Army Corps of Engineers San Francisco District.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

CESPN-ET-P 14 March 2014

Memorandum for Record: South San Francisco Bay Shoreline Study Supplemental Analyses on Sea Level Change and Flood Risk Associated with U.S. Fish & Wildlife Service's (USFWS) Refuge Lands

ISSUE: The recently completed supplemental analyses for the South San Francisco Bay Shoreline Study suggest greater flood risks to the community of Alviso, fronted by USFWS's dikes, than previously determined under this study.
The USFWS's San Francisco Bay National Wildlife Refuge Complex includes a former Cargill, Incorporated salt harvesting operation that includes a series of ponds and dikes to manage water levels primarily for wildlife benefits, but which historically have also peripherally reduced the risk of tidal flooding to the community of Alviso. USFWS has assumed maintenance responsibilities nominally to the same level as those once practiced by Cargill, Incorporated and is committed to continuing this practice. Increasing sea level and associated storm events will increase tidal flooding risk to Alviso, which sits behind these unengineered dikes. Recent analysis of the flood risk has identified that the risk of some tidal flooding to Alviso, even at project year zero (2017, prior to significant sea level rise), may be as high as 1 in 3 (0.33 annual chance exceedance). While this is not a surprising finding relative to the National Flood Insurance Rate Map program mapping that currently attributes no flood protection to these dikes, this nonetheless could be an alarming message to residents and certainly one that USFWS is considering when budgeting for management of their complex. USFWS's limited capacities on dike maintenance are a fundamental aspect of the future without-project conditions assumed for the South San Francisco Bay Shoreline Study and needed to be confirmed following the results of the supplemental analyses.

ASSESSMENT: On 4 March 2014, a meeting was held with Anne Morkill, San Francisco Bay National Wildlife Refuge Complex Manager, Eric Mruz, Refuge Manager for the Don Edwards San Francisco Bay National Wildlife Refuge, Craig Conner, CESPN Flood Risk Program Manager, Caleb Conn, CESPN Project Manager, and the undersigned to discuss the flood risk findings and the USFWS's response.

The USFWS is aware of the results of the new analysis, which shows the higher likelihood of inner dike failure and an associated increased chance (over previous analyses) of flood waters reaching Alviso (perhaps as high as a 0.33 annual chance in 2017). These analyses do recognize that USFWS has assumed the maintenance responsibilities once practiced by Cargill, Incorporated; however, USFWS efforts to perform maintenance are to the best of their abilities and within their means. This situation has meant prioritizing work on the outboard dikes and de-prioritizing the inner ones. The USFWS does not propose to take on a major flood risk management investment in levee upgrades in the foreseeable future, only to perform continued maintenance consistent with the current regime.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET
SAN FRANCISCO, CALIFORNIA 94103-1398

Given the potential sensitivities of this message, and as part of the ongoing study partnership and in their co-lead role for Environmental Impact Statement (EIS), the USFWS will review the Draft EIS as well as talking points for any public meeting where flood risks to Alviso are discussed for the South San Francisco Bay Shoreline Study.

CONCLUSION: The USFWS is not planning to change their maintenance actions based on any perception of increased liability stemming from the flood risk analyses. The USACE's geotechnical assumptions (or "fragility curves") used for the dikes in the current and future without-project condition are therefore consistent with the current and proposed maintenance practices by the USFWS. A "risk communication strategy" on USFWS dike maintenance should be prepared and vetted with USFWS.

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Date: 2014.04.22 18:56:18 -07'00'

Thomas R. Kendall, P.E.
Chief of Planning
San Francisco District, U.S. Army Corps of Engineers

United States Department of the Interior

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

In Reply Refer To:
08ESMF00-2013-CPA-0002

DEC 26 2012

Lt. Col. John K. Baker P.E.,
Commander,
U.S. Army Corps of Engineers, San Francisco District
1455 Market Street
San Francisco, California 94103-1398

Dear Colonel Baker:

This letter is in response to a request received via email from Bill DeJager of your office on December 11, 2012, for the U.S. Fish and Wildlife Service (Service) to document our position regarding the selection of levee alignment alternatives to be studied by the San Francisco Bay Shoreline Study.

On June 5, 2012, the Service participated in a meeting attended by the Corps of Engineers (Corps) and California Coastal Conservancy, in which several levee alignment alternatives were discussed. During the course of the meeting, two alternatives were proposed to be dropped from further consideration by the Corps as they were not supported by the local sponsors. These two alternatives were the Alviso Railroad Spur and WPCP South, which borders Pond A18 and the San Jose Waste Water Treatment Plant (see Attachment 1). The Service did not support removing these two alternatives from further consideration as proposed by the Corps and local sponsors. We continue to recommend that the Alviso Railroad Spur and WPCP South levee alignments remain part of the ongoing NEPA/CEQA process. It is our position that the implementation of these two alternatives would have less impact on fish and wildlife resources, including endangered species, and would allow for a more sustainable restoration project.

The Service recommended retaining the Alviso Railroad Spur alignment in the EIS/EIR in order to minimize effects to New Chicago Marsh and to evaluate a full range of alternatives pursuant to NEPA. Based on the Service's current understanding of the New Chicago Marsh, implementation of the Alviso Railroad Spur alignment would potentially minimize impacts to fish and wildlife resources, including federally listed species protected under the Endangered Species Act. In contrast the construction of the Alviso North levee alignment would continue to isolate the remaining portion of New Chicago Marsh from the San Francisco Bay, limit the ability to restore the area to a fully functioning tidal marsh, and result in a largely fresh water or brackish marsh.

Based on our review of materials presently available, the Service is concerned that the WPCP North levee alignment would have potentially unacceptable effects to listed species. The WPCP

South alignment would have less impact on existing habitat functions and would potentially result in a more comprehensive restoration of Pond A18. The WPCP South alignment may also better support the long-term management of the pond as fish and wildlife habitat by reducing management costs and minimizing human disturbance as a result of creating a larger intact habitat area. Furthermore, the WPCP South alignment has been identified in the Service's draft Tidal Marsh Recovery Plan as providing habitat functions (i.e., high marsh refugia) which would help contribute to the recovery of salt marsh harvest mouse, California clapper rail, and snowy plover.

If you have any further questions please contact Mark Littlefield, Chief, Watershed Planning Branch, at (916) 414-6520.

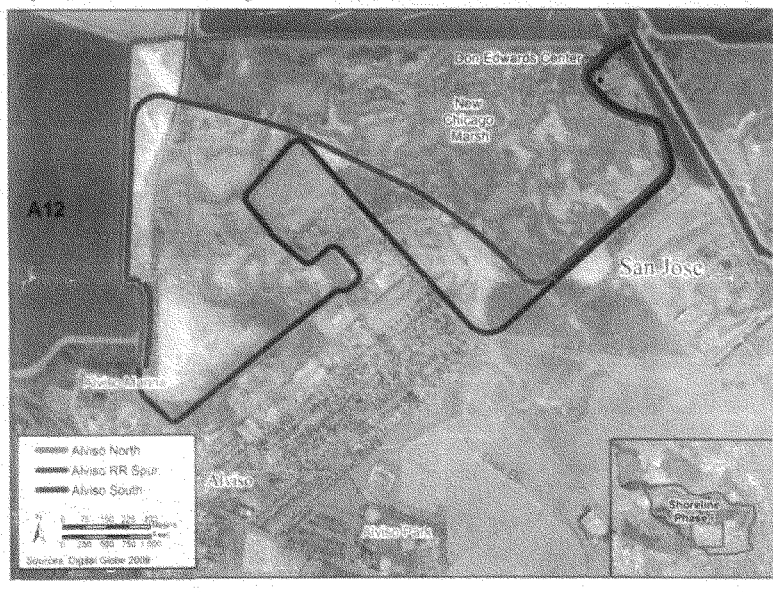
Sincerely

Daniel Welsh
Assistant Field Supervisor

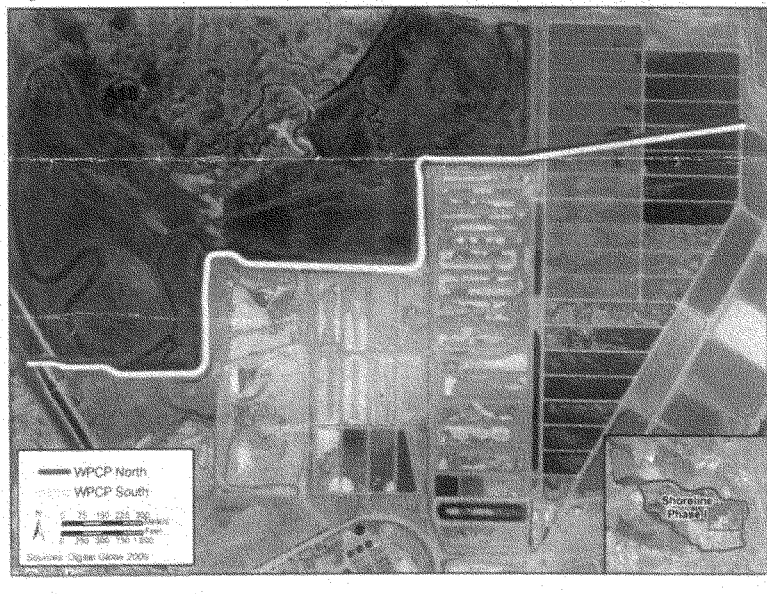
cc:
Joseph Terry, Sacramento Fish and Wildlife Office, Sacramento, California
Eric Mruz, Refuge Manager, Don Edwards NWR, Fremont, California
William DeJager, San Francisco Corps of Engineers, San Francisco, California
Judy Sheen, San Francisco Corps of Engineers, San Francisco, California
Brenda Buxton, California Coastal Conservancy, Oakland, California

ATTACHMENT 1

Map 1. Alviso Levee Alignments



Map 2. WPCP Levee Alignments



Appendix B4

Draft Memorandum Regarding Shoreline Study Ecosystem Restoration Phasing Alternatives (Ponds A9–A15)

South Bay Salt Pond Restoration Project

Restoring the Wild Heart of the South Bay

Memorandum

To: Shoreline Study planning team

From: South Bay Salt Pond planning team

Date: 17 November 2011

Re: Shoreline Study Ecosystem Restoration Phasing Alternatives (Ponds A9-15)
(*Draft*)

DRAFT

Below is the consensus preferred approach for the phasing of Ponds A9-A15 as they relate to the Shoreline Study planning. All of these alternatives assume that the project will be able to proceed beyond the 50:50 scenario based on the adaptive management plan, particularly regarding the issues of waterbird use and mercury.

Preferred Phasing Alternative

The different starting times for each breach event (phase) place the restored ponds on a different part of the sea level rise curve. This means that without substantial suspended sediment, if delayed, Ponds A12-15 will end up at lower elevations because they have fewer years to accrete sediment and their restoration begins on a steeper part of the sea level rise curve.

Therefore, the preferred alternative phasing sequence would be to expedite the restoration of Pond A12 (the most deeply subsided pond). This will help scour out Alviso Slough and will also provide an area to construct upland ecotone areas from the beginning of the project. Subsequent phases may then include Ponds A9-A11, and finally A13-A15. Upland refugia areas would be designed into each phase, with the upland ecotone areas located on the landward side of restored ponds that are adjacent to flood protection levees.

The ecosystem features proposed under the "less fill" to "more fill" scenarios still apply to this Alternative.

Issues to be addressed under Adaptive Management

If the adaptive management plan indicates that we are not ready to open Pond A12 due to waterbird and/or mercury concerns, options for capturing sediment in A12 include:

- Installing a new water control structure in Pond A12 to begin capturing sediment.
- Importing clean fill to raise the pond bottom to accelerate marsh evolution (as was done with Inner Bair Island).

The potential import of fill could be done in advance, after, or simultaneously with breaching other ponds in the A9-15 complex. The filling of A12 (and possibly the other deeply subsided Ponds A13 and A15) may reduce scour in Alviso Slough, bury any in situ mercury, and reduce the material volumes needed for future construction of a broad upland ecotone area.

If concerns about Pond A12 persist, the project could then proceed with breaching Ponds A9-A10. The division between the restored and managed ponds includes the realignment of the internal berm between Pond A9 and A11 to more accurately reflect the historic marsh drainage patterns. Subsequent phases may include restoration of Ponds A11-A15.

Upland refugia areas would be designed into the original phase. If the first phase (A9 and A10) alone remains the ultimate configuration of the restoration in these ponds, then a broad upland ecotone area can be added to the realigned internal berm described above. If further phases of tidal restoration are constructed, then the upland ecotone areas would be located on the landward side of all restored ponds as described above.

Proposed Timing

For purposes of habitat evolution modeling, we propose the following timing for the preferred alternative:
Pond A12: breached in 2017
Ponds A9-A11: breached in 2022
Ponds A13-A15: breached in 2030

ESA-PWA will be providing updated habitat maps of this scenario.

New Chicago Marsh

New Chicago Marsh (NCM) will not be analyzed as part of the ecosystem benefits for the proposed project. However, the Refuge has spelled out below their long term vision for NCM to assist the team in understanding the rationale behind some of the proposed levee alignments.

For the foreseeable future (next 10 to 20 years), the ecological goal for NCM will be to maintain or improve the quality of the existing managed marsh for the salt marsh harvest mouse (SMHM) and nesting bird species in NCM and A16. This goal is unlikely to change until sufficient replacement habitat for the SMHM and breeding birds has been created in the adjacent areas. However, in the longer term, once there is high-quality marsh habitat in the project area to support SMHM populations and nesting birds, the Refuge could change the management or configuration of NCM. These future changes would need to be defined through an adaptive management process and are not proposed to be part of the Shoreline Study alternatives. Rather this alternative acknowledges that the future management options for NCM greatly depend on the alignment of the flood protection levee build by the Shoreline Study. By constructing a levee alignment "behind" NCM (Alignments 2 and 3) the Shoreline Study would avoid impacts to NCM and allow for future habitat enhancement by allowing the Refuge to:

1. Continue existing management for the SMHM and maintain the connection between the nesting islands in Pond A16 and forage/cover for chicks in NCM; or
2. Connect NCM to the tides and create a deep water pond; or
3. Connect NCM to the tides and manage flows with a water control structure to accumulate sediment and raise existing elevation to marsh plain.

DRAFT

If the levee is constructed on the existing pond berm alignment (Alignment 1), the Refuge's future options will be constrained to the existing management régime with the additional impact of degraded connectivity between Pond A16 and NCM.

DRAFT

Appendix B5

Biological Resources: Species Scientific Names, CNDDB Report, and CRPR Report

Appendix B5. Scientific Names of Plants, Fish, and Wildlife Mentioned in the Integrated Document

Common Name	Latin Name
Plants	
Alkali bulrush	*Schoenoplectus robustus* (former *Scirpus robustus)*
Alkali heath	*Frankenia salina*
Annual pickleweed (slender pickleweed, glasswort)	*Salicornia europaea*
Atlantic cordgrass	*Spartina alterniflora*
Black mustard	*Brassica nigra*
Brass buttons	*Cotula coronopifolia*
Bristly ox-tongue	*Picris echioides*
Broad-leaved cattail	*Typha latifolia*
Bull thistle	*Cirsium vulgare*
California blackberry	*Rubus sp.*
California bulrush	*Schoenoplectus californicus* (former *Scirpus californicus)*
California cordgrass	*Spartina foliosa*
Chilean cordgrass	*Spartina densiflora*
Cocklebur	*Xanthim strumarium*
Common sow thistle	*Sonchus oleraceus*
Congdon's tarplant	*Centromadia parryi ssp. Congdonii*
Cordgrass species	*Spartina spp.*
Coyote brush	*Baccharis pilularis*
Curly dock	*Rumex crispus*
Elderberry	*Sambucus mexicana*
English cordgrass	*Spartina anglica*
Fremont cottonwood	*Populus fremontii*
French broom	*Genista monspessulana*
Giant reed	*Arundo donax*
Hall's bush-mallow	*Malacothamnus halli*
Hardstem bulrush	*Schoenoplectus acutus* (former *Scirpus acutus)*
Hyssop loosestrife	*Lythrum hyssopifolium*
Italian ryegrass	*Lolium multiflorum*
Italian thistle	*Carduus pycnocephalus*
Marsh gumplant	*Grindelia stricta var. angustifolia*
Mediterranean barley	*Hordeum marinum ssp. gussoneanum*
Pampas grass	*Cortaderia sp.*
Perennial pepperweed	*Lepidium latifoium*
Perennial pickleweed	*Sarcocornia pacifica (*former *Salicornia virginica)*
Purple star-thistle	*Centaurea calcitrapa*
Rabbits foot grass	*Polypogon monspeliensis*

Common Name	Latin Name
Ripgut brome	*Bromus diandrus*
Saltmarsh bulrush	*Bolboschoenus maritimus* (former *Scirpus maritimus)*
Saltmeadow cordgrass	*Spartina patens*
Scotch broom	*Cytisus scoparius*
Sweet fennel	*Foeniculum vulgare*
Wild oats	*Avena fatua*
Wild radish	*Raphanus sativus*
Wild rose	*Rosa californica*
Willow	*Salix sp.*
Yellow star-thistle	*Centaurea solstitialis*
********	*Eliocharis* ****
Fishes	
American shad	*Alosa sapidissima*
Arrow goby	*Clevelandia ios*
Bay goby	*Lepidogobius lepidus*
Bay pipefish	*Syngnathus leptorhynchus*
Black bullhead	*Ameiurus melas*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Brown bullhead	*Ictalurus nebulosus*
California bat ray	*Myliobatis californica*
California central coast DPS steelhead	*Oncorhynchus mykiss irideus*
California halibut	*Paralichthys californicus*
California roach	*Lavinia symmetricus*
California skate	*Raja inornata*
Carp	*Cyprinus carpio*
Chameleon goby	*Tridentiger trigonocephalus*
Channel catfish	*Ictalurus punctatus*
Chinook salmon (Central Valley)	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
English sole	*Parophrys vetulus*
Fathead minnow	*Pimephales promelas*
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Green sturgeon	*Acipenser medirostris*
Green sunfish	*Lepomis cyanellus*
Hitch	*Lavinia exilicauda*
Inland silverside	*Menidia beryllina*
Jack mackerel	*Trachurus symmetricus*
Jacksmelt	*Atherinopsis californiensis*

Common Name	Latin Name
Largemouth bass	*Micropterus salmoides*
Leopard shark	*Trikakis semifasciata*
Longfin smelt	*Spirinchus thaleichthys*
Longjaw mudsucker	*Gillichthys mirabilis*
Mississippi silverside	*Menidia audens*
Mosquitofish	*Gambusia affinis*
Northern anchovy	*Engraulis mordax*
Pacific herring	*Clupea pallasii*
Pacific lamprey	*Lampetra tridentata*
Pacific sardine	*Sardinops sagax*
Pacific staghorn sculpin	*Leptocottus armatus*
Plainfin midshipman	*Porichthys notatus*
Prickly sculpin	*Cottus asper*
Rainwater killifish	*Lucania parva*
Red shiner	*Notropis lutrensis*
Redear sunfish	*Lepomis microlophus*
Riffle sculpin	*Cottus gulosus*
Sacramento blackfish	*Orthodon microlepidotus*
Sacramento perch	*Archoplites interruptus*
Sacramento pikeminnow	*Ptychocheilus grandis*
Sacramento sucker	*Catostomus occidentalis occidentalis*
Shimofuri goby	*Tridentiger bifasciatus*
Shiner surfperch	*Cymatogaster aggregata*
Shokahaze goby	*Tridentiger barbatus*
Speckled dace	*Rhinichthys osculus*
Speckled sanddab	*Citharichthys stigmaeus*
Splittail	*Pogonichthys macrolepidotus*
Starry flounder	*Platichthys stellatus*
Striped bass	*Morone saxatilis*
Surf smelt	*Hypomesus pretiosus*
Thicktail chub	*Gila crassicauda*
Threadfin shad	*Dorosma petenense*
Three-spined stickleback	*Gasterosteus aculeatus*
Topsmelt	*Atherinops affinis*
Tule perch	*Hysterocarpus traski*
White crappie	*Pomoxis annularis*
White sturgeon	*Acipenser transmontanus*
Yellow bullhead	*Ameiurus natakis*
Yellowfin goby	*Acanthogobius flavimanus*

Common Name	Latin Name
Invertebrates	
(Amphipod)	*Grandidierella japonica*
(Amphipod)	*Corophium sp.*
(Amphipod)	*Ampelisca abdita*
Asian clam	*Corbula amurensis*
Asian cumacean	*Nippoleucon hinumensis*
Asian mussel	*Musculista sp.*
Atlantic clam	*Gemma sp.*
Atlantic ribbed marsh mussel	*Arcuatula demissa*
Baltic clam	*Macoma petalum*
Blackspotted bay shrimp	*Crangon nigromaculata*
Blacktrail bay shrimp	*Crangon nigricauda*
Brine flies	Family Ephydridae
Brine shrimp	*Artemia* sp.
Brine shrimp	*Artemia franciscana*
California bay shrimp	*Crangdon franciscorum*
Capet shell, littleneck clam	*Venerupis sp.*
Chinese mitten crab	*Eriocheir sinensis*
European green crab	*Carcinus maenas*
Miniature spinyhead	*Mesocrangon munitella*
Mud snail	*Illyanassa obsoleta*
New Zealand burrowing isopod	*Sphaeroma quoyanum*
Opossum shrimp	*Mysida sp.*
Oriental shrimp	*Palaemon macrodactylus*
Reticulate water boatmen	*Trichocorixa reticulate*
Ribbed mussel	*Ischadium demissum*
Ridgetail prawn	*Exopalaemon carinicauda*
Soft-shell clam	*Mya arenaria*
Stout coastal shrimp	*Heptacarpus brevirostris*
Visored shrimp	*Betasus longidactylus*
Yellow shore crab	*Hemigrapsus oregonensis*
Reptiles and Amphibians	
Arboreal salamander	*Aneides lugubris*
Bullfrog	*Rana catesbeiana*
California slender salamander	*Batrachoseps attenuatus*
California tiger salamander	*Ambystoma californiense*
Garter snake	*Thamnophis couchi, T. elegans,* and *T. sirtalis*
Gopher snake	*Pituophis melanoleucus*
Pacific treefrog	*Hyla regilla*
Southern alligator lizard	*Elgaria multicaranata*

Common Name	Latin Name
Western fence lizard	*Sceloporus occidentialis*
Western pond turtle	*Emys marmorata*
Western toad	*Bufo boreas*
Mammals	
Audubon's cottontail	*Sylvilagus audubonii*
Black rat	*Rattus rattus*
Black-tailed jack rabbit	*Lepus californicus*
Botta's (valley) pocket gopher	*Thomomys bottae*
Brush rabbit	*Sylvilagus bachmani*
California ground squirrel	*Spermophilus beecheyi*
California vole	*Microtus californicus*
Common muskrat	*Ondatra zibethicus*
Deer mouse	*Peromyscus maniculatus*
Feral cat	*Felis catus*
Hoary bat	*Lasiurus cinereus*
House mouse	*Mus musculus*
Long-tailed weasel	*Mustela frenata*
Mexican free-tailed bat	*Tadarida brasiliensis*
Norway rat	*Rattus norvegicus*
Pacific harbor seal	*Phoca vitulina richardsi*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes regalis*
Salt marsh harvest mouse	*Reithrodontomys raviventris raviventris*
Salt marsh wandering shrew	*Sorex vagrans halicoetes*
Shrew	*Sorex sp.*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana*
Western harvest mouse	*Reithrodontomys megalotis*
Western red bat	*Lasirurs blossevillii*
Yuma myotis	*Myotis yumanensis*
Birds	
Alameda song sparrow	*Melospiza melodia pusillula*
American avocet	*Recurvirostra americana*
American coot	*Fulica americana*
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American kestrel	*Falco sparverius*
American pipit	*Anthus rubescens*
American white pelican	*Pelecanus erythrorhynchos*
American wigeon	*Anas americana*

Common Name	Latin Name
Anna's hummingbird	*Calypte anna*
Barn swallow	*Hirundo rustica*
Belted kingfisher	*Ceryle alcyon*
Black phoebe	*Sayornis nigricans*
Black skimmer	*Rynchops niger*
Black-bellied plover	*Pluvialis squatarola*
Black-chinned hummingbird	*Archilochus alexandri*
Black-crowned night-heron	*Nycticorax nycticorax*
Black-necked stilt	*Himantopus mexicanus*
Bonaparte's gull	*Chroicocephalus philadelphia*
Brown pelican	*Pelecanus occidentalis*
Bufflehead	*Bucephala albeola*
Burrowing owl (western burrowing owl)	*Athene cunicularia*
Bushtit	*Psaltriparus minimus*
California black rail	*Laterallus jamaicensis coturniculus*
California clapper rail	*Rallus longirostris obsoletus*
California gull	*Larus californicus*
California least tern	*Sterna antillarum browni*
California yellow warbler	*Dendroica petechia brewsteri*
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Caspian tern	*Hydroprogne caspia*
Chestnut-backed chickadee	*Poecile rufescens*
Cinnamon teal	*Anas cyanoptera*
Clark's grebe	*Aechmophorus clarkii*
Cliff swallow	*Petrochelidon pyrrhonota*
Common goldeneye	*Bucephala clangula*
Common loon	*Gavia immer*
Common moorhen	*Gallinula chloropus*
Common raven	*Corvus corax*
Common tern	*Sterna hirundo*
Cooper's hawk	*Accipiter cooperii*
Double-crested cormorant	*Phalacrocorax auritus*
Downy woodpecker	*Picoides pubescens*
Dunlin	*Calidris alpina*
Eared grebe	*Podiceps nigricollis*
Elegant tern	*Sterna elegans*
European starling	*Sturnus vulgaris*
Forster's tern	*Sterna forsteri*
Fox sparrow	*Passerella iliaca*

Common Name	Latin Name
Gadwall	*Anas strepera*
Glaucous-winged gull	*Larus glaucescens*
Golden-crowned sparrow	*Zonotrichia atricapilla*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Greater scaup	*Aythya marila*
Greater yellowlegs	*Tringa melanoleuca*
Green heron	*Butorides virescens*
Herring gull	*Larus argentatus*
Horned lark	*Eremophila alpestris actia*
House finch	*Haemorhous mexicanus*
House sparrow	*Passer domesticus*
Killdeer	*Charadrius vociferus*
Least sandpiper	*Calidris minutilla*
Lesser goldfinch	*Carduelis psaltria*
Lesser scaup	*Aythya affinis*
Lincoln's sparrow	*Melospiza lincolnii*
Little blue heron	*Egretta caerulea*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Mallard	*Anas platyrhynchos*
Marbled godwit	*Limosa fedoa*
Marsh wren	*Cistothorus palustris*
Merlin	*Falco columbarius*
Mew gull	*Larus canus*
Mourning dove	*Zenaida macroura*
Northern harrier	*Circus cyaneus*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Orange-crowned warbler	*Oreothlypis celata*
Pacific-slope flycatcher	*Empidonax difficilis*
Peregrine falcon (American peregrone falcon)	*Falco peregrinus*
Pied-billed grebe	*Podilymbus podiceps*
Red knot	*Calidris canutus*
Red-breasted merganser	*Mergus serrator*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Ring-billed gull	*Larus delawarensis*
Rock pigeon	*Columba livia*

Common Name	Latin Name
Ruddy duck	*Oxyura jamaicensis*
Saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*
Savannah sparrow	*Passerculus sandwichensis*
Semipalmated plover	*Charadrius semipalmatus*
Short-billed dowitcher	*Limnodromus griseus*
Short-eared owl	*Asio flammeus*
Snowy egret	*Egretta thula*
Song sparrow	*Melospiza melodia*
Sora	*Porzana carolina*
Surf scoter	*Melanitta perspicillata*
Swainson's thrush	*Catharus ustulatus*
Thayer's gull	*Larus thayeri*
Tricolored blackbird	*Agelaius tricolor*
Virginia rail	*Rallus limicola*
Warbling vireo	*Vireo gilvus*
Western grebe	*Aechmophorus occidentalis*
Western gull	*Larus occidentalis*
Western meadowlark	*Sturnella neglecta*
Western sandpiper	*Calidris mauri*
Western snowy plover	*Charadrius alexandrinus nivosus*
Whimbrel	*Numenius phaeopus*
White-crowned sparrow	*Zonotrichia leucophrys*
White-faced ibis	*Plegadis chihi*
White-tailed kite	*Elanus leucurus*
Willet	*Tringa semipalmata*
Wilson's warbler	*Wilsonia pusilla*

Appendix B6

South San Francisco Bay Shoreline Study
Existing Biological Conditions Report

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

SOUTH SAN FRANCISCO BAY SHORELINE STUDY
EXISTING BIOLOGICAL CONDITIONS REPORT

DRAFT

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
CALIFORNIA STATE COASTAL CONSERVANCY

Prepared by:

H. T. HARVEY & ASSOCIATES

05 November 2007 Project No. 2606-01

983 University Avenue, Building D • Los Gatos, CA 95032 • Ph: 408.458.3200 • F: 408.458.3210

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ACRONYMS AND ABBREVIATIONS

CDFG	California Department of Fish and Game
CIR	Color infrared
ESU	Evolutionary Significant Unit
GIS	Geographic Information Systems
ISP	Interim Stewardship Plan
PG&E	Pacific Gas & Electric
PRBO	PRBO Conservation Science
SBSP	South Bay Salt Ponds
SCVWD	Santa Clara Valley Water District
MHW	Mean High Water
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
SFBBO	San Francisco Bay Bird Observatory
SFBNWR	Don Edwards San Francisco Bay National Wildlife Refuge
USACOE	U.S. Army Corp of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WPCP	Water Pollution Control Plant

1. EXECUTIVE SUMMARY

The San Francisco Estuary is an extremely productive, diverse ecosystem. Despite the loss of more than 90% of historic tidal wetlands in the Bay Area to diking, draining, and filling (Goals Project 1999), wildlife diversity is high, with more than 250 species of birds, 120 species of fish, 81 species of mammals, 30 species of reptiles, and 14 species of amphibians regularly occurring in the estuary (Siegel and Bachand 2002). More importantly, the San Francisco Bay supports populations of a number of species of regional, hemispheric, or even global importance. Numerous endemic, endangered, threatened, and rare wildlife species or subspecies reside in the San Francisco Bay Area.

The South San Francisco Bay (South Bay) is a vital component of the larger estuary. The South Bay supports some of the most important habitat remaining in the entire Bay Area for a number of wildlife species, in spite of the surrounding areas being highly urbanized and the Bay itself having been dramatically altered by the diking and filling of wetlands for salt production and urban development (Goals Project 1999).

This report characterizes the existing biological conditions related to the Shoreline Study which focuses on ecosystem restoration and flood damage reduction for the entire Study Area. The principal biological components of concern are the vegetation and habitats, and the wildlife. This report outlines the current state of understanding of these resources in the South Bay. The description of existing biological conditions is an important step in the early stages of planning as this description provides a foundation from which to evaluate and contrast a wide range of flood control and restoration alternatives, will serve to help inform the selection of the preferred alternative, and will provide baseline data for monitoring and adaptive management.

Habitats and Vegetation. The Shoreline Study Area (approximately 44,624 total acres) encompasses a variety of habitat types due to its land use history, its hydrologic placement within the landscape, and the extreme range of abiotic soil variables present within the area. Habitats vary from urbanized areas lined with concrete culverts to riparian fluvial drainages to freshwater, brackish, and salt marsh habitat. The dominant habitats that occur in the Study Area include approximately:

- 14,480 acres of developed area;
- 7498 acres of intertidal mudflat habitat (at –0.9 ft Mean Lower Low Water);
- 7135 acres of former and current salt production ponds;
- 3679 acres of wetland and riparian areas; and
- 2664 acres of open water/bay habitat.

Numerous occurrences of six special-status plant species, including Point Reyes bird's-beak, Hoover's button-celery, Congdon's tarplant, alkali milk-vetch, Contra Costa goldfields, and San Joaquin spearscale, have been documented in the immediate vicinity of the Study Area; the latter five species are known from the Study Area primarily from the Warm Springs Unit of the Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR) and the adjacent Pacific Commons Preserve in Fremont. Historical (likely

extirpated) populations of alkali milk-vetch and Point Reyes bird's-beak are documented in the vicinity of Alviso.

Wildlife Resources. This report includes discussions of the species composition and structure of invertebrate, fish, reptile, amphibian, mammal, bird, and plant communities in the South Bay. These species' life histories (as they pertain to their use of the South Bay), habitat requirements and habitat use in the South Bay, and the spatial and temporal variation in these species' presence/distribution in the region are summarized, as are the occurrence and use of the South Bay by special-status plant and wildlife species.

In summary, the ecology of South Bay wildlife communities is characterized by:

- High productivity of tidal marshes, with export of organic matter from tidal marshes to tidal sloughs, channels, and mudflats, and to the Bay, supporting high abundance of invertebrates, fish, and birds.
- High productivity of salt ponds and former salt ponds, supporting an abundance of invertebrates (particularly in higher-salinity ponds) and high numbers of fish in lower-salinity ponds, but with virtually no export of organic matter to other habitats aside from variable (and at times, very heavy) use of the salt ponds by birds.
- A heavily invaded aquatic invertebrate community dominated by non-native species, particularly in the estuarine and salt pond habitats.
- Heavy use of South Bay habitats by waterbirds, including significant proportions of Pacific Coast migratory shorebird populations.
- Highly dynamic bird and fish communities, with use of different areas varying several times a day with tide height, and with abundance and community composition varying seasonally depending on migration, precipitation, temperature, salinity, and other factors. In particular, large numbers of shorebirds forage on intertidal mudflats at low tide and use salt ponds and other alternative habitats (e.g., water treatment plant ponds) for roosting and/or foraging, particularly at high tide, and steelhead use bay habitats during their migrations as adults to spawn in tributaries and as juveniles moving from tributaries to the sea .
- The presence of rare San Francisco Bay endemics, including the California clapper rail and salt marsh harvest mouse, in remnant tidal marsh habitat.
- The presence of rare vernal pool-associated species, including the vernal pool tadpole shrimp and California tiger salamander, in vernal pools within the Warm Springs unit of the SFBNWR.
- The presence of several freshwater streams flowing into the South Bay; woody riparian habitat is limited to narrow corridors, or is highly degraded or even absent, along these streams, although moderately high-quality riparian habitat is present along lower Coyote Creek, and riparian habitats in the Study Area support very high densities of birds.

2. INTRODUCTION

This document describes the existing biological conditions of the South San Francisco Bay Shoreline (Shoreline Study) Study Area. The purposes of the Shoreline Study are to investigate the feasibility of a federally cost-shared project to meet the objectives of flood damage reduction, ecosystem restoration, and related purposes such as public access, and, if a potential project can be justified through existing Corps policy, to recommend such a project for Congressional authorization. An understanding of the existing natural landscape is necessary to accomplish these goals.

Other existing documents that are relevant to this report include the South Bay Salt Ponds (SBSP) Initial Stewardship Plan (ISP) (Life Science 2003), SBSP Biology and Habitats Existing Conditions Report (H. T. Harvey & Associates 2005), and the SBSP Draft Programmatic Environmental Impact Statement/Environmental Impact Report (PWA 2007).

To help guide the ecosystem restoration and flood protection aspects of the planning effort, the Shoreline Study will incorporate findings from the SBSP Restoration Project, a California Coastal Conservancy-led effort to restore historical wetlands on 15,100 acres of former salt-harvesting ponds in the South Bay. The U.S. Army Corps of Engineers (USACOE) and the Santa Clara Valley Water District (SCVWD) are active project management team members of the SBSP Restoration Project. Extensive coordination has occurred, and will continue to occur, between the Shoreline Study and SBSP projects.

This existing conditions report documents the current conditions within the Shoreline Study Area, including portions of this area that have not already been investigated for the SBSP Restoration Project. Therefore, in preparing this report, existing conditions information for the relevant portions of the SBSP project area were augmented by compiling information for the baylands area outside of the SBSP project area, but within the Alviso Ponds and Santa Clara County Interim Feasibility Study area, at the same level of detail as for the SBSP Restoration Project.

The existing biological conditions described in this document include habitat type, plant species composition, and potential wildlife use within the Shoreline Study Area at the onset of planning. This report contains the following sections:

Section 3. Habitats and Vegetation. Here, the existing conditions for habitats and vegetation in the Shoreline Study Area are presented, including an overall habitat assessment, the presence of non-native plant species, and the occurrence and potential for reintroduction of special-status plant species along with associated maps.

Section 4. Wildlife Resources. In this section, the existing conditions for wildlife in the Shoreline Study Area are documented. Included here are discussions of the composition and structure of invertebrate, fish, reptile, amphibian, mammal, and bird communities in the Study Area. Details of these species' life histories (as they pertain to their use of the South Bay), habitat requirements and use, and the spatial and

temporal variation in these species' distributions in the region are also included. Further, the occurrence and use of the Shoreline Study Area by special-status wildlife species is summarized.

2.1 Regional Setting

The San Francisco Estuary is an extremely productive, diverse ecosystem. Despite the loss of more than 90% of historic tidal wetlands in the Bay Area to diking, draining, and filling (Goals Project 1999), wildlife diversity is high, with more than 250 species of birds, 120 species of fish, 81 species of mammals, 30 species of reptiles, and 14 species of amphibians regularly occurring in the estuary (Siegel and Bachand 2002). More importantly, the San Francisco Bay supports populations of a number of species of regional, hemispheric, or even global importance. Numerous endemic, endangered, threatened, and rare wildlife species or subspecies reside in the San Francisco Bay Area.

The South San Francisco Bay (South Bay) is a vital component of the larger estuary. The South Bay supports some of the most important habitat remaining in the entire Bay Area for a number of wildlife species, in spite of the surrounding areas being highly urbanized and the Bay itself having been dramatically altered by the diking and filling of wetlands for salt production and urban development (Goals Project 1999).

The term "South Bay" is typically used to refer to the portion of the San Francisco Bay south of Coyote Point on the western shore of the Bay and San Leandro Marina on the eastern shore of the Bay (Goals Project 1999). This region differs in several physical and ecological aspects from the Central Bay, North Bay, San Pablo and Suisun Bays, and the Delta portions of the San Francisco Estuary. The Shoreline Study Area, for this existing conditions document, includes the open waters of the Bay up to the upper reaches of tidal action, the tidal and nontidal wetlands adjacent to the Bay, the former salt evaporation ponds adjacent to the Bay, the upland areas adjacent to and surrounding these features, developed areas, and the fluvial riparian inputs into the South Bay (Figure 1). This Study Area is bordered by the open waters of the South Bay to the northwest and by urban development on all other sides. While this Study Area is likely larger than what would be included in an actual Shoreline Study project, this landscape-level description of potentially impacted areas will be integral to the consideration of feasible restoration options and the concomitant benefits and impacts of those options.

2.2 Study Area

Broadly, the Study Area includes the Palo Alto/Mountain View area (south of San Francisquito Creek); Moffet Field, and the Alviso Ponds (and the areas inland to them) owned by the USFWS, SCVWD (Pond A4), and the City of San Jose (Pond A18) (Figure 1). It includes all of the Shoreline Study geographic area in Santa Clara County, as well as a small area in Alameda County that is part of the Coyote Creek/Mud Slough drainage from Santa Clara County. For aquatic Bay habitats, the Dumbarton Bridge is used as the northern boundary of the Study Area.

The Shoreline Study will focus on ecosystem restoration and flood damage reduction for the entire Study Area, though ecosystem restoration will most likely occur within the Alviso Ponds. The drainages in this

Study Area all flow through Santa Clara County and include: Coyote Creek/Mud Slough, Artesian Slough, Guadalupe River/Alviso Slough, Guadalupe Slough/Moffett Channel/Sunnyvale East and West Channels, Stevens Creek, Permanente Creek/Mountain View Slough, Charleston Slough/Barron Creek/Adobe Creek, and Matadero Creek/Mayfield Slough. The Study Are also includes the lower reaches of Laguna Creek and its watershed in Alameda County. The Alviso ponds occur at the base of several watersheds formed by the following drainages: Coyote watershed, Guadalupe watershed, San Tomas/Calabazas watersheds, Sunnyvale East/West watersheds, Permanente/Stevens watersheds, Adobe/Matedero watersheds and the San Francisquito watershed. Flood protection for San Francisquito Creek is being studied under separate authorization. San Francisquito Creek serves as the northern edge of the Study area, dividing the Santa Clara County and Alviso Ponds from San Mateo County and the Ravenswood Ponds.

3. HABITATS AND VEGETATION

3.1 Introduction

The Shoreline Study, which serves to identify and recommend for Federal funding one or more projects for flood damage reduction, ecosystem restoration and public access, serves as a complementary effort to the SBSP Restoration Project, a programmatic plan for habitat restoration, flood management and wildlife-oriented public access within former salt ponds of the South Bay. The physical boundaries of these two efforts overlap at the Alviso ponds and the open water/mudflats extending north to the Dumbarton Bridge, with the Shoreline Study Area reaching beyond the Alviso ponds into adjacent uplands. To describe existing conditions for habitats and vegetation in the Shoreline Study Area, an analysis of surrounding habitat types (Figure 1) was performed utilizing aerial mapping and site visits. This included a general habitat assessment, along with considerations for the potential occurrence and/or reintroduction of special-status plant species. The assessment of historical habitats in the Shoreline Study Area was also used to provide a baseline for the existing conditions of the ecological communities.

3.2 Methods

3.2.1 Base Imagery

All habitat mapping was rendered on IKONOS satellite imagery. The City of San Jose acquired the IKONOS imagery from a satellite pass that occurred at noon on 8 May 2004. The tidal elevation at this time was –0.9 feet Mean Lower Low Water (MLLW) near the mouth of Coyote Creek in the Alviso complex. The City of San Jose purchased the satellite images and subsequently donated them for use in the SBSP restoration planning. The 1-meter Multispectral (four-bands) CIR & True Color IKONOS satellite imagery is projected in UTM NAD83 (meters) Zone 10 North. Habitat mapping was based upon the imagery obtained and completed at a 1:2400 (1 inch = 200 feet) scale using the IKONOS imagery as a base layer.

3.2.2 Habitat Mapping and Area Calculations

Habitat mapping was completed using laptop computers (Panasonic Toughbook 18) equipped with GIS software (ArcView 9). The computers and software allow the IKONOS imagery to be used for mapping in the field or office.

Initial habitat boundaries and classifications using the IKONOS imagery were identified based on the signatures of the photographic imagery. Topographic features, marsh boundaries, and tentative habitat types (based on photographic signatures) were mapped in the office prior to field visits.

During the site visits in January 2007, extensive ground-truthing of those areas in the Shoreline Study Area that were not included in the original SBSP mapping was conducted. Marshes and riparian corridors were observed primarily from levee trails, unimproved salt pond levees, and Pacific Gas and Electric

(PG&E) walkways. The GIS database was downloaded and backed up weekly, and the digitized boundaries of habitat areas were reviewed for consistency and quality. Habitat acreages and color-coded figures for the entire Study Area were generated in GIS (ArcView 9.0).

3.3 Habitats and Vegetation

The Shoreline Study Area encompasses a variety of habitat types due to its land use history, its hydrologic placement within the landscape, and the extreme range of abiotic soil variables present within the area. Habitats vary from urbanized areas lined with concrete culverts to riparian fluvial drainages to freshwater, brackish, and salt marsh habitat. The Shoreline Study serves to analyze the unique demands placed upon this area of the Bay to balance urban demands for flood protection with restoration efforts and the needs of special-status plant and animal species.

3.3.1 Historical Habitats

The assessment of habitats that historically occurred along the South Bay provides a context in which to examine the existing conditions of South San Francisco Bay. Historical ecological communities of the South Bay are described in detail in the South Bay Salt Ponds Biology and Habitats Existing Conditions Report (H. T. Harvey & Associates 2005), Collins and Grossinger (2004), and Grossinger et al. (2006). Historically, the margins of San Francisco Bay were surrounded by a mosaic of wetland habitats, dominated by tidal salt marsh with large expanses of upland ecotones, intramarsh ponds, salt pannes, sinuous channel networks, beaches, lagoons, and sausals (Collins and Grossinger 2004).

Collins and Grossinger (2004) describe three major historical South Bay landscapes: saline tidal marsh, riparian tidal marsh, and salt pond. The South Bay saline tidal marsh landscape once consisted of marshlands with high channel density, abundant marsh pannes and salinas, moist grasslands along the backshore, large sausals, and extensive tidal flats. The South Bay riparian tidal marsh landscape existed along a salinity gradient from fresh to saline or brackish waters, influenced by perennial creeks such as Coyote Creek and the Guadalupe River. These areas had large marsh pannes and a less dense channel network in the vicinity of major freshwater sources. The South Bay salt pond landscape comprised tidal marshlands dominated by salt ponds. Native Americans developed these early ponds from salinas and marsh pannes by using low berms and weirs to control their hydroperiod. Tidal marsh and salt ponds were roughly equal in area, with minimal tidal channel network development. Small salinas and marsh pannes were adjacent to the salt ponds, with moist grasslands occurring along the backshore. Saltgrass-alkali meadow habitat existed in the complex transition zone between the tidal marsh and the wet meadows of the bottomlands of the South Bay. Unusually high concentrations of salt in alluvial soils created favorable conditions for unique plant communities with characteristics of high tidal marsh, alkali flats, and vernal pools (Grossinger et al. 2006).

Most of these historical communities have been greatly reduced in size due to land use changes in the South Bay, including residential development, agricultural use, salt production, and flood protection. More recently, South Bay marshes were significantly modified via diking to retain and concentrate Bay

water for salt production. Beginning in the mid- to late 1800's through the 1940's, levee construction led to the direct loss of tens of thousands of acres of tidal marsh in the South Bay (Collins and Grossinger 2004). Apart from these direct impacts, this construction led to dramatic changes in the physical processes influencing marsh development. By diking off these large expanses of marsh habitat, the tidal prism (volume of water that moves in and out of an area during a tidal cycle) was drastically reduced. The results of this decrease in tidal prism are still being observed in the South Bay, particularly in the Alviso pond complex (H. T. Harvey & Associates 2006).

3.3.2 Current Habitat Mapping Results

To generally assess existing conditions, broad-scale mapping for the Shoreline Study area included the Alviso pond complex, Moffett Field and the Palo Alto/Mountain View area south of San Francisquito Creek in Santa Clara County. In addition, a small area in Alameda County that is part of the Coyote Creek/Mud Slough drainage from Santa Clara County was also included in the Shoreline Study area. All habitats within the Shoreline Study Area were mapped at the scale shown in Figure 1.

During the mapping of the Shoreline Study Area, 25 different habitat categories were utilized. These habitat types included open water, mudflat, salt marsh, brackish marsh, freshwater marsh, riparian/creek corridor, muted tidal/diked marsh, active salt ponds, restored tidal salt ponds (under ISP Management) [1], seasonal ponds (under ISP Management), high salinity ponds (under ISP Management), system ponds (under ISP Management), seasonal ponds/high salinity ponds (under ISP Management), related projects (ponds), vernal pools, peripheral halophytes, landfill, water/sewage treatment, golf course, upland vegetation, parks/upland grassland, levee, airport, unvegetated, and developed (Figure 1). Each of these habitats is briefly described below, with survey results, and the locations of each habitat type are shown in Figure 1. It is important to note that small inclusions of differing habitat types may occur within a mapped section; however, these inclusions do not change the overall value or use of the habitat as described. For example, golf courses and/or airports probably contain areas of annual grassland or other such habitat types. Summary tables including all habitat types follow at the end of this section (Tables 1 and 2).

Open Water. Approximately 2664 acres of open water are found in the Study Area (Figure 1). The open waters of South San Francisco Bay, to the north of the Study Area, extend from a maximum depth of 25+ feet in the channel between the San Mateo and Dumbarton Bridges up to the MLLW elevation. However, water depth across the majority of the South Bay, particularly in the area southeast of the Dumbarton Bridge in the Study Area, is six to12 feet deep or less. Open water exists along Mountain View Slough, Charleston Slough, Stevens Creek, Alviso Slough, Artesian Slough, Guadalupe Slough, and in Coyote Creek and extends into their corresponding drainages. The open water category includes a variety of habitat types, including subtidal Bay waters, tidal sloughs and channels, and areas of standing or flowing

[1] The Initial Stewardship Plan (ISP)(Life Sciences 2003) describes the operation and maintenance of the ponds prior to the long-term restoration plan and, as such the ISP represents the existing condition. Since the ISP implementation began in July 2004 and will continue to be implemented through 2007, assumptions have been made regarding biological functions and values that will be present once the ISP is fully operational, but prior to the implementation of the SBSP Restoration plan. The ISP will continue beyond 2007 for many ponds, until tidal restoration or managed pond condition is "implemented" in phases of the SBSP Restoration Project.

waters within all of the salt ponds as well as within tidal marshes. Despite lacking terrestrial or emergent vegetation, deep bays and channels support large aquatic invertebrates, fishes, waterbirds, and marine mammals and, in a few areas within the upper reaches of shallow bays, eelgrass (*Zostera pacifica*), an important submerged plant species.

Open water habitat that was mapped in detail occurs within the low-flow channel of adjacent creeks and slough channels that drain to the Bay, within the borrow ditches and former tidal meanders found within the salt ponds throughout the Study Area, and within the interior marsh ponds. The tidal sloughs and channels that carry water between and through salt ponds and marsh remnants provide important habitat for large numbers of benthic and pelagic invertebrates and fish. These detritus-rich channels serve as important nurseries and feeding areas for estuarine resident fish as well as migratory species such as the migratory life stages (adult, juveniles) of Central California Coast steelhead (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and green sturgeon (*Acipenser medirostris*). Shorebirds, waterfowl, and other waterbirds utilize the channels and marsh ponds while the open waters of the Bay support a high diversity of benthic and pelagic macroinvertebrates. Piscivorous (fish-eating) birds such as the Forster's tern (*Sterna forsteri*), California least tern (*Sterna antillarum browni*), and double-crested cormorant (*Phalacrocorax auritus*) fly over open water in search of fish, while diving ducks such as greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), canvasbacks (*Aythya valisineria*), and surf scoters (*Melanitta perspicillata*) dive in shallower water for bivalves, crustaceans, and other invertebrates. Only birds that can forage from the air (e.g., terns) or that are able to swim can exploit subtidal areas of the Bay, resulting in low bird diversity in the open waters. However, large densities of diving ducks occur in some areas where appropriate depths and concentrations of benthic invertebrates, particularly bivalves, provide a rich food source. Some wildlife species, such as gulls, also roost on the Bay, especially at night.

Mudflats. Approximately 7498 acres of intertidal mudflat habitat (based on the satellite imagery obtained during a –0.9 feet MLLW tide condition) are found in the Study Area (Figure 1). Mudflat habitat occurs in intertidal areas from below MLLW to Mean Tide Level (MTL) just beyond the edge of wetlands along the Bay and between the low-flow channel and edge of wetlands within the tidal reaches of slough and creek channels that drain to the Bay. Intertidal mudflats are expanses of unvegetated mud lying between MLLW and the lower marsh zone. These flats are generally covered by shallow water during high tide, but are uncovered at low tide. Narrow mudflats occur along the edges of the tidal sloughs and channels and on the outboard side of some salt pond levees, while much more extensive flats are present at the mouths of the major sloughs and along the edge of the Bay. Mudflats are dynamic depositional features, changing in extent and location depending on the nature of erosion and deposition of sediments.

Large expanses of newly formed mudflat habitat exist downstream of the Island Ponds (A19, A20, and A21), including a large, newly formed mudflat island at the mouth of Alviso Slough adjacent to Pond A9. Mudflat habitat also occurs at the mouth of Guadalupe Slough and along Charleston Slough and accreting mudflat occurs adjacent to Calaveras Point, the mouth of Mountain View Slough, and the mouth of Stevens Creek adjacent to Ponds A1 and A2W. Small areas of mudflat surrounded by open water are

adjacent to Pond A12. Additional small areas of mudflat are surrounded by freshwater marsh at the upper end of the reach of Coyote Slough to the south of the Island Ponds.

Mudflats are located on the bayside of ponds and provide important habitat for resident and migratory bird populations in the South Bay as well as foraging habitat for Bay fishes and invertebrates. Shorebirds, gulls, terns, American white pelicans (*Pelecanus erythrorhynchos*), and ducks often use exposed mudflats as roosting or loafing areas when they are available, as will Pacific harbor seals (*Phoca vitulina richardsi*).

This habitat typically supports less than 10% cover of vascular emergent vegetation, typically in the form of cordgrass (*Spartina* spp.) and annual pickleweed (*Salicornia europaea*) that is too sparse to map as distinct salt marsh habitat. The mudflat substrate comprises primarily fine-grained silts and clays that support an extensive community of diatoms, worms, shellfish, and algal flora. Inundated mudflats provide foraging habitat for many species of fish, and, during low tides, these mudflats additionally provide a primary food source for shorebirds.

High productivity of benthic invertebrates on mudflats is a result of nutrient availability resulting from detritus from tidal marshes, phytoplankton that settle in the water column, algae, and diatoms growing on the intertidal mudflats (Life Science 2003; Warwick and Price 1975). Crustaceans, polychaete worms, mollusks, and other invertebrates live on or just below the surface of the mud. During daily high tides, fish school over mudflats to feed on these invertebrates. As the tide recedes and the flats emerge, the fish retreat to subtidal areas while large numbers of birds, primarily shorebirds, leave their high-tide roosts to feed on the flats. These mudflats are primarily what make the San Francisco Bay Area important to West Coast shorebird populations; an average of 67% of all the shorebirds on the West Coast of the U.S. use San Francisco Bay wetlands (Page et al. 1999). Gulls and some dabbling ducks forage on the exposed mudflats as well. Because benthic invertebrates often recede deeper into the mud as the tidal elevation drops, especially large concentrations of foraging birds usually occur at the edge of the receding or rising tideline. Although the largest numbers of shorebirds forage on the broad flats along the edge of the Bay at low tide, some shorebirds, gulls, and large waders (e.g., herons and egrets) feed on the exposed flats along sloughs and channels. The smaller channels in the brackish and salt marshes are the favored foraging areas for the state and federally endangered California clapper rail (*Rallus longirostris obsoletus*).

Tidal Wetlands. For purposes of this study, tidal wetlands were divided into salt marsh, brackish marsh, and freshwater marsh. Although not fully tidal, muted tidal and diked marsh habitat is also discussed in this section. These habitats collectively account for the greatest acreage of vegetated habitat adjacent to the ponds, occupying 3419 acres of the surrounding habitat (Figure 1). Each of these distinct types of tidal wetland habitat is described in further detail, below. The tidal wetlands are mainly located in narrow strips between the mudflats and the Cargill and salt pond levees.

> **Salt Marsh.** Approximately 725 acres of tidal salt marsh occurs on the outboard levees of the Study Area. Areas of tidal salt marsh in the South Bay are characterized by interstitial soil salinities greater than approximately 27 ppt, on average (H. T. Harvey & Associates 2002b). Salt

marsh habitat occurs primarily along the outboard (tidal) side of existing levees separating the salt ponds from the Bay. Salt marshes typically consist of three zones in the Bay: low marsh dominated by cordgrass, middle marsh dominated by pickleweed, and high marsh with a mixture of pickleweed and other moderately halophytic species that can tolerate occasional high tides.

The salt marsh habitat in the South Bay consists primarily of low and middle marsh and is dominated by pickleweed (*Sarcocornia pacifica*, formerly known as *Salicornia virginica*) and cordgrass. Pickleweed and cordgrass salt marsh habitats are separated by elevation; cordgrass typically occurs below the MHW mark and pickleweed occurs above the MHW, often extending up levee banks. Differences in pickleweed and cordgrass salt marsh habitat types also affect wildlife use and sedimentation in the slough and channels draining into the Bay.

There are two species of dominant cordgrass in the South Bay, the native Pacific cordgrass (*Spartina foliosa*) and smooth cordgrass (*S. alterniflora*), a non-native species from the east coast of North America. Smooth cordgrass can easily hybridize with the native cordgrass, causing widespread distribution of the hybridized species within a short amount of time. Smooth cordgrass and its hybrids are the predominant invasive plant species found in the tidal marshes south of the San Francisco Bay Bridge. In the Palo Alto Baylands, a survey conducted by the Coastal Conservancy's San Francisco Estuary Invasive Spartina Project from 2003 to 2006 showed an increase in the size of infestation from 0.61 acres spread over 49 patches in 2005, to 0.94 acres spread over 46 patches in 2006, a 54% increase (Porcella 2007). Total infestation of invasive cordgrass, based on both the SCVWD and Invasive Spartina Project's 2006 survey efforts, is estimated to be 18.9 acres spread amongst 286 patches. This is a 117% increase in acreage from 2005 to 2006 (Porcella 2007). Research has found that these infestations not only affect the foodweb, but that the smooth cordgrass and its hybrids grow lower into channels than the native cordgrass, which can reduce the extent of mudflat edge and possibly result in the loss of channels to vegetation encroachment and subsequent sedimentation (PWA and H.T. Harvey & Associates 2006). Current research and management programs on smooth cordgrass and its hybrids can provide guidance for salt pond restoration work (California State Coastal Conservancy and U.S. Fish and Wildlife Service 2003).

Other halophytic plant species commonly found in salt marsh habitat located within the South Bay include alkali heath (*Frankenia salina*), saltgrass (*Distichlis spicata*), saltmarsh dodder (*Cuscuta salina*), fleshy jaumea (*Jaumea carnosa*), spearscale (*Atriplex triangularis*), sea lavender (*Limonium californicum*), marsh gumplant (*Grindelia stricta* var. *angustifolia*), and the invasive perennial pepperweed (*Lepidium latifolium*). These species typically occur above the MHW mark in the high marsh zone, up to the ecotone between salt marsh and upland habitats. While these species usually occur in areas dominated by pickleweed, species such as marsh gumplant and perennial pepperweed sometimes occur in dense patches with less than 50% aerial coverage of pickleweed--areas assigned the *other salt marsh* classification. Areas with greater than 50% coverage of pickleweed, among any combination of other prevalent species, were classified as pickleweed salt marsh habitat.

Brackish Marsh. Approximately 955 acres of brackish marsh occur throughout the Study Area (Figure 1). This habitat covers the marsh plain in the transition from salt to brackish marsh along Coyote Creek, and also dominates the outboard levees near the junction of Mud Slough and Coyote Creek. Brackish marsh replaces salt marsh moving upstream along Guadalupe Slough, Alviso Slough, Mountain View Slough, and Stevens Creek.

Brackish marsh habitat typically occurs in the low-to-mid intertidal reaches of sloughs and creeks draining into the Bay where vegetation is subject to tidal inundation diluted by freshwater flows from upstream. As such, the average interstitial soil salinity of tidal brackish marsh is lower than in salt marshes, ranging from 15 to 20 ppt in the South Bay (H. T. Harvey & Associates 2002b). The water-surface elevation within reaches of brackish marsh in the Study Area (primarily located in the upper reaches of the Study Area) can vary by as much as ten feet, depending on daily tidal activity, seasonal freshwater flows from upstream, and their location within this estuary system.

The vegetation in brackish marsh habitat is dominated by emergent, vascular plant species adapted to intermediate (brackish) interstitial soil salinities including short bulrushes such as alkali bulrush (*Schoenoplectus robustus,* formerly known as *Scirpus robustus*) and saltmarsh bulrush (*Bolboschoenus maritimus,* formerly known as *Scirpus maritimus*). These species dominate lower brackish marsh habitat where sediment deposits have formed terraced floodplains between the low-flow channels and levees. The middle reaches of these channels are also dominated by shorter bulrushes, but in addition may have dense stands of tall bulrushes such as California bulrush (*Schoenoplectus californicus,* formerly known as *Scirpus californicus*) and hard-stem bulrush (*Schoenoplectus acutus*, formerly known as *Scirpus acutus*) adjacent to the low-flow channel of creeks and sloughs. Large, dense patches of invasive perennial pepperweed may also occur within terraced areas in middle reaches otherwise exclusively dominated by alkali bulrush. Other plants that can occur in brackish marshes include alkali heath, spearscale, and, along the high marsh/upland ecotone, pickleweed. Higher-order slough channels and upper-creek reaches dominated by these species may also be considered brackish marsh, depending on the extent of intrusion of fresher water in these areas.

Muted Tidal/Diked Marsh. There are a number of muted tidal/diked marsh areas occupying approximately 1250 acres in total in the vicinity of the Study Area, including New Chicago Marsh, the Palo Alto Flood Basin, and several smaller, adjacent areas (Figure 1). Muted tidal/diked marshes have limited tidal exchange due to the presence of levees around the perimeter of Bay waters/salt ponds. Water exchange is limited, so that the range in water level in the muted tidal marsh is small (usually a few inches) compared to the range of tidal change in other marsh areas (several feet). Muted tidal marshes exhibit many of the same features as fully tidal marshes, but they often have lower plant diversity due to the limited range in tidal action. The muted tidal and diked marshes in the Study Area represent the gradient from fresh to brackish to saline marsh habitat. For example, New Chicago Marsh is dominated by salt marsh, while the Palo Alto Flood Basin ranges from freshwater marsh habitat in the south to salt marsh habitat in the north.

Freshwater Marsh. Approximately 489 acres of freshwater marsh habitat occur throughout the Study Area (Figure 1). The majority of this habitat type is tidal freshwater marsh found in the upper reaches of Coyote Creek, Artesian Slough, Alviso Slough, and Guadalupe Slough where it transitions from brackish marsh. Freshwater marsh vegetation then extends from the upper reaches of Alviso Slough into the Guadalupe River and from the upper reaches of Guadalupe Slough into San Tomas Aquino and Calabazas Creeks. Freshwater marsh habitat typically occurs in the upper reaches of sloughs and creeks draining into the Bay. While these reaches may be subject to occasional tidal influence associated with high (usually spring) tides, and/or have somewhat saline historical sediments, these reaches are otherwise flushed with fresh water on a daily basis and therefore support mostly freshwater emergent vegetation. The water-surface elevation within reaches of freshwater marsh may also vary by as much as ten feet depending on daily tidal activity and seasonal, freshwater flows from upstream. Other non-tidal freshwater marshes are also present in the Study Area, including the Emily Renzel wetlands in Palo Alto.

Broad-leaf cattail (*Typha latifolia*) and taller bulrushes, including California bulrush and hard-stem bulrush, typically dominate the freshwater marsh habitat. Due to regular inundation, these species often form dense stands covering entire floodplain terraces along channels. Patches of perennial pepperweed and thickets of California blackberry (*Rubus ursinus*) also occur in regions of freshwater marsh.

Tidal marshes in the South Bay are remnants of their former extent, but support high densities of several wildlife species, including several San Francisco Bay endemic wildlife species. The state and federally endangered salt marsh harvest mouse (*Reithrodontomys raviventris*) and the salt marsh wandering shrew (*Sorex vagrans halicoetes*) occur in the salt marshes of the South Bay, particularly where pickleweed is present. The California vole (*Microtus californicus*) occurs here as well and is often the most common small mammal in tidal marshes. California clapper rails nest in cordgrass, denser stands of pickleweed, and marsh gumplant, particularly in the lower marsh zone where numerous small tidal channels are present, in both salt and brackish tidal marshes. The Alameda song sparrow (*Melospiza melodia pusillula*), endemic to the Central and South San Francisco Bay, nests in dense herbaceous vegetation in salt and brackish marshes as well, while the savannah sparrow (*Passerculus sandwichensis*) nests in pickleweed and peripheral halophytes in the upper marsh and upland transitional zones. The saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*) nests in tidal and nontidal brackish and freshwater marshes, and possibly in low densities in salt marsh habitat as well (Ray 1919; Steve Rottenborn, pers. obs.), in the South Bay. Several species of ducks, and in a few locations herons and egrets, also nest in the tidal marshes of the South Bay (Gill 1977), and California black rails (*Laterallus jamaicensis coturniculus*) winter in small numbers in these marshes. Non-breeding birds, including larger shorebirds, swallows, blackbirds, and other species roost, occasionally in large numbers, in the tidal marsh, and tidal marshes (and mudflats) in several South Bay areas are used as haul-outs and pupping sites by harbor seals.

Riparian/Creek Corridor. Approximately 260 acres of fluvial riparian habitat and urban creek corridors are found throughout the Study Area (Figure 1). Riparian habitat is found along the upstream portions of

the majority of the drainages within the Study Area. Riparian habitat includes vegetation that occurs adjacent to freshwater streams, creek, and rivers. The historical riparian landscape found in the South Bay was characterized by perennial creeks that intersect the intertidal zone, producing brackish marsh at the interface with the saline landscape. Currently in the South Bay, riparian habitats that include large, mature riparian trees are limited to select portions of Coyote Creek and the Guadalupe River. Dominant canopy species in the South Bay include willow (*Salix* sp.) and Fremont cottonwood (*Populus fremontii*) while common understory species include elderberry (*Sambucus mexicana*) and wild rose (*Rosa californica*). Many of the creek corridors however, are concrete-lined channels with little to no woody vegetation and are confined by flood control levees.

Salt Ponds (Active and Inactive). Approximately 7612 acres of the Study Area are occupied by active and inactive salt ponds. Approximately 235 acres of Cargill-managed active salt ponds occur within the Study Area (Figure 1) represented by the southeast portions of salt ponds M4 and M5 which border the northern extent of the bayland boundary of the Study Area. The vast majority of salt ponds within the Study Area, referred to as the "Alviso salt ponds" and numbered A1 to A23 on Figure 1, are inactive, meaning that they have been taken out of salt production. These ponds were mapped and described according to their prescribed management regime, and encompass approximately 7377 acres. The salinity and hydrologic circulation regimes outlined in the ISP (Life Science 2003) result in five types of pond management systems: System, Full Tidal, High Salinity (Batch), Seasonal, and Mixed (e.g., Seasonal /High Salinity) Ponds. A sixth pond type, categorized under Related Projects and encompassing approximately 1436 acres, is not under a current management regime; the fate of these ponds is unknown at this time. Each of these pond types is described below:

System Ponds (ISP Management). The System Ponds, with approximately 4638 acres of salt ponds, are second only to mudflat habitat as the most abundant habitat found in the Study Area, and are by far the most extensive type of salt pond in the Study Area (Figure 1). They primarily occur along the east-west extent of the southern portion of the South Bay baylands, with two (Ponds A16 and A17) separated from the other System Ponds by the three high-salinity ponds. System Ponds are managed to have water circulating through a series of ponds linked by water control structures that are controlled to reduce or maintain ambient salinities. Management of these ponds under the ISP focuses primarily on meeting discharge requirements for salinity and dissolved oxygen; management for selected habitat conditions (e.g., shallow water for shorebirds, deeper water for waterfowl and diving birds) occurs as feasible while meeting water quality requirements.

Full Tidal Ponds (ISP Management). Approximately 477 acres of former salt ponds fully restored to tidal action occur within the three Island Ponds (A19, A20, A21), which are located between Coyote Creek and Mud Slough in the northern portion of the Alviso Pond complex (Figure 1). Levees were breached in March 2006 to allow full tidal action to be reintroduced to the pond.

High Salinity Ponds (ISP Management). Approximately 826 acres of high-salinity ponds (A12, A13, A15) occur within the east-central portion of the Study Area located between Coyote

Creek and Alviso Slough (Figure 1). High-salinity ponds are also referred to as batch ponds. This management strategy consists of a series of ponds, managed to maintain higher salinity levels to provide habitat for salt pond-associated bird species.

Seasonal Ponds (ISP Management). The two seasonal ponds (A22, A23) lie in the northern portion of the Alviso Pond complex and encompass approximately 712 acres (Figure 1). Seasonal ponds have no bay-water inputs; water levels rise and recede depending on precipitation and groundwater hydrology.

Seasonal Ponds/High-Salinity Ponds (ISP Management). Approximately 724 acres of seasonal/high-salinity ponds are located between the upper reaches of Alviso Slough and Guadalupe Slough in the pond complex (A8 North and South) and along the lower reach of Guadalupe Slough around the central portion of the Study Area (A3N) (Figure 1). These ponds are also referred to as mixed ponds. These ponds are managed differently at different times of the year, or managed adaptively.

Related Projects (Ponds). Approximately 1436 acres of former salt ponds in the Study Area, including Ponds A4 and A18 and the Crittenden Marsh area in the northern part of Moffett Field, are associated with related projects (Figure 1). Currently, the management plans for these ponds are actively being designed and future management of these ponds is uncertain. Future habitat enhancement options may include, but are not limited to, tidal restoration, managed pond, and diked or muted tidal wetland.

Generally, salt ponds in the South Bay are characterized by expanses of non-tidal open water, bare mud, or bare salt flats surrounded by mostly barren levees. Vegetation is sparse and where it does occur, it is limited primarily to levees. Due to the paucity of vegetation, salt ponds provide little to no cover for small mammals or reptiles, and provide nesting habitat only for species that nest on the bare levees and the occasional islands that have been created (by breaching of levees or deposition of material dredged from borrow ditches) within the ponds. Furthermore, much of the biomass produced by these ponds is unavailable to birds due to water depth and fish due to high salinity, which precludes these vertebrates' use of most of the invertebrates in the deeper, higher-salinity ponds.

At least 16 species of fish occur in the lower-salinity intake ponds, where they feed on an abundant supply of benthic and pelagic invertebrate prey. The native topsmelt (*Atherinops affinis*), longjaw mudsucker (*Gillichthys mirabilis*), staghorn sculpin (*Leptocottus armatus*), and non-native yellowfin goby (*Acanthogobius flavimanus*) and rainwater killifish (*Lucania parva*), are among the most common fish within these ponds (Takekawa et al. 2005). Because most of these fish cannot tolerate salinity > 70-80 ppt (Carpelan 1957; Lonzarich 1989), piscivorous birds in salt ponds generally forage only in the lower salinity intake ponds. Dabbling ducks are also usually present in highest concentrations in the lower salinity ponds, where they take both invertebrates and aquatic vegetation.

Salt ponds in the San Francisco Bay area provide habitat for more than one million waterbirds each year, including large percentages of the populations of some shorebird, duck, and tern species (Accurso 1992;

Harrington and Perry 1995; Page et al. 1999; Stenzel and Page 1988; Takekawa et al. 2001). Numerous waterbirds use the salt ponds and their associated islands and levees primarily for roosting, either at night or during high tide when their preferred foraging habitats are submerged. Large mixed-species flocks of shorebirds, gulls, terns, cormorants, pelicans, herons, and other birds are often seen roosting or loafing on levees, in shallow water, or on exposed mud in the ponds. A few species, including the black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), western snowy plover, Caspian tern (*Sterna caspia*), Forster's tern, black skimmer (*Rhynchops niger*), California Gull (*Larus californicus*), and double-crested cormorant nest on islands or levees within the ponds, particularly those that are not accessible by mammalian predators, or in the case of the western snowy plover and California Gull, on barren salt flats on the bottoms of dried ponds.

The highest-salinity ponds support little, if any, wildlife. Above a salinity of 200 ppt, even brine shrimp cannot survive, and thus there is no prey to support predatory wildlife. Although birds may occasionally roost in these hypersaline ponds, the high salinity may have adverse effects on the birds, such as impairing the waterproofing of their feathers (Rubega and Robinson 1997), and little use is made of such ponds by wildlife (Takekawa et al. 2000).

Unvegetated Areas. Approximately 77 acres of unvegetated islands exist within several of the salt ponds (Figure 1). The majority of this acreage was mapped in ponds A6 and A2E. This habitat occasionally occurs on levee side slopes below approximately MHW. Unvegetated areas are typically confined to salt pond basins and consist of bare ground and salt flat areas. Most of the salt-pond basins were historically subject to regular tidal inundation and were vegetated with salt marsh species, but salinity resulting from their use as salt ponds over decades has resulted in conditions too saline to support even halophytic vegetation. While these areas typically lie below the MHW mark, they are no longer subject to tidal flooding.

Vernal Pool Grassland. There are approximately 481 acres of vernal pool grassland located in the northeastern portion of the Study Area in the Warm Springs area (Figure 1). Here, vernal pools occur within a grassland matrix, and no attempt has been made to map individual pools on Figure 1 or quantify their acreage. The vernal pool complex in the Study Area is adjacent to the backshore of historical tidal marshlands located near Warm Springs and consists mostly of small, distinct depressions among more diffuse swales. These vernal pools harbor the Contra Costa goldfields (*Lasthenia conjugens*) listed as endangered by the federal government. Upland grassland habitat containing vernal pool habitat is located landward from the salt ponds, between the salt ponds and urbanized areas.

Vernal pools are seasonally flooded depressions that occur on ancient soils that thinly cover an impermeable substrate of hardpan, clay, or bedrock above the tideline. The impermeable substrate causes the vernal pools to retain rainwater and local runoff seasonally, but to dessicate as evaporation drains their shallow topography. Because, vernal pools are essentially temporary wetlands, they undergo distinct vegetative phases: aquatic, flowering, and drought. During the aquatic phase of the vernal pool habitat, algae may flourish, along with the aquatic stages of coyote thistle (*Eryngium* sp.) and other vernal pool plant species. Later, after the winter rainstorms have ended, the pool will begin to dry and these plant species will flower, producing rings of color around the reducing pool, with the most water-tolerant

species occurring within the middle portions of the pool. During the drought phase, upland plant species may move into the vernal pool, resulting in an area that contains upland species, bare earth, dessicated hydrophytes, and residual algal matting during the late summer months.

Vernal pools in the Study Area provide important habitat for two rare wildlife species, the vernal pool tadpole shrimp (*Lepidurus packardi*) and California tiger salamander (*Ambystoma californiense*). These pools also provide seasonal foraging habitat for shorebirds, dabbling ducks, and egrets.

Peripheral Halophytes. Approximately 119 acres of peripheral halophytes are found along the banks and tops of levees surrounding the baylands and along the levees separating the salt ponds in the Study Area (Figure 1). The extent of peripheral halophytic vegetation is primarily determined by the salinity of the levee soils and how recently the levee soils were excavated from borrow pits in adjacent salt ponds. Peripheral halophytes typically include non-native, ruderal ("disturbance-loving") species such as iceplant (*Mesembryanthemum nodiflorum*), New Zealand spinach (*Tetragonia tetragonioides*), Russian thistle (*Salsola soda*), and Australian saltbush (*Atriplex semibaccata*), which usually occur only above the MHHW mark. Native high marsh species also occasionally form peripheral halophytic habitat along levee banks as conditions permit. These species include marsh gumplant, alkali heath, spearscale, and saltgrass. In addition, pickleweed may occur on levee banks; assemblages of pickleweed and peripheral halophytes are mapped as salt marsh if pickleweed is dominant in the area. Low-lying, or eroded levees between salt ponds are usually too saline to support halophytes. Levees contiguous with uplands are typically dominated by upland species (described below) rather than peripheral halophytes.

Peripheral halophytes are used as foraging (and occasionally nesting) sites by ducks, song sparrows, and savannah sparrows, and provide foraging habitat and cover for several additional sparrows and finches during the nonbreeding season. In addition, peripheral halophytic vegetation provides important refugial habitat for salt marsh wildlife species during high tides.

Upland Vegetation/Golf Courses. There are approximately 1465 acres of upland habitat within the Study Area (mostly non-native grassland habitat), the majority of which consists of parcels of ruderal vegetation in the eastern and southern undeveloped portions of the Study Area (Figure 1). A small area of upland vegetation was also found bordering sections of freshwater and brackish marshes within the Study Area. In addition, 990 acres of golf course land, primarily within the southern extent of the Study Area, were identified.

Aside from numerous ornamental plant species occurring in landscaped areas, assemblages of annual, non-native plants that thrive in disturbed areas (ruderal species) dominate most of the upland habitat. These species include most tree, shrub, and herbaceous species found in upland areas. The predominant upland species surrounding the ponds include Italian ryegrass (*Lolium multiflorum*), ripgut brome (*Bromus diandrus*), black mustard (*Brassica nigra*), wild radish (*Raphanus sativus*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), wild oats (*Avena fatua*), yellow star-thistle (*Centaurea solstitialis*), common sow thistle (*Sonchus oleraceus*), bull thistle (*Cirsium vulgare*), bristly ox-tongue (*Picris echioides*), rabbitsfoot grass, brass buttons, alkali heath, and coyote brush (*Baccharis pilularis*).

Most of the wildlife species found in peripheral upland areas are common species adapted to urban or ruderal habitats. Reptiles such as the western fence lizard (*Sceloporus occidentialis*), gopher snake (*Pituophis melanoleucus*), and southern alligator lizard (*Elgaria multicaranata*), and mammals such as the house mouse (*Mus musculus*), California vole (*Microtus californicus*), western harvest mouse (*Reithrodontomys megalotis*), California ground squirrel (*Spermophilus beecheyi*), black-tailed jack rabbit (*Lepus californicus*), cottontail (*Sylvilagus auduboni*), brush rabbit (*S. bachmani*), valley pocket gopher (*Thomomys bottae*), and striped skunk (*Mephitis mephitis*), all occur in the upland transitional areas along the edge of the Bay. A small, isolated population of western pond turtles (*Emys marmorata*) is present in brackish habitats near the Sunnyvale WPCP and Moffett Field, and California tiger salamanders occur in vernal pool habitats in the Warm Springs area.

In most areas, the bird species that occur in the peripheral habitats are also common, widespread species. These include permanent residents such as the Anna's hummingbird (*Calypte anna*), mourning dove (*Zenaida macroura*), black phoebe (*Sayornis nigricans*), northern mockingbird (*Mimus polyglottos*), bushtit (*Psaltriparus minimus*), California towhee (*Pipilo crissalis*), red-winged blackbird (*Agelaius phoeniceus*), Brewer's blackbird (*Euphagus cyanocephalus*), house finch (*Carpodacus mexicanus*), lesser goldfinch (*Carduelis psaltria*), summer residents such as the barn swallow (*Hirundo rustica*) and cliff swallow (*Petrochelidon pyrrhonota*), transients (some of which breed at higher elevations in the Bay Area), including the orange-crowned warbler (*Vermivora celata*) and Swainson's thrush (*Catharus ustulatus*), and winter residents such as the hermit thrush (*Catharus guttatus*), white-crowned sparrow (*Zonotrichia leucophrys*), golden-crowned sparrow (*Zonotrichia atricapilla*), yellow-rumped warbler (*Dendroica coronata*), and American pipit (*Anthus rubescens*). Burrowing owls (*Athene cunicularia*) are also present in ruderal habitats and non-native grasslands in scattered areas surrounding the South Bay salt ponds and marshes. The extent of the upland fields that once probably provided extensive alternate foraging habitat for shorebirds has been reduced considerably by development. Nevertheless, shorebirds such as killdeer (*Charadrius vociferus*), long-billed curlews (*Numenius americanus*), and dunlin (*Calidris alpina*) occasionally forage in more extensive upland fields in the Alviso, Fremont, and Newark areas during the wet season, and greater yellowlegs (*Tringa melanoleuca*) and least sandpipers (*Calidris minutilla*) may forage around ponded water in such fields in winter.

Parks/Upland Grassland. Approximately 466 acres of parks/upland grassland were found within the survey area, mostly located along the southern extent of the undeveloped portion of the Study Area (Figure 1). Included in this habitat description are areas within the Study Area designated as city or county parkland, including fallowed agricultural fields, manicured irrigation basins, and large areas of landscaped vegetation. Wildlife species in this habitat type are similar to those described for upland vegetation/golf courses above.

Levee. Approximately 416 acres of levees were mapped throughout the Study Area, found along the periphery of the baylands and separating many of the individual ponds in the salt pond complex (Figure 1). Levees are linear, barren, earthen structures that separate salt ponds from tidal areas and adjacent salt ponds. The levees in the South Bay salt pond complexes were typically constructed from soils excavated from borrow pits in former salt marshes which have since been developed into salt ponds; standing water can usually be found in the borrow ditches of otherwise empty salt ponds. The levee substrate is therefore

primarily saline, silty clay. Dirt roadways along the upland perimeters of salt ponds or bayfronts were typically mapped as levee. Portions of levees dominated by peripheral halophytes, or upland vegetation, were categorized as either of those habitat types, rather than as levee habitat.

Developed. Approximately 14,480 acres of developed areas make up the largest land use category within the Study Area. Development is found along the entire periphery of the Study Area boundary and extends towards the South Bay to the outward edge of the baylands (Figure 1). Approximately 1487 acres of lands designated for water/sewage treatment use are found in the Study Area. The majority of this acreage includes the water pollution control plants for the cities of San Jose and Sunnyvale. Approximately 779 acres of lands designated for landfill use are found in the including Newby Island, the Zanker Road Landfill, and Palo Alto Baylands. Approximately 975 acres of lands designated for airport use are found in the Study Area. Moffett Field makes up the majority of this airport designation.

Developed areas within each complex include roadways, parking areas, building complexes, pump facilities, water/sewage treatment areas, landfills, airports, and powerline facilities. Such areas are typically maintained free of vegetation, but may occasionally support isolated ruderal upland vegetation (described above). Larger areas of upland or ornamental (landscaping) vegetation in developed settings are categorized as parks/upland grassland. Sludge ponds, oxidation ponds, drying beds, and associated impoundments at the South Bayside System Authority Wastewater Treatment Works in Redwood City, the San Jose-Santa Clara WPCP in Alviso, and the Sunnyvale WPCP support high densities of breeding dabbling ducks, Canada geese (*Branta canadensis*), and black-necked stilts, and depending on pond conditions can support very high densities of migrant and wintering waterfowl.

Table 1 - Habitat Types mapped in the Shoreline Study Area (acreages).

Habitat Type	Acres
Muted Tidal/Diked Marsh	1250
Brackish Marsh	955
Salt Marsh	725
Freshwater Marsh	489
Riparian/Creek Corridor	260
Wetland/Riparian subtotal	**3679**
Mudflat	7498
System Ponds (ISP Management)	4638
Open Water	2664
Water/Sewage Treatment	1487
Related Projects	1436
High Salinity Ponds (ISP Management)	826
Seasonal Ponds/High Salinity Ponds (ISP Management)	724
Seasonal Ponds (ISP Management)	712
Full Tidal (ISP Management)	477
Salt Ponds (Active)	235

Habitat Type	Acres
Pond/Open Water subtotal	**20,697**
Developed	14,480
Parks/Upland Grassland	466
Airport	975
Upland Vegetation	1465
Landfill	779
Golf Course	990
Vernal Pool Grassland	481
Levee	416
Peripheral Halophytes	119
Unvegetated	77
Other subtotal	**20,248**
Total	**44,624**

Table 2 - Summary Table for the Habitat Types in the Shoreline Study Area.

Habitat Type	Acres	Proportion of Total
Wetland/Riparian	3679	8.2%
Pond/Open Water	20,697	46.4%
Other	20,248	45.4%
Total Area Mapped	**44,624**	**100%**

3.4 Special-Status Plant Species

Historically, special-status plant species were neither commonly occurring nor widely distributed within the upper zones of the tidal salt marsh and brackish marshes of the San Francisco Bay. However, those special-status species with broad edaphic tolerances were, and are today, locally common. For example, marsh gumplant (*Grindelia stricta* var. *angustifolia*), is limited to the upper marsh zone of the Bay, but tolerates disturbed fill soils; it is abundant within South Bay marshes and was recently removed from the California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants (2001). Similarly, Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*), while limited in distribution (CNPS List 1b), is associated with alkaline upper marsh habitats as well as with low-lying alkaline soils; large stands occur well east of the San Francisco Bay. Conversely, plants with highly restrictive growth requirements, such as for coarse substrates on high-energy shorelines, salt panne edges, or channel edges within tidal brackish marsh, are now extremely rare in the urban estuary of the Bay due to the limited acreage and distribution of these habitat types within the area. The continued persistence of these plants is further threatened by non-native, invasive plant species, particularly perennial pepperweed, which generally thrive under disturbed conditions with increased urban runoff.

3.4.1 Special-Status Plant Assessment

The California Natural Diversity Database (CNDDB, CDFG 2007) was queried to identify special-status plant species potentially occurring within the Palo Alto, Mountain View, and Milpitas USGS 7.5 minute quadrangles in which the majority of the Study Area occurs, as well as the ten quadrangles surrounding the Study Area, and the Newark and Redwood Point quadrangles that contain very small portions of the Study Area. In addition, to be inclusive of all species that may occur within the Study Area, particularly within grassland fringe areas with saline or alkaline soils, valley and foothill grassland, marsh and swamp, and vernal pool habitats were queried within the CNPS database (http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi, accessed 8 February 2007) for Alameda, San Mateo, and Santa Clara Counties.

Numerous occurrences of six species, including Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*), Hoover's button-celery (*Eryngium aristulatum* var. *hooveri*), Congdon's tarplant, alkali milk-vetch (*Astragalus tener* var. *tener*), Contra Costa goldfields (*Lasthenia conjugens*), and San Joaquin spearscale (*Atriplex joaquiniana*), have been documented in the immediate vicinity of the Study Area; the latter five species are known from the Study Area primarily from the Warm Springs Unit of the Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR) and the adjacent Pacific Commons Preserve in Fremont. Historical (likely extirpated) populations of alkali milk-vetch and Point Reyes bird's-beak are documented in the vicinity of Alviso. One additional species, Pacific cordgrass (*Spartina foliosa*), has been considered for inclusion in the USFWS draft recovery plan and is common in the area, but was not included in this assessment.

CNDDB (2006) records list 22 species as occurring within five miles (eight km) of the Study Area: San Joaquin spearscale, Congdon's tarplant, Contra Costa goldfields, alkali milk-vetch, hairless popcorn flower (*Plagiobotrys glaber*), robust spineflower (*Chorizanthe robusta* var. *robusta*), Hoover's button-celery, California seablight (*Suaeda californica*), arcuate bush mallow (*Malacathamnus arcuatus*), Point Reyes bird's-beak, slender-leaved pondweed (*Potamogeton filiformis*), lost thistle (*Cirsium praeteriens*), San Mateo thorn-mint (*Acanthomintha duttonii*), Marin western flax (*Hesperolinon congestum*), Franciscan onion (*Allium peninsulare* var. *franciscanum*), fragrant fritillary (*Fritillaria liliacea*), caper-fruited tropidocarpum (*Tropidocarpum capparideum*), western leatherwood (*Dirca occidentalis*), San Francisco collinsia (*Collinsia multicolor*), Hall's bush mallow (*Malacothamnus hallii*), most beautiful jewel-flower (*Streptanthus albidus* ssp. *peramoenus*), and Davidson's bush mallow (*Malacothamnus davidsonii*).

From this analysis, 49 special-status plant species have been identified that occur in similar Alameda, San Mateo, and Santa Clara county habitats and elevations, or are found within the USGS quads listed above, based on the query, including 22 special-status plant species that have been recorded within a five mile radius of the Study Area (CNDDB, CDFG 2007). All species selected from these queries were then cross referenced with the most recent state and federal listing update according to the California Department of Fish and Game to verify listing status and identify any recently listed species.

Presence of suitable habitat was the principal criterion used for inclusion in the list of species potentially occurring within the Study Area. Many of the special-status plant species that occur in Alameda, San Mateo, and Santa Clara Counties are associated with habitat or soil types that did not occur in the Study Area historically, or no longer occur in the Study Area due to the extensive removal of soil and addition of fill material. Following an analysis of the microhabitat conditions associated with these species, and the edaphic factors that favor their occurrence, 36 plant species of the original 49 are considered absent from the Study Area (Table 3a). The majority of the species were rejected for occurrence based on one or more of the following reasons:

1. The species would not occur within the Study Area due to the limited extent of degraded, upland habitat within the pond complexes or adjacent to developed areas and the highly saline and/or ruderal nature of these areas
2. The species occurs in chaparral habitat or cismontane woodland habitat, which do not exist within the Study Area.
3. The species nearly always or always occurs on serpentinite outcroppings, of which none were observed within the Study Area. Also, no serpentinite soil series are mapped in this area as being present by SCS (1968), and are not indicated as being present in the region by the Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area.
4. The species' published elevation range is outside the range of elevations found along the Study Area.
5. The species has a highly endemic range that does not include areas within or reasonably near to the Study Area, or the species is considered by CNPS to be extirpated or absent from Alameda, Santa Clara, and San Mateo Counties

Table 3a - Plant Species considered, but rejected for occurrence within the South San Francisco Bay Shoreline Study Area (Santa Clara and Alameda Counties).

Scientific Name	Common Name	Lack of Chaparral or Other Suitable Habitat	Lack of Mesic Habitat	Lack of Serpentine Soils	Other Edaphic Factors Absent from the Site	Associated Species Absent from the Site	CNPS Records List the Species as Extirpated or Never Occurred	Suitable Habitat on Site Disturbed/Degraded
Acanthomintha duttonii	San Mateo thorn-mint	X		X			X	
Allium peninsulare var. *franciscanum*	Franciscan onion			X	X			
Amsinckia lunaris	bent-flowered fiddleneck	X						
Atriplex cordulata	heartscale				X	X		
Atriplex coronata var. *coronata*	crownscale		X			X		
Atriplex depressa	brittlescale		X			X		
Centromadia parryi ssp. *parryi*	pappose tarplant						X	
Chorizanthe robusta var. *robusta*	robust spineflower	X			X			
Cirsium praeteriens	lost thistle						X	

Scientific Name	Common Name	Lack of Chaparral or Other Suitable Habitat	Lack of Mesic Habitat	Lack of Serpentine Soils	Other Edaphic Factors Absent from the Site	Associated Species Absent from the Site	CNPS Records List the Species as Extirpated or Never Occurred	Suitable Habitat on Site Disturbed/Degraded
Collinsia multicolor	San Francisco collinsia	X		X				
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's-beak						X	
Dirca occidentalis	western leatherwood	X			X			
Eriogonum truncatum	Mt. Diablo buckwheat				X			
Eryngium aristulatum var. *hooveri*	Hoover's button celery					X		X
Erysimum franciscanum	San Francisco wallflower			X				
Eschscholzia rhombipetala	diamond-petaled California poppy					X		X
Fritillaria liliacea	fragrant fritillary			X				
Hesperevax caulescens	hogwallow starfish				X			
Hesperolinon congestum	Marin western flax	X		X			X	
Hordeum intercedens	vernal barley						X	
Leptosiphon grandiflorus	large-flowered leptosiphon							
Lilium maritimum	coast lily	X			X		X	
Limnanthes douglasii ssp. *sulphurea*	Point Reyes meadowfoam				X		X	
Lotus formosissimus	harlequin lotus	X			X		X	
Malacathamnus arcuatus	Arcuate bush mallow	X						
Malacothamnus davidsonii	Davidson's bush mallow	X					X	
Malacothamnus hallii	Hall's bush mallow	X						
Microseris paludosa	marsh microseris	X					X	
Navarretia cotulifolia	cotula navarretia				X			
Perideridia gairdneri ssp. *gairdneri*	Gairdner's yampah					X		X
Plagiobotrys glaber	hairless popcorn flower						X	
Potamogeton filiformis	Slender-leaved pondweed						X	
Streptanthus albidus ssp. *peramoenus*	most beautiful jewel-flower	X		X				
Suaeda californica	California seablite						X	
Trifolium amoenum	showy Indian clover			X			X	
Tropidocarpum capparideum	caper-fruited tropidocarpum						X	

The remaining 13 species considered for occurrence within the Study Area did not match any of the above rejection criteria, and could not be reasonably excluded due to the range of habitat types and ecotones present on-site; these species are considered in Table 3b. These include three species (Contra Costa goldfields, Congdon's tarplant, and prostrate navarretia) that are known to occur in the Study Area;

two species (San Joaquin spearscale and alkali milk-vetch) that are not known to occur in the Study Area but that occur immediately adjacent to the Study Area in the Pacific Commons Preserve, and thus have the potential to occur in the Study Area; one species (Delta tule pea [*Lathyrus jepsonii* var. *jepsonii*]) that is not known from extant occurrences in the South Bay but which could potentially occur in the Study Area; five species (palmate-bracted bird's-beak [*Cordylanthus palmatus*], hispid bird's-beak [*Cordylanthus mollis* ssp. *hispidus*], recurved larkspur [*Delphinium recurvatum*], Delta woolly-marbles [*Psilocarphus brevissimus* var. *multiflorus*], and saline clover [*Trifolium depauperatum* var. *hydrophilum*]) that are unlikely to occur in the Study Area; and two species (Mason's lilaeopsis [*Lilaeopsis masonii*] and Coastal Marsh milk-vetch [*Astragalus pycnostachyus* var. *pycnostachyus*]) that are considered absent from the Study Area, which probably has never provided suitable habitat for these two species. The ecology, distribution, and potential for reintroduction of these species are provided below.

Three terrestrial communities of concern appeared on CNNDB (2007) records within a five mile radius of the Study Area: Northern Coastal Salt Marsh, Serpentine Bunchgrass, and Valley Oak Woodland. Of these habitat types, only Northern Coastal salt marsh habitat occurs within the Study Area, as described above within the listed habitat descriptions.

Table 3b – Special-status plant species, their status, and potential occurrence in the Shoreline Study Area.

NAME	STATUS*	HABITAT/ DESCRIPTION	POTENTIAL FOR OCCURRENCE ON SITE
Federal or State Threatened or Endangered Species			
Palmate-bracted bird's-beak (*Cordylanthus palmatus*)	FE, SE, CNPS 1B	Chenopod scrub, Valley and foothill grassland/alkaline. Known from Alameda, Colusa, Fresno, Glenn, Madera, and Yolo Counties. Believed to be extirpated from San Joaquin County. Annual hemiparasitic herb that blooms May through October.	**Unlikely.** Due to the general degraded nature or lack of alkaline flat substrate within the Study Area, the occurrence of Palmate-bracted bird's-beak within the Study Area is unlikely.
Contra Costa goldfields (*Lasthenia conjugens*)	FE, CNPS 1B	Saline/alkaline vernal pools, mesic areas within grassland. Known from Alameda, Solano, Monterey, Contra Costa, and Napa counties. Annual; blooms March through June.	**Present.** Two large colonies associated with grassy seasonal wetlands in Fremont vicinity; otherwise occurs in disjunct populations in Monterey and North Bay. The Warm Springs portion of the Study Area provides suitable habitat and is included within the vernal pool critical habitat for Contra Costa Goldfields (Unit 8).
Mason's lilaeopsis (*Lilaeopsis masonii*)	SR, CNPS 1B	Exposed banks of tidal meanders and channels within brackish to freshwater marsh. Locally common in Suisun Marsh. Perennial; blooms April through November.	**Absent.** Not known to occur in the South Bay; historical and current records in Suisun Bay only.
State Rare and CNPS Species			
Coastal marsh milk-vetch (*Astragalus pycnostachyus* var. *pycnostachyus*)	FSC, CNPS 1B	Coastal salt marshes, streamsides, and mesic coastal dunes in Marin and San Mateo counties. Perennial; blooms April to October.	**Absent.** Not known to occur in South Bay; no suitable habitat in Shoreline Study Area (Extant populations associated with maritime salt marsh).
Alkali milk-vetch (*Astragalus tener* var. *tener*)	FSC, CNPS 1B	Alkaline soils in playas, vernal pools, and adobe clay areas within grassland. Alameda, Merced, Solano, and Yolo counties. Annual; blooms March to June.	**Potential.** Recently rediscovered in seasonal wetlands near Fremont, on Pacific Commons Preserve immediately outside Shoreline Study Area. Considered extirpated from Santa Clara County. Currently suitable vernal pool habitat occurs within the Warm Springs portion of the Shoreline Study area.
San Joaquin spearscale (*Atriplex joaquiniana*)	FSC, CNPS 1B	Alkaline soils within chenopod scrub, meadows, playas, and grasslands in 14 central California counties. Annual; blooms April through October.	**Potential.** Occurs in seasonal wetlands in Warm Springs vicinity; known from Pacific Commons Preserve. Potential habitat present in Warms Springs portion of Shoreline Study Area.
Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*)	CNPS 1B	Moist, alkaline soils within grassland. Tolerates disturbance. Annual; blooms June through November. Known from Alameda, Monterey, San Luis Obispo, and Santa Clara counties.	**Present.** Occurs in seasonal wetlands in Warm Springs vicinity; known from Pacific Commons Preserve. Also recently recorded in Alviso and at Sunnyvale Baylands Park. May occur in peripheral halophyte or disturbed upland zones in Shoreline Study Area, but not currently associated with salt marsh.

NAME	STATUS*	HABITAT/ DESCRIPTION	POTENTIAL FOR OCCURRENCE ON SITE
Hispid bird's-beak (*Cordylanthus mollis* ssp. *hispidus*)	CNPS 1B	Meadows and seeps, Playas, Valley and foothill grassland/alkaline. Known from Alameda, Fresno, Kern, Merced, Placer, and Solano counties. Annual hemiparasitic herb that bloomsJune through September.	**Unlikely.** Due to the general degraded nature or lack of saline flats substrate within the Study Area, the occurrence of Hispid bird's-beak within the Study Area is unlikely.
Recurved larkspur (*Delphinium recurvatum*)	CNPS 1B	Chenopod scrub, Cismontane woodland, Valley and foothill grassland/alkaline. Known from Alameda, Contra Costa, Fresno, Glenn Glenn, Kings, Kern, Madera, Merced, Monterey, San Joaquin, San Luis Obispo, Solano, and Tulare Counties. It is believed to be extirpated from Butte and Colusa counties. Perennial herb that blooms from March through June.	**Unlikely.** Due to the general degraded nature or lack of grassland habitat with alkaline soils within the Study Area, the occurrence of recurved larkspur within the Study Area is unlikely.
Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)	CNPS 1B	High marsh zone in brackish and freshwater marshes. Known from Suisun Marsh (Sacramento, San Joaquin, Solano and Contra Costa counties) and Napa marshes. Perennial; blooms May through September.	**Potential.** Historical and current records are from the North Bay only. However, marginal habitat is present within the Study Area, and there is some potential for occurrence.
Prostrate navarretia (*Navarretia prostrata*)	FSC, CNPS 1B	Seasonal wetlands and vernal pools within grassland and coastal scrub. Ranges from Monterey County south to San Diego. Annual; blooms April through July.	**Present.** In South Bay, known only from Pacific Commons Preserve and the Warm Springs unit of the SFBNWR.
Delta woolly-marbles (*Psilocarphus brevissimus* var. *multiflorus*)	CNPS 4	Dried beds of vernal pools and flats, especially in grasslands, in Alameda and Santa Clara counties north to Yolo County. Annual; blooms April to June.	**Unlikely.** Currently the Warm Springs area presents potentially suitable habitat within the Shoreline Study Area.
Saline clover (*Trifolium depauperatum* var. *hydrophilum*)	FSC, CNPS 1B	Edges of salt marshes, alkali meadows, and vernal pools along the coast from Sonoma County south to San Luis Obispo, as well as in the inland counties of Solano and Colusa. Annual; blooms April through June.	**Unlikely.** Historical collection (type locality) from Belmont; not recorded since in South Bay. Currently the Warm Springs area presents potentially suitable habitat within the Shoreline Study Area.

CNPS LISTS:
1A – Plants presumed extinct in California
1B – Plants rare, threatened, or endangered in California and elsewhere
2 – Plants rare, threatened, or endangered in California, but more common elsewhere
3 – Plants about which more information is needed – a review list
4 – Plants of limited distribution – a watch list

Other Listed Status:
FE –Federally Endangered
FSC –Federal Species of Concern
SR –State Rare
SE –State Endangered

Palmate-bracted bird's-beak (*Cordylanthus palmatus*). Federal Status: Endangered; State Status: Endangered; CNPS Status: List 1B. Palmate-bracted bird's-beak is a hemiparasitic annual herb in the Scrophulariaceae typically found in chenopod scrub or alkaline valley and foothill grassland habitat at elevations of five to 155 meters. Plants are between ten to 30 centimeters, gray-green, and soft-hairy. Flowers are whitish and appear from May to October.

Palmate-bracted bird's-beak is known from only nine occurrences (CNPS 2001) and is threatened by agriculture, urbanization, grazing, and industrial development. No local occurrences exist in CNDDB records (2007). It is expected to occur within alkaline flats in the Study Area.

Potential for occurrence in the Study Area. Due to the general degraded nature or lack of alkaline flat substrate within the Study Area, the occurrence of palmate-bracted bird's-beak within the Study Area is unlikely.

Contra Costa goldfields (*Lasthenia conjugens*). Federal Status: Endangered; State Status: None; CNPS Status: List 1B. Contra Costa goldfields is a small, ephemeral annual sunflower typically occurring in mesic depressions within open, grassy habitats. Plants range in height from four to 12 inches and bear one to several flowerheads from March through June. Both ray and disk flowers are yellow. Contra Costa goldfields is distinguished from other common, co-occurring *Lasthenia* species by its lack of a pappus (an appendage arising from the ovary) on individual flowers.

Contra Costa goldfields occurs in 20 widely scattered populations in Alameda, Contra Costa, Mendocino, Monterey, Napa, and Solano Counties (CDFG 2004a). Extant populations in the South Bay area occur at the Pacific Commons Preserve (seasonal wetlands) and at the nearby Don Edwards San Francisco Bay NWR, Warm Springs Unit (vernal pools and swales). Management of both preserve areas focuses on the conservation of the species (USFWS and CDFG 2003; Wetlands Research Associates 1999).

Contra Costa goldfields is not expected to occur within tidal wetlands, but may occur in seasonal wetlands in the upland transition zone. According to the critical habitat designation for this species (Department of the Interior 2003), Contra Costa goldfields is most often found in vernal pools, swales, moist flats and depressions within grassland. However, Baye (2000) discusses the historical association of Contra Costa goldfields with saline seasonal wetlands at the marsh/upland boundary, as well as an apparent collection from a salt evaporator pond. Typical associated species include brass buttons (*Cotula coronipifolia*) and alkali heath, two common species of the upper and middle marsh, as well as the freshwater wetland species downingia (*Downingia* spp.), button celery (*Eryngium* spp.), water starwort (*Callitriche marginata*), and other species of goldfields (*Lasthenia glaberrima, L. fremontii*).

Potential for occurrence in the Study Area. Contra Costa Goldfields is present within the Study Area. Two large colonies associated with grassy seasonal wetlands occur in the Warm Springs unit of the SFBNWR. The Warm Springs portion of the Study Area provides suitable habitat and is included within the vernal pool critical habitat for Contra Costat Goldfields (Unit 8).

Mason's lilaeopsis (*Lilaeopsis masonii*). Federal Status: Species of Concern; State Status: Rare; CNPS Status: List 1B. Mason's lilaeopsis is a small, rhizomatous perennial in the carrot family (Apiaceae). Reaching heights of approximately three inches, plants form dense, turf-like colonies ranging from approximately 50 to over 7500 ft^2 (CDFG 2004a). Inflorescences of white or maroon flowers appear on short (≤1 inch), open umbels from April through November. Mason's lilaeopsis colonizes recently deposited, fine-grained soils on the edges of tidal meanders, sloughs, and saline-influenced reaches of creeks and rivers. This species is not known to occur in the highly saline environment of tidal salt marsh; rather, it favors the edges of marshes with significant fresh water inputs (i.e., the low brackish marsh zone). As such, populations are concentrated in the northern portion of the Bay, particularly in the Delta region, where large expanses of tidal brackish marsh occur.

Mason's lilaeopsis occurs on exposed tidal meanders and flats in the northeastern portion of the San Francisco Bay area. Associated species include marsh pennywort (*Hydrocotyle verticillata*), aquatic pygmy-weed (*Crassula aquatica*), tule (*Schoenoplectus californicus*, formerly known as *Scirpus californicus* var. *acutus*), and rushes (*Juncus* spp.) According to herbarium records catalogued by the University of California, the majority of reported occurrences of Mason's lilaeopsis are in San Joaquin, Sacramento, Contra Costa, and Solano Counties (CalFlora 2004). Although two Alameda County records exist, both apparently refer to a population south of Clifton Court Forebay at the Contra Costa County line (CalFlora 2004; CDFG 2004a).

Historically, creek flows into the South Bay were intermittent, and broad expanses of riparian vegetation and seasonal wetlands ringing the Bay retained runoff of rainwater prior to its reaching the marshes. Extremely high salinities at the edges of South Bay marshes are apparent in the historical distribution of salt pannes and natural salt ponds (San Francisco Estuary Institute 1999). Currently, salinity in the South Bay typically approaches that of seawater (Life Science 2004). This may account for the lack of historical records of Mason's lilaeopsis from the Alameda/San Mateo/Santa Clara counties region, although fringing brackish marshes do occur at Mud Slough, Coyote Creek, Artesian Slough, Alviso Slough, and Guadalupe Slough (Baye et al. 2000), and are currently increasing in extent (H. T. Harvey & Associates 1997b). Furthermore, extensive brackish marsh occurs at Petaluma Marsh, and Mason's lilaeopsis has not been documented there. Detailed studies of the distribution and abundance of this species are not available.

Potential for occurrence in the Study Area. Populations of Mason's lilaeopsis are absent from the South Bay, perhaps due to the lack of appropriate brackish habitat. Because Mason's lilaeopsis has never been documented in the Study Area, it is considered to be absent within the Shoreline Study Area.

Coastal marsh milk-vetch (*Astragalus pycnostachyus* var. *pycnostachyus*). Federal Status: Species of Concern; State Status: None; CNPS Status: List 1B. Coastal marsh milk-vetch is a stout, perennial herb in the pea family (Fabaceae) associated with maritime salt marshes, seeps, and mesic sites within dunes in Humboldt, Marin, and San Mateo counties. Plants have an open, clumping habit and are densely soft-hairy, with long pinnate leaves and distinctive papery, inflated fruits. Many greenish-white or cream colored flowers appear on in the axils of leaves from April through October.

Coastal marsh milk-vetch is known from three locations in coastal San Mateo County (Pescadero Marsh, Pomponio State Beach, San Gregorio State Beach), where plants are associated with sandy-clay or gravelly soils. Little published information is available on the ecological requirements of this plant, but suitable microhabitat apparently occurs within a range of plant communities. One population occurs on a steep slope within coastal scrub, associated with coyote brush (*Baccharis pilularis*), sea lettuce (*Dudleya farinosa*), and sticky monkeyflower (*Mimulus aurentiacus*). The Pescadero Marsh population, on the other hand, persists in a diked area with peripheral halophytes, including alkali heath and marsh gumplant. Approximately ten extant populations/occurrences are documented in Marin and Humboldt counties (CDFG 2004a), predominantly associated with the upper marsh ecotone. Coastal marsh milk-vetch's southern relative, Ventura marsh milkvetch (*A. p.* ssp. *lanosissimus*) is listed as endangered.

Potential for occurrence in the Study Area. Coastal marsh milk-vetch is found exclusively on course substrates such as sandy clay and gravel and has never been observed east of the immediate coast. Despite the relative tolerance of this species to disturbed habitats such as levees, it is considered to be absent from the Study Area due to historical and current patterns of sediment deposition. Furthermore, the Study Area is outside the known range of this species.

Alkali milk-vetch (*Astragalus tener* var. *tener*). Federal Status: None; State Status: None; CNPS Status: List 1B. Alkali milk-vetch is a delicate annual plant associated with vernal pools, alkaline flats, and vernally moist meadows and grasslands in Alameda, Merced, Napa, Solano, and Yolo counties. Plants range in height from two to 12 inches, appearing in late winter as erect or ascending stems with glabrous, pinnately compound leaves. Pinkish-purple flowers appear from March through June, depending on timing of soil saturation/inundation and drying. All taxa within this species complex are associated with moist, vernally mesic soils and are extremely rare.

Alkali milk-vetch is associated with seasonal wetland species such as owl's clover (*Orthocarpus* spp.), downingia, semaphore grass (*Pleuropogon californicus*), and popcorn-flower (*Plagiobothrys* spp.), and occasionally with peripheral halophytes such as salt grass and alkali heath, within alkali meadows. Plants occur on the upper edges of vernal pools, within grasslands underlain by heavy, moisture-retentive clay soils, and within the upper floodplains of rivers. Populations are often associated with, and threatened by, non-native annual grasses and forbs. At least one location, a population of alkali milk-vetch is threatened by management activities for waterfowl, which create perennially-inundated conditions unsuitable for supporting the species (CDFG 2004a). Approximately 30 extant populations/occurrences of alkali milk-vetch are documented by CDFG (2004a). The majority of these occurrences is the result of intensive surveys of historical locations, and is likely an accurate representation of the actual current range of the species.

Potential for Occurrence in the Study Area. Many historical locations of alkali milk-vetch in the South Bay (i.e., Alviso, Milpitas, and "Mayfield", now Palo Alto) are now heavily developed or degraded and, until recently, the species was presumed to be extirpated from the Bay Area. However, a population of alkali milk-vetch was discovered along the upper boundaries of created vernal pools at the Pacific Commons Preserve in 1999 (Wetlands Research Associates 1999). This population has persisted at least through 2006. This site is the location of a historical collection of the species, which likely persisted

through years of unfavorable conditions by remaining dormant in the seedbank. It is therefore possible that other sites along the outer edges of the baylands of the Study Area, particularly those within the marsh/upland transition zone, contain viable alkali milk-vetch propagules. Currently suitable vernal pool habitat occurs within the Warm Springs portion of the Shoreline Study Area.

San Joaquin spearscale (*Atriplex joaquiniana*). Federal Status: None; State Status: None; CNPS Status: List 1B. San Joaquin spearscale is an annual, grey-scaly, ascending plant in the goosefoot family (Chenopodiaceae). Like all *Atriplex* species, San Joaquin spearscale lacks petals, and flowers instead appear as dense clusters of fleshy, grey-green perianth parts in terminal inflorescences. This species flowers over a long period from April to October, depending on hydrological characteristics of the associated mesic habitat.

San Joaquin spearscale occurs on moist alkaline soils within a range of habitats, including non-native annual grassland, alkali meadow and scald, alkali sink, and the cut banks of eroded vernal pools. Huge populations occur in the vicinity of the Springtown Wetlands Preserve (in Livermore, CA, which is outside of the Study Area), most commonly associated with alkali heath, alkali weed (*Cressa truxillensis*), saltgrass, and tarweeds (*Centromadia* spp.) (Boursier 1997.). CDFG documents 69 populations/ occurrences of this species, nearly all of which were observed relatively recently and are presumed to be extant (CDFG 2004a).

Potential for Occurrence in the Study Area. San Joaquin spearscale, like alkali milk-vetch, was recently discovered growing along the margins of created vernal pools at the Pacific Commons Preserve in Fremont, adjacent to the Warm Springs Unit of the SFBNWR. Plants occur along the upper edges of created vernal pools, where they are associated with non-native grasses and forbs. No other occurrences are documented in the Study Area. Because the Pacific Commons population likely resulted from an existing seedbank, areas of suitable habitat in the Study Area may harbor dormant populations.

Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*). Federal Status: None; State Status: None; CNPS Status: List 1B. Congdon's tarplant is a spiny, resinous annual herb in the sunflower family associated with moist, alkaline grasslands. Populations are frequently located within sumps or disturbed areas where water collects, and may be favored by moderate levels of disturbance that reduce the cover of non-native grasses and forbs. Unlike many of its community associates, this species matures in late summer and can flower into mid-fall; tarweeds in general are among the latest-blooming wildflowers of the area. Congdon's tarplant can be differentiated from co-occurring species of tarweed by the lack of tack-shaped glands on the leaves and flower bracts and the structure of its chaff scales (dry bracts among individual flowers).

Known populations of Congdon's tarplant occur in Monterey, San Luis Obispo, and Santa Clara counties, where CNNDB documents 62 occurrences. Congdon's tarplant was once common along salt marsh edges in the South Bay (Munz and Keck 1959) and, as evidenced by recent observations of small, remnant colonies, has a slight potential for occurrence on levees and adjacent upland areas throughout the Alviso Complex. Associated species include Italian rye (*Lolium multiflorum*) alkali heath, and salt grass.

Potential for Occurrence in the Study Area. In the Study Area, several populations are known from disturbed annual grassland habitat in the vicinity of Alviso (H. T. Harvey & Associates 2002b; LSA Associates 1999), in the Warm Springs district of Fremont, near Milpitas, and in the Sunnyvale Baylands Park (CDFG 2004a). Congdon's tarplant has been reported from near the mouth of Stevens Creek, where a small, remnant occurrence of a historical population was observed in hard-packed gravel along the levee road north of the end of Crittenden Road (CDFG 2004a). Populations are also known from slightly saline grasslands in the Warm Springs district, and historical observations are reported from Cooley Landing in Menlo Park and from East Palo Alto (in the vicinity of the Ravenswood Complex). Congdon's tarplant is frequently associated with disturbed, alkaline habitats that pond water in the late winter and spring. As such, suitable habitat occurs on the margins of evaporation ponds or within the peripheral halophyte zone along the levees, and several occurrences are noted within the Study Area.

Hispid bird's-beak (*Cordylanthus mollis* ssp. *hispidus*). Federal Status: None; State Status: None; CNPS Status: List 1B. Hispid bird's-beak is a hemiparasitic annual herb in the Scrophulariaceae typically found in meadows and seeps, playas, or valley and foothill grassland habitats in alkaline soils at elevations of five to 155 meters. Plants are bristly and between ten and 40 centimeters, gray-green, often tinged purple, and long-non-glandular hairy. Flowers are whitish and appear from June to September.

Hispid bird's-beak is extirpated from much of the lower San Joaquin Valley (CNPS 2001) and is threatened by agricultural conversion, development, and grazing. No local occurrences exist in CNDDB records (2007). It is expected to occur within saline marshes and flats in the Study Area.

Potential for Occurrence in the Study Area. Due to the general degraded nature or lack of saline flats substrate within the Study Area, the occurrence of Hispid bird's-beak within the Study Area is unlikely.

Recurved larkspur (*Delphinium recurvatum*). Federal Status: None; State Status: None; CNPS Status: List 1B. Recurved larkspur is a perennial herb in the Ranunculaceae typically found in chenopod scrub, cismontane woodland, and valley and foothill grassland habitats in alkaline soils at elevations of three to 750 meters. Plants are between 18 and 85 centimeters, with flowers generally consisting of light-blue sepals and white petals, blooming from March to May.

Recurved larkspur is known from many historical occurrences (CNPS 2001), although much habitat has been converted to agriculture. It is also threatened by grazing. No local occurrences exist in CNDDB records (2007). It is expected to occur within poorly drained, fine, alkaline soils in grassland habitat in the Study Area.

Potential for Occurrence in the Study Area. Due to the general degraded nature or lack of grassland habitat with alkaline soils within the Study Area, the occurrence of recurved larkspur within the Study Area is unlikely.

Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*). Federal Status: Species of Concern; State Status: None; CNPS Status: List 1B. Delta tule pea is a robust, climbing perennial plant in the Pea family (Fabaceae) associated with freshwater and brackish marsh. Plants often occur in large colonies, where

they are found twining through associated vegetation or as tangled masses; individual plants can reach six feet in length. Rose-purple flowers appear from May through June, after which plants gradually senesce to overwinter as underground rootstocks. Key characters distinguishing Delta tule pea from common taxa, include the co-occurring California tule pea, are compound leaves with elongated tendrils and ten to 16 leaflets, broadly-winged stems, and lack of hairs on the stems and leaves.

Populations of Delta tule pea are restricted to the edges of marshes and sloughs with significant freshwater inputs. Plants typically occur in relatively well-drained areas, often on slight topographic relief above the marsh plain (Baye et al. 2000), and are most frequently associated with cattail, bulrush, California rose (*Rosa californica*), and coyote brush (*Baccharis pilularis*). Several populations are associated with plants more typical of the high salt marsh, including saltgrass, pickleweed, and jaumea. The center of population distribution is in the Delta region, where plants may co-occur with other rare species such as Suisun Marsh aster (*Aster lentus*) and Mason's lilaeopsis. Delta tule pea is reported to occur in the vicinity of Niles in Alameda County, but is considered extirpated in Santa Clara County (CNPS 2001).

Potential for Occurrence in the Study Area: Although reportedly extant in Alameda County (CNPS 2001), no populations of Delta tule pea have been documented in the South Bay area (CDFG 2004a). Like Mason's lilaeopsis, Delta tule pea is associated with a brackish to freshwater marsh habitat that was never common in the Study Area and is considered to be absent from the area.

Prostrate navarretia (*Navarretia prostrata*). Federal Status: Species of Concern; State Status: None; CNPS Status: List 1B. Prostrate navarretia is a small annual herb in the Phlox family (*Polemoniaceae*) associated with vernal pools and mesic, alkaline areas within grassland. Plants have a stalkless, central flower head with many prostrate flowering branches spreading radially from beneath, and leaves are long, narrow, and deeply pinnately-lobed. White to violet flowers appear from April through July as dense clusters surrounded by spiny bracts.

Prostrate navarretia is associated with relatively coarse-grained sediments in small depressions within mesic areas. Associated species include the typical vernal pool indicator species coyote-thistle (*Eryngium vaseyi*), popcorn-flower (*Plagiobothrys* spp.), and spike rush (*Eleocharis macrostachya*). The majority of known populations of prostrate navarretia occur in southern California, where plants are associated with the large vernal pool complexes of the Santa Rosa Plateau, mima mound topography in Los Angeles County, and mesas south through San Diego. Significant populations also occur on military lands in southern Monterey County and at the Kesterson National Wildlife Refuge near Merced. In the South Bay area, prostrate navarretia is known only from the seasonal wetlands and created vernal pools at the Pacific Commons Preserve.

Potential for Occurrence in the Study Area: Populations of prostrate navarretia occur in the Study Area within the Warm Springs unit of the SFBNWR. This species is also present in the immediately adjacent Pacific Commons Preserve. Currently the Warm Springs area presents the only potentially suitable habitat within the Shoreline Study Area.

Delta woolly-marbles (*Psilocarphys brevissimus* var. *multiflorus*). Federal Status: None; State Status: None; CNPS Status: List 4. Delta woolly-marbles is an annual, vernal-pool endemic in the Sunflower family (Asteraceae) with silky-hairy foliage and several spreading stems from the base. Plants are grey-green throughout and produce small (less than 1 centimeter) oval heads of pale, cobweb-like flowers from May through June. Delta woolly-marbles occur along the drying edges of vernal pools within grassland.

Potential for Occurrence in the Study Area: Populations are not known, or expected, to occur in the Study Area. While vernal pool habitat occurs in the Study Area (e.g., in the Warm Springs unit of the SFBNWR) and its vicinity (e.g., in the Pacific Commons Preserve), none of these areas currently support populations of Delta woolly marbles. With no known seed source, it is highly unlikely that this species would naturally colonize the Study Area.

Saline clover (*Trifolium depauperatum* var. *hydrophilum*). Federal Status: Species of Concern; State Status: None; CNPS Status: List 1B. Saline clover is a very small, fleshy annual plant in the Pea family. Plants are decumbent to erect, with pink-purple, white-tipped flowers appearing from April through June. Flowers become inflated as fruits mature.

This species is associated with saline-alkaline soils within grasslands, seasonal wetlands, and, at Moss Landing in Monterey County, along the margins of upper salt marsh habitat. Throughout most of its known range, saline clover is associated with typical seasonal wetland plants such as meadow barley (*Hordeum brachyantherum*), semaphore grass, and downingia, or with alkali associations of brass buttons, saltgrass, and Italian rye. Populations near Moss Landing occur at the brackish marsh-grassland ecotone.

Potential for Occurrence in the Study Area. Historical records of saline clover from seasonal wetlands in the Belmont and Alameda areas document extirpated populations; and no extant populations are known from the South Bay area. While potential habitat is present in the Study Area, there are no known occurrences of the species in the vicinity. With no known seed source, it is highly unlikely that this species would naturally colonize the Study Area, despite the presence of suitable habitat.

3.4.2 Occurrence of Non-native Plant Species within the Shoreline Study Area

Research has shown that a number of variables control the distribution of plant species in coastal marshes, including depth and duration of flooding over the marsh surface (Mendelssohn and McKee 1988; Pennings and Callaway 1992; Webb and Mendelssohn 1996; Webb et al. 1995), accumulation of phytotoxins such as hydrogen sulfide in marsh soils (DeLaune et al. 1983; King et al. 1982; Koch and Mendelssohn 1989; Webb and Mendelssohn 1996; Webb et al. 1995), interstitial nutrient concentrations (Bradley and Morris 1990; Koch and Mendelssohn 1989; Koch et al. 1990; Morris 1980), and soil mineral and organic matter content (DeLaune et al. 1979; Nyman et al. 1990). Natural variability in abiotic factors such as precipitation, tidal fluctuation, and evapotranspiration, as well as anthropogenic changes to those factors such as freshwater discharges, non-point source pollution (nutrients and

sediments), and regional/global climate changes (drought, temperature, sea level) influence these variables (Boyer and Zedler 1999, Kennish 2001). Among these variables, hydroperiod and salinity are the primary abiotic factors that control the distribution of the dominant plant species in a tidal marsh (H. T. Harvey & Associates et al. 1982; Josselyn and San Francisco State Univ. 1983; Zedler et al. 1992; Zedler et al. 1999).

Competition between different plant species (interspecific) with similar environmental tolerances also influences their distribution. Although environmental tolerance and competitive ability are inversely related (Bertness 1991; Grace and Wetzel 1981; Zedler 1982), competition still plays a role among species with similar environmental tolerances (Ervin and Wetzel 2002). For example, Zedler (1982) found that competitive interactions occur in salt marshes, and concluded that pickleweed does compete with cordgrass for light and, to some extent, nutrients. Furthermore, competitive interaction is what allows for the successful invasion of non-indigeneous species into wetland habitat and the subsequent alteration of plant distribution that is commonly observed (Vitousek 1990, Hooper and Vitousek 1997).

Many invasive plant species are known to occur or may potentially occur within the Shoreline Study Area. These species out-compete native plants, displacing entire communities of plants and associated wildlife. Control of these species is important throughout the Shoreline Study Area. While the scope of this analysis does not include a species-by-species prescription for removal, the California Invasive Plant Council (Cal-IPC) publishes the Weed Worker's Handbook (1994) describes the biology and tested methods of removal for 35 of the most noxious weeds in the Bay Area. The following species occur or may occur within the Shoreline Study Area: 1) Salt wheatgrass (*Agropyron elongatum*) has been planted along many levees to stabilize levee banks throughout the San Francisco Bay, and has spread in areas near Union City and along the levee slopes within the Palo Alto floodbasin; 2) Perennial pepperweed (*Lepidium latifoium*) has invaded many wetland areas within the San Francisco Bay, including areas within the Shoreline Study Area, but also occurs in upland areas with ruderal grassland habitat dominated by Italian ryegrass, varius non-native bromes, Mediterranean barley, and wild oats; 3) black mustard (*Brassica nigra*) and wild radish (*Raphanus sativus*) dominate the banks of the levees within much of the Shoreline Study Area; 4) non-native smooth cordgrass (*Spartina alternifolia*) and hybrids between smooth and Pacific cordgrass have spread throughout tidal salt marshes in much of the San Francisco Bay area, and the Invasive Spartina Project is actively engaged in controlling this non-native; 5) pampas grass (*Cortaderia* sp.) occurs in ruderal areas including adjacent to developed areas; 6) French broom (*Genista monspessulana*) and Scotch broom (*Cytisus scoparius*) occur in upland, disturbed areas; 7) giant reed (*Arundo donax*) invades freshwater marsh and creeks; 8) sweet fennel (Foeniculum vulgare) spreads quickly within ruderal areas; 9) common reed (*Phragmites australis*) which may have strains that are not native to California and which has invaded portions of the Palo Alto Flood Basin; and, 9) yellow star-thistle (*Centaurea solstitialis*), purple star-thistle (*Centaurea calcitrapa*), and Italian thistle (*Carduus pycnocephalus*) quickly invade and dominate grassland areas. With the restoration of the SBSP areas and this Shoreline Study, documentation of infestation by non-native plant species should allow for better planning of the removal/containment of these species.

4. WILDLIFE RESOURCES

4.1 Introduction

The San Francisco Estuary is an extremely productive, diverse ecosystem. Despite the loss of more than 90% of its original wetlands to diking, draining, and filling (Goals Project 1999; Harvey et al. 1988), wildlife diversity is high, with more than 250 species of birds, 120 species of fish, 81 mammals, 30 reptiles, and 14 amphibians regularly occurring in the estuary (Siegel and Bachand 2002). More importantly, the San Francisco Bay supports populations of a number of species that are of regional, hemispheric, or even global importance. A number of endemic, endangered, threatened, and rare wildlife species or subspecies reside in the San Francisco Bay area.

Though surrounded by urban development and highly altered by the diking of wetlands for salt production, the South Bay supports some of the most important remaining habitat in the entire estuary for a number of special-status wildlife species. In this section, the existing conditions of wildlife resources in the South Bay are described, specifically pointing to the species composition and structure of invertebrate, fish, reptile, amphibian, mammal, and bird communities. The life histories and habitat requirements of these species are also described, as well as the spatial and temporal variation in their presence/distribution in the region. In addition, the occurrence of special-status wildlife species within the South Bay is summarized.

Slight variations in microhabitat conditions, plant structure, or species composition occur within the various habitat types of the South Bay (see Section 3.3). Such variations may result in important changes in ecological conditions that affect wildlife populations and communities. However, as they pertain to wildlife use of the Study Area, the previously described habitat types can generally be divided into several broad categories: open waters of the Bay, tidal sloughs and channels, intertidal mudflats, vegetated tidal marsh, salt ponds, vernal pool grasslands, riparian habitats, and upland habitats. Note that existing South Bay salt ponds (and former salt ponds) provide habitat that is used by large numbers of a number of wildlife species, particulary birds. Thus, in the descriptions of wildlife habitat use within Shoreline Study Area, salt ponds are included and the interchange that occurs between these and other habitats in the region is discussed. The freshwater stream, riparian, and vernal pool resources within the Study Area are also discussed.

4.1.1 Overview of Wildlife Resources in the South Bay

The ecology of South Bay wildlife communities is characterized by:

- High productivity of tidal marshes, with export of organic matter from tidal marshes to tidal sloughs, channels, and mudflats, and to the Bay, supporting high abundance of invertebrates, fish, and birds.
- High productivity of salt ponds and former salt ponds, supporting an abundance of invertebrates (particularly in higher-salinity ponds) and high numbers of fish in lower-salinity ponds, but with

virtually no export of organic matter to other habitats aside from variable (and at times, very heavy) use of the salt ponds by birds.

- A heavily invaded aquatic invertebrate community dominated by non-native species, particularly in the estuarine and salt pond habitats.
- Heavy use of South Bay habitats by waterbirds, including significant proportions of Pacific Coast migratory shorebird populations.
- Highly dynamic bird and fish communities, with use of different areas varying several times a day with tide height, and with abundance and community composition varying seasonally depending on migration, precipitation, temperature, salinity, and other factors. In particular, large numbers of shorebirds forage on intertidal mudflats at low tide and use salt ponds and other alternative habitats (e.g., water treatment plant ponds) for roosting and/or foraging, particularly at high tide, and steelhead use bay habitats during their migrations as adults to spawn in tributaries and as juveniles moving from tributaries to the sea.
- The presence of rare San Francisco Bay endemics, including the California clapper rail and salt marsh harvest mouse, in remnant tidal marsh habitat.
- The presence of rare vernal pool-associated species, including the vernal pool tadpole shrimp and California tiger salamander, in vernal pools within the Warm Springs unit of the SFBNWR.
- The presence of several freshwater streams flowing into the South Bay; woody riparian habitat is limited to narrow corridors, or is highly degraded or even absent, along these streams, although moderately high-quality riparian habitat is present along lower Coyote Creek, and riparian habitats in the Study Area support very high densities of birds.

In summary, the diversity and high productivity of habitat types present within the South Bay support a diverse assortment of wildlife species in surprisingly large numbers. A detailed discussion of the biology of wildlife species present within the Study Area is provided below.

4.2 Methods

Resource agencies such as the USFWS, CDFG, and the U.S. Geological Survey; non-profit organizations and research groups such as PRBO and SFBBO; consultants working for private landowners, municipalities, and public resource agencies; researchers; and private individuals (e.g., birders) together have collected a vast amount of data on wildlife use of the South Bay. Much of the data on the wildlife species and communities of the South Bay were summarized for the Goals Project (2000). In preparing this existing conditions document, the team relied primarily on previously collected information rather than fieldwork conducted specifically for the preparation of this document. However, the wildlife ecologists have a solid understanding of the wildlife and habitats of the South Bay during all seasons. Reconnaissance-level wildlife surveys by foot and car were performed during summer and fall 2004 for the existing conditions report for the South Bay Salt Ponds Project. H.T. Harvey & Associates ecologists have made numerous visits to the Study Area since that time, and additional surveys were conducted in March 2007 specifically to assess wildlife habitat in portions of the Shoreline Study Area outside the SBSP Project Area.

4.3 Description of Wildlife Communities in the South Bay

4.3.1 Invertebrates

Invertebrate communities of the South Bay are important consumers, controlling phytoplankton biomass in the Bay, and are key prey for fish and birds. They are also important in nutrient and contaminant recycling and the accumulation of contaminants (Thompson and Shouse 2004). Invertebrate communities vary considerably among different habitats in the South Bay. This section includes a separate description of invertebrates in subtidal/intertidal habitats, tidal marshes, salt ponds, terrestrial habitats, and freshwater habitats, as well as a discussion of invasive invertebrates and mosquitoes.

Subtidal/Intertidal Invertebrate Communities. Intertidal mudflats contain three main groups of invertebrates: benthic infauna (less mobile invertebrates living in or on the mudflats), epifauna (more mobile species on the mud's surface), and pelagic fauna (highly mobile species living in the water column). Most research has focused on benthic infauna. Because of the instability caused by nearly constant erosion and deposition of sediments, as well as dramatic fluctuations in salinity, benthic infauna are dominated by species that can easily colonize mudflats, many of which are non-native species (Nichols 1979). Within the San Francisco Estuary, the South Bay contains by far the highest invertebrate biomass, likely due to greater stability of salinity and sediments, large detritus biomass, and the abundance of several introduced bivalve species (Nichols 1979; Nichols and Pamatmat 1988). The estimated biomass of invertebrates in the South Bay in winter (637 g/0.1m^2) and summer (609 g/0.1m^2) is nearly six times that for the Central Bay, San Pablo Bay, and Suisun Bay combined (115 g/0.1m^2 and 112 g/0.1m^2 in winter and summer, respectively) (Meiorin et al. 1991; Nichols and Pamatmat 1988). Studying infaunal productivity on mudflats in the South Bay, Nichols (1979) determined rates of annual productivity varying from 53 to 100 grams/meter^2/year. Although biomass was dominated by two or three common bivalves, the standing crop of invertebrates was abundant throughout the year. Migratory shorebirds were thought to be the primary consumers of invertebrate biomass on South Bay mudflats.

Much of the food for benthic invertebrates on mudflats of the South Bay comes from phytoplankton that settle to the bottom of the water column (Meiorin et al. 1991) and diatoms and blue-green algae growing on the surface of the sediment (Nichols and Pamatmat 1988). Both phytoplankton and microalgae blooms occur in the South Bay primarily in spring, in turn supporting large numbers of filter-feeders (Nichols and Pamatmat 1988). The South Bay tidal invertebrate community is dominated primarily by filter/suspension feeders such as shrimp, clams, and mussels that obtain food from phytoplankton and organic debris and bacteria, and deposit feeders, which include worms and some clams that obtain food primarily from organic debris on the surface of the mud.

Several studies of the infaunal invertebrate communities of South Bay mudflats have been conducted. Nichols and Pamatmat (1988) and Nichols and Thompson (Nichols and Thompson 1985a; Nichols and Thompson 1985b) determined that the numerically dominant species on mudflats in the vicinity of the Alviso salt ponds are the gem clam (*Gemma gemma*), the amphipod *Ampelisca abdita*, and the polychaete

worm *Streblospio benedicti*. Although less abundant, the Baltic clam (*Macoma balthica/petulam*), soft-shelled clam (*Mya arenaria*), and eastern mud snail (*Illyanassa obsoleta*) "often represent the bulk of benthic invertebrate biomass" (Nichols and Thompson 1985a). All of these dominant species except for the Baltic clam are introduced.

The benthic infaunal community has been studied in the South Bay at three stations on intertidal mudflats near the Palo Alto Water Quality Control Plant since 1974 (Thompson and Shouse 2004). The number of invertebrate species at each of three stations ranged from ten to 16 and included five bivalves, one cnidarian, seven crustaceans, two gastropods, and 14 polychaetes and oligochaetes. *Gemma*, *Streblospio* and *Ampelisca* dominated the community until the 1980s, but since 1998 *Gemma* has been the overwhelming dominant on the Palo Alto flats. Since trace element concentrations at the plant were reduced in the mid-1980s, this research has noted a substantial decline in metals accumulation in the Baltic clam and an increase in the species' reproductive activity (Hornberger et al. 2000).

Sampling nearby areas along lower San Francisquito Creek and the Palo Alto Water Quality Control Plant outfall channel, Cressey (1997) had somewhat different results. He found simple invertebrate communities in these areas, with the most abundant taxa consisting of four annelids (*Neanthes succinea*, *Eteoni lighti*, *Tubificidae* sp., and *Heteromastus filiformis*), three arthropods (*Nippoleucon hinumensis*, *Corophium alienense*, and *Grandidierella japonica*), and two mollusks (the Baltic clam and the Asian clam *Potamocurbula amurensis*); all except the Asian clam were found at all stations in both channels, in a variety of salinities from one to 27 ppt. The 1994-1996 Benthic Pilot Study of San Francisco Estuary Regional Monitoring Program (1997) found that in muddy estuarine sediments of the South Bay, the most abundant species were *Potamocurbula amurensis*, *Ampelisca abdita*, *Nippoleucon hinumensis*, *Corophium heteroceratum*, *C. alienense*, *Grandidierella japonica*, *Balanus improvisus*, *Tubificidae* sp., *Neanthes succinea*, and *Streblospio benedicti*.

More recently, the USGS sampled invertebrates in eight South Bay sloughs in 2004 (Takekawa et al. 2005). *Heteromastus*, *Streblospio*, and Tubeficoides were the dominant taxa in these sloughs. The clam *Gemma gemma* was numerous in Mt. Eden Creek and Alameda Creek. *Macoma balthica* was present in all sloughs sampled. Low insect diversity was observed; insects were recorded in only three sloughs, with four species in Mt. Eden Creek representing the highest diversity in any of the sloughs sampled.

Bivalve mollusks, which represent the majority of the invertebrate biomass of the San Francisco Estuary (Nichols 1979), are primarily filter feeders, taking in large quantities of phytoplankton. A variety of clams and mussels, many of which are introduced, occur in the South Bay. Of the native species, the Baltic clam is the only one that is still common in the South Bay. The Baltic clam is the largest-bodied infaunal invertebrate in the South Bay and thus contributes significantly to the biomass of the region. It is eaten by birds (Painter 1966) and bat rays (*Myliobatus californica*) (Thompson and Shouse 2004) and likely by a number of other fish species as well. In the mid-1800s, the eastern oyster (*Crassostrea virginica*) and Pacific oyster (*C. gigas*) were introduced into San Francisco Bay, replacing much of the fishery for the native oyster (*Ostrea lurida*). Until around 1910, extensive oyster beds were located in the South Bay south of Dumbarton Bridge, and off Eden Landing and Redwood City. However, the introduced oysters declined in the early 1900s due in part to reduced Bay water quality; the loss of

marshes may have also influenced the decline in oyster populations, as much of the oysters' food is detritus that is derived from tidal marshes (Harvey et al. 1977) . A native oyster bed was present in Salt Pond A-9 in Alviso until the 1970s (Laine, pers. comm.).

Thompson (1999), studying the spatial and temporal distribution of bivalves in the South Bay (primarily between the San Mateo and Dumbarton Bridges but with some stations scattered throughout the far South Bay, from 1991 to 1995), found that bivalves mostly disappeared from shallower areas in winter and spring; they declined in, but did not disappear from, deeper areas in winter. Recruitment varied among years, but was more likely to be limited in higher-elevation mudflats in some years than in deeper mudflats closer to channels, possibly due to predation by shorebirds and bat rays. Thompson and Shouse (2004) hypothesized that recruitment of bivalves onto South Bay mudflats where they are available to birds is dependent on the abundance of adult bivalves in deeper water and circulation patterns that transport larvae from either deeper water or from North Bay areas.

Tidal invertebrates in South Bay estuarine habitats must either be able to tolerate daily and seasonal changes in salinity (e.g., benthic invertebrates) or be mobile enough to follow preferred salinities. During particularly wet years, species intolerant of fresher water (e.g., *Mya arenaria*, *Corophium acherusicum*, *Ampelisca abdita*, and *Streblospio benedicti*) virtually disappear from portions of the upper San Pablo Bay and shallow areas of the Bay. During a two-year drought, these same species colonized Suisun Bay, which is usually too fresh for these species (Nichols and Thompson 1985a). Similarly, Hopkins (1987) noted that several intertidal invertebrate species disappeared during an unusually wet winter but had re-established the following year under normal conditions; two of his four intertidal study sites were near Palo Alto and Hayward. In contrast, limited observational data following unplanned breaches of Napa ponds 2a and 3, with releases of water having salinity of 50 and >60 ppt into South Slough, revealed no extensive losses of benthic invertebrates, suggesting that this elevated salinity did not have a significant impact on benthics.

The epifaunal invertebrate community in the South Bay is dominated by several species of shrimps and crabs. Two native caridean shrimps, the California bay shrimp (*Crangon franciscorum*) and blacktail bay shrimp (*C. nigricauda*), are common in tidal sloughs and in the Bay itself. The California bay shrimp supports the only commercial fishery remaining in the South Bay aside from the limited harvest of brine shrimp that occurs in salt ponds (as discussed below). Each year, two to four boats are involved in shrimping in the South Bay, catching approximately 75,000 lb valued between $154K and $312K per year (Hansen 2003), although shrimping activity and success have declined in recent decades (Laine, pers. comm.). Most shrimping activity occurs between the Dumbarton Bridge and Calaveras Point, with limited activity above Calaveras Point in Coyote Creek (Hansen 2003).

According to Hatfield (1985), adult California bay shrimp spawn in the ocean in March and April. The planktonic larvae are carried into the San Francisco Bay by tides, and by currents into the Suisun and South Bays. Juvenile bay shrimp arrive in the South Bay in May, and use shallow waters having lower salinities as nurseries. These juveniles migrate up sloughs to brackish water, seeking out waters with salinities of three to 19 ppt, preferring a range of ten to 15 ppt (Baxter et al. 1999). Thus, they use the Guadalupe, Alviso, and Coyote Slough systems, and likely other South Bay tributaries as well, for

feeding and growth through the summer. As they mature, the shrimp migrate to deeper, more saline Bay waters until they migrate out of the Bay to spawn in the ocean in winter (Baxter et al. 1999; Kinnetic Laboratories 1987). California bay shrimp are present in the South Bay year-round, but they are most abundant September-October and least abundant March-April (Hansen 2003). Bay shrimp are sensitive to changes in salinity and water quality, and may abandon sloughs in the far South Bay for deeper, more saline waters during periods of high freshwater runoff. Effluent from wastewater treatment plants may have altered the distribution of bay shrimp as well, as this species has declined in abundance in the far South Bay in recent decades (Laine, pers. comm.).

Crabs of South Bay tidal habitats include the yellow shore crab (*Hemigrapsus oregonensis*), lined shore crab (*Pachygrapsus crassipes*), Dungeness crab (*Cancer magister*), brown rock crab (*Cancer antennarius*), red rock crab (*Cancer productus*), and several introduced species, including the xanthid crab (*Rothropanopeus harrisii*), Chinese mitten crab (*Eriocheir sinensis*), and European green crab (*Carcinus maenas*) (Josselyn and San Francisco State Univ. 1983). Most of these species forage both in tidal sloughs and on mudflats and deeper waters of the South Bay. Although Dungeness crabs, and particularly larger individuals, occur much more commonly in the north and central Bay, this species was historically more common in the South Bay (i.e., into the 1970s) (Laine, pers. comm.). The *Cancer* crabs do not support a fishery within the South Bay, but use of South Bay marshes by juveniles of these species, and detrital export to the Central Bay from South Bay marshes, may help to support the economically important ocean fishery for these crabs. Crabs tagged as juveniles in the Bay have been caught by commercial fishermen in the ocean (Harvey et al. 1977). Furthermore, Dungeness crabs in the Bay mature nearly twice as fast as populations outside the Bay, presumably because of higher Bay water temperatures but possibly also due to the high productivity of the estuary (Life Science 2004). Early larval stages of the Dungeness crab are currently limited primarily to the Central Bay, but later planktonic larvae and juveniles may be found throughout the Bay (Life Science 2004).

The California Department of Fish and Game has conducted a fishery survey for shrimp and crabs within the San Francisco Bay since 1980, with monthly surveys in deeper subtidal areas and some beach seine sampling (CDFG data Life Science 2004). These surveys include data from three open-water stations (Stations 102, 101, and 140) located near the San Mateo and Dumbarton Bridges, and two beach seine stations (171 and 172) also located in the South Bay. Between 1980 and 2001, Dungeness crabs accounted for 52.6, 43.8, and 73.3% of crabs caught at Stations 101, 102, and 140. Chinese mitten crabs were 42.1, 12.5, and 18.8% of the total crab captures at these stations. Graceful rock crabs (*Cancer gracilis*) and brown rock crabs were, collectively, 18.8% of the total catch at Station 102 but <3% of the crab catch at the other two stations. California bay shrimp accounted for 79.5, 58.8, and 78.7% of shrimp captures at Stations 101, 102, and 140, while blacktail bay shrimp were 12.8, 34.2, and 14.0% of captures. Other shrimp species, including blackspotted bay shrimp (*Crangon nigromaculata*), oriental shrimp (*Palaemon macrodactylus*), stout coastal shrimp (*Heptacarpus brevirostris*), miniature spinyhead (*Mesocrangon munitella*), ridgetail prawn (*Exopalaemon carinicauda*), and visored shrimp (*Betasus longidactylus*), were all represented but were much less abundant in the South Bay.

Tidal Marsh Invertebrate Communities. The invertebrates of the vegetated portions of tidal salt and brackish marshes, which include benthic infauna, epifauna, and terrestrial species, have not received as

much study as those of intertidal habitats, in part because much of the invertebrate biomass within tidal marshes occurs within the intertidal and subtidal zones of sloughs and smaller marsh channels. However, tidal salt marsh invertebrates perform a variety of important ecological services, as discussed by Maffei (2000b).

Within tidal salt marshes in the South Bay, common invertebrates include the ribbed mussel (*Ischadium demissum*), the Baltic clam, the mud snail (*Illyanassa obsoleta*), and the yellow shore crab (*Hemigrapsus oregonensis*) (Niesen and Lyke 1981). The introduced ribbed mussel is common within the lower zone of tidal marshes (among Pacific cordgrass), and the Baltic clam may occur up into the cordgrass zone as well (Josselyn and San Francisco State Univ. 1983; Vassallo 1969). The native hornsnail *Cerithidea californica* formerly occurred in pickleweed marshes and on mudflats throughout much of the Bay, but it has been displaced from much of its former habitat and range by the introduced mud snail, and it is now restricted to high salt pannes in the South Bay (Race 1981). The mud snail is abundant in intertidal habitats and sloughs. The marsh snails *Assiminea californica* and *Ovatella myosotis* inhabit dense pickleweed marshes (Fowler 1977). Several amphipod species, including *Anisogammarus confervicolus*, *Orchestria traskiana*, *Hyale plumulosa*, and *Grandidierella japonica*, occur within the ground litter in pickleweed-dominated marshes (Josselyn and San Francisco State Univ. 1983). The amphipod *Traskorchestia traskiana* is abundant in at least some pickleweed marshes of the San Francisco Bay (Obrebski et al. 2000). This detritivore tolerates salinities up to 50 ppt (Koch 1989), and is one of the only invertebrates known to consume pickleweed (Page 1997).

Terrestrial invertebrate assemblages of salt marshes are dominated by a variety of insects and spiders. Diptera (true flies) are a major component of South Bay cordgrass/pickleweed marshes, while the orders Homoptera (plant hoppers and aphids) and Lepidoptera (butterflies and moths) are also well represented (Lane 1969). Reticulate water boatmen, brine flies, chironomid midges, and other species dominate open-water areas such as marsh ponds within the tidal marsh (Barnby et al. 1985; Maffei 2000b).

Detritus from macrophytic vegetation in the tidal marsh is an important component of the food web of the tidal marsh itself, as Teal (1962) demonstrated in Atlantic tidal salt marshes. Cameron (1972) determined that half of the detritus produced in San Pablo Bay marshes was exported out of the marsh, where it serves as an extremely important source of nutrients and carbon for the aquatic components of the Bay ecosystem (Harvey et al. 1977; Warwick and Price 1975).

Salt Pond Invertebrate Communities. Invertebrate communities in South Bay salt ponds have been extensively studied (Carpelan 1957; Anderson 1970; Swarth et al. 1982; Lonzarich and Smith 1997). Carpelan (1957), studied the floral and faunal communities in six Alviso salt ponds ranging in salinity from a mean of 27.5 ppt in the intake ponds to 94 ppt in the highest-salinity pond. Only one vascular plant species, wigeon grass, was present in this study; it only occurred one of the lower-salinity ponds for a brief period in mid-summer. Thus, the flora of the salt ponds is dominated by the macroscopic green algae *Rhizoclonium* and *Enteromorpha* in the lower-salinity ponds and by unicellular algae, particularly *Stichococcus bacilaris*, in higher-salinity ponds.

In salt ponds, invertebrate species richness decreases, and biomass increases (to a point) as salinity increases, primarily because of the increase in brine shrimp (Anderson 1970; Britton and Johnson 1987; Carpelan 1957; Lonzarich 1989; Swarth et al. 1982; Williams et al. 1990). In lower-salinity ponds, numerous nematodes occur in decaying organic matter and mud. The most prevalent worm in lower-salinity ponds is the polychaete *Polydora ligni*. This polychaete serves as prey for fish and the nemertinean *Tubulanus sexlineatus*, which is common in decomposing algae in the lowest-salinity ponds. Carpelan (1957) found few mollusks within the salt ponds. The introduced mud snail, which was abundant on the adjacent tidal mudflats, was found in scattered areas, although in its limited areas of distribution it was the dominant benthic species. Anderson (1970) reported that mud snails did not survive long in the Newark-area ponds he studied, and that although the ribbed mussel and native oyster were present in the adjacent slough, they did not become established in the intake ponds. A number of other non-arthropod species of varying abundance, including roundworms, rotifers, protozoans, and coelenterates, occur throughout the salt ponds (Anderson 1970; Carpelan 1957).

A survey of benthic invertebrates in Alviso salt ponds by Lonzarich (1989) found three mollusks (*Gemma gemma*, *Ilyanassa obsoleta*, and *Tryonia imitator*), two annelids (*Nereis succinea* and *Tubificoides* sp.), and six crustaceans (*Anisogammarus confervicolus*, *Crangon* sp., *Hemigrapsus oregonensis*, *Ostracoda* sp., *Palaemon macrodactylus*, and *Sphaeroma quoyana*) in ponds that seasonally reached salinities of 40 ppt, but not in higher-salinity ponds. Only the annelid *Polydora ligni* and the crustaceans *Artemia franciscana*, *Balanus* sp., *Copepoda* sp., and *Corophium* sp. tolerated salinities in the ponds that averaged 22-84 ppt.

Studying North Bay salt ponds, Takekawa et al. (2004) recorded 20 zooplankton taxa, with more taxa in lower-salinity ponds and highest abundance at mid-salinities. Copepods and brine shrimp accounted for 66.1 and 28.2% of all zooplankton sampled; copepods dominated low and mid-salinity ponds (23-48 ppt), while brine shrimp dominated higher-salinity ponds (170 ppt). Brine flies were also common in higher-salinity ponds. Total zooplankton abundance was highest in spring and early summer, with biomass several orders of magnitude higher in a pond having a salinity of 170 ppt than in lower-salinity ponds due to the abundance of brine shrimp. The diversity of macroinvertebrates was also higher in lower-salinity ponds (23 ppt), which contained 50-55 taxa (only three to four at high densities, including the polychaete *Heteromastus*, the bivalve *Gemma*, and the amphipods *Corophium* and *Ericthonius*). Mid-salinity ponds (48 ppt) contained 25 taxa dominated by the polychaetes *Polydora*, *Capitella*, and *Streblospio*, by *Corophium*, and by water boatmen, while a high-salinity pond (170 ppt) contained 12 taxa dominated by brine shrimp and brine flies.

Sampling of South Bay salt ponds between 2003 and 2005, Takekawa et al. (2005) recorded 58 taxonomic groups of macroinvertebrates. Crustaceans were the best represented group, with 17 taxa, followed by 12 annelid taxa; these taxa were predominantly in lower-salinity ponds (i.e., below 60 ppt). Five species of bivalves and nine insect families were also recorded, with overall taxa richness occurring in the ponds with the lowest salinity (27-44 ppt).

Arthropods are the dominant, and ecologically most important, group of invertebrates inhabiting salt ponds in the South Bay. The brine shrimp (*Artemia franciscana*) is the predominant animal in higher-

salinity ponds. Although it can occur in salinities near that of seawater (Persoone and Sorgeloos 1980), the brine shrimp's aquatic predators (e.g., insects such as water boatmen) are more abundant in less saline water (Wurtsbaugh 1992), allowing brine shrimp to reach high densities only in their optimal hypersaline environments (70 to 170 ppt) (Carpelan 1957). Herbst (2001) found water boatmen to be most abundant in lower-salinity ponds while brine shrimp were most abundant in moderate to high salinity salt ponds in the Mojave Desert. Brine shrimp are absent from crystallizer ponds with salinities exceeding 200 ppt (Larsson 2000). Historically, brine shrimp occurred in the San Francisco Bay area in salt pannes and ponds with hypersaline conditions. They still occur in these natural features within tidal salt marshes in the South Bay, in addition to salt ponds.

Carpelan (1957) estimated that brine shrimp in the Alviso salt ponds produced up to eight generations/year, with winter eggs having delayed hatching. Larsson (2000) reported that females produce an average of ten broods during their 50-75 day lifespan in the lab, although under natural conditions three to four broods may be more likely. Productivity of brine shrimp in the highest-salinity pond in Carpelan's study area was estimated at 56 lb/acre/year. Brine shrimp are so abundant in some ponds that they have supported a small commercial industry, primarily as food for aquarium fish. According to Thomas Laine (pers. comm.), these shrimping operations can regularly obtain 10,000-13,000 lb of shrimp per day, with two people once collecting 27,000 lb in a day in South Bay ponds, and a 42-day operation netting 500,000 lb of brine shrimp in South Bay salt ponds. Brine shrimp are still harvested in Newark salt ponds, where they fetch $0.55/lb (Laine, pers. comm.).

Two insect groups are also important components of the South Bay invertebrate fauna due to numerical abundance and importance to foraging birds. Adult reticulate water boatmen inhabit salt ponds year-round. Carpelan (1957) found that egg-laying occurs in spring, summer, and fall, with the main hatch in spring; many nymphs are observed in April and May. Water boatmen have been reported to occur in water ranging from brackish to 170 ppt (Carpelan 1957; Cox 1969; Jang 1977), and Carpelan (1957) found them in Alviso salt ponds with salinities from 23 to 153 ppt. However, they occur and reproduce in greatest abundance in ponds with salinities between 35 and 80 ppt (Maffei 2000c). A number of species of brine flies occur within the San Francisco Bay area; the most common species within the Shoreline Study Area are *Ephydra millbrae*, *E. cinerea*, and *Lipochaeta slossonae*, which occur in variable numbers in natural salt pannes and marsh ponds, and in artificial salt ponds and crystallizers (Carpelan 1957; Maffei 2000b). *E. millbrae* has been reported to occur in pools with salinity concentrations up to 42 ppt (Jones 1906), while *E. cinerea* and *Lipochaeta slossonae* occur in saline and hypersaline environments, with *Lipochaeta* found commonly in crystallizers (Maffei 2000a). Even as adults, water boatmen are primarily aquatic, although they can fly. In the South Bay, adult brine flies become common by early March and can be seen in dense swarms on the edges of high-salinity ponds from April through September (Swarth et al. 1982).

The biomass of brine shrimp in South Bay salt ponds may be four times that of water boatmen (Swarth et al. 1982), and brine shrimp have been found to be a numerically important component of the diet of the western sandpiper, Wilson's and red-necked phalaropes, and other waterbirds (Anderson 1970; Colwell and J.R. Jehl 1994; Hamilton 1975; Harvey et al. 1992; 1988; Jehl 1988). Despite the high biomass of brine shrimp in salt ponds, the nutritive value of brine shrimp to foraging shorebirds may be limited, as

Rubega and Inouye (1994) found that red-necked phalaropes could not survive foraging on brine shrimp alone. As a result, brine flies (both adults and larvae) and reticulate water boatmen are also very important to shorebirds that forage in mid- to high-salinity South Bay salt ponds. Amphipods, most notably *Corophium* spp., are numerous in South Bay salt ponds as well (Carpelan 1957), serving as additional prey items important to shorebirds and fish.

Freshwater Macroinvertebrate Communities. Stream macroinvertebrate communities are structured largely by physical factors, such as temperature, light, current velocity, and substrate composition, and chemical factors, such as oxygen levels, pH, nutrients, and chemical pollutants. These communities are comprised of a diverse array of species that can generally be grouped into functional assemblages based on their feeding mechanisms and the roles that they play in stream ecology. Within a given taxonomic group, different species often assume different ecological functions and feeding preferences.

Collectors and filterers include certain decapods (freshwater crayfish), or larvae of some tricopterans (caddisflies), plecopterans (stoneflies), ephemeropterans (mayflies), and others. Many of these species filter fine particulate organic matter directly from the water column; and members of this functional group typically dominate invertebrate communities in larger-order, lower-gradient streams because of the high concentrations of particulate detritus suspended within the water column within these river mouth habitats. Representative South Bay groups include larval common midges (*Chironomus* sp., Diptera:Chironomidae) which are abundant filterers of living phytoplankton from the water column, and leptocerid caddisflies (Trichoptera:Leptoceridae), which are indiscriminant detritus feeders that are common in ponds and slow-moving river mouths.

Grazers can include large invertebrates such as gastropods (freshwater snails), or larval insects such as other species of caddisflies and nematoceran true flies. These groups are more prevalent in open areas with ample light and substantial algal growth, such as mid-order riverine systems and open ponds. Common Bay Area groups include the northern snailshell caddisfly (*Helicopsyche borealis*, Trichoptera:Helicopsychidae), which actually constructs a larval case that looks like a snail's shell. Larval psycodid gnats such as the lance-winged moth fly (*Maruina lanceolata*, Diptera: Psychodidae) are frequently found in foothill streams around the South Bay, where they graze on algal or diatomaceaous films (Powell and Hogue 1979). In contrast, shaded, steeper, lower-order streams in higher elevation areas support more vegetation shredders, because most of the plant material in these areas of streams is large and relatively undecayed. Shredders include larval or naiad members of many caddisflies, mayflies, and diperans (true flies).

Predatory invertebrates, such as larva of species in the Order Odonata (dragonflies and damselflies), larval culicid flies (mosquitos), some larval stoneflies, and adults of certain hemipterans (true bugs) and coleopterans (beetles), occur throughout all stream types. Some predaceous insects are so large and powerful that their prey can include tadpoles or even small fish. Giant water striders (*Gerris reigis*, Hemiptera:Gerridae) are common on many types of surface aquatic habitats across the area from smaller high elevation streams to stock tanks, while toad bugs (*Gelastocoris oculatus*, Hemiptera:Gelastocoridae) hunt for prey along the shores of water bodies. Other impressively large and common aquatic hemipterans include the large water boatman (*Hesperocorixa laevigata*, Hemiptera:Corixidae) and

common water scorpion (*Ranatra brevicollis*, Hemiptera:Nepidae). Aquatic predaceous beetles such as dytiscids and gyrinids are predaceous both as larval and adult forms, and common species or genera in the area include giant green water beetles (*Dytiscus marginicollis*, Coleoptera:Dytiscidae), river beetles (*Agabus* sp., Coleoptera:Dytiscidae), and common whirligig beetles (*Gyrinus* sp., Coleoptera:Gyrinidae).

In the South Bay, studies of freshwater invertebrates have focused primarily on invertebrate assemblages in the middle and upper reaches of streams entering the Bay. In comparison, there are relatively few data on the downstream reaches of these streams, the reaches that are present within the Shoreline Study Area. A 1997 study of stream macroinvertebrates in the Santa Clara Valley identified 261 taxa at 44 sites along seven streams (Carter and Fend 2000). Taxon richness decreased from upstream to downstream sampling locations. Generally, higher-elevation sites supported higher taxon richness and a higher percentage composition of the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), while lower-elevation sites supported a higher percentage composition of taxa contained within the Chironomidae (midges) and Oligochaeta (worms). These results parallel perceived gradients in stream water quality, with mayflies, stoneflies, and caddisflies generally having low tolerance of stream pollutants and midges and oligochaete worms being much more tolerant of low water quality.

In the vernal pool habitats of the Warm Springs Unit of the SFBNWR, studies of invertebrates have focused primarily on the federally endangered vernal pool tadpole shrimp; this species is discussed in detail below under Section 4.3.1).

Upland Invertebrate Communities. As in much of the American West, there has been limited published data providing comprehensive species lists for the upland invertebrate communities of the South Bay. In fact, much like annual plants, insect populations can be extremely ephemeral from year to year, with a given species reaching large densities in some years and appearing completely absent from the fauna in others. The following provides a very general description of the species that would be most likely found in upland habitat, since a more detailed description would go far beyond the scope of this document. When considering ecosystem function, four pricipal groups bear discussion: soil fauna, responsible for consuming decayed organic matter (detrivores) or those that predate upon soil detrivores; phytophagous invertebrates, which consume tissue from living plants, zoophagous invertebrates, which predate or parasitize other invertebrates or larger animals; and pollinators, responsible for reproduction of many flowering plants. Upland habitat contains an immensely diverse array of terrestrial invertebrates including multiple species in the Hexapoda (insects), Diplopoda (millipedes), Chilopoda (centipedes), Arachnida (arachnoids, including spiders, mites, and ticks), Gastropoda (terrestrial snails and slugs), Malacostraca (terrestrial crustaceans), and Oligochaeta (worms).

Invertebrates that reside primarily in soil or under tree bark on fallen, dead logs comprise an important component of the terrestrial habitat of the South Bay and include a diverse array of species that specialize in feeding on decaying organic material, or that predate on other detrivores in the soil profile. Soil macrofauna carry out extremely important ecosystem functions by facilitating nutrient cycling through their feeding activities and soil pedturbation. Some represenative examples of soil macrofauna include colonial insects such as ants (Hymenoptera:Formicidae) and termites (Isoptera). The South Bay hosts colonies of invasive Argentine ants (*Iridomyrmex humilis*, Hymenoptera:Formicidae), as well as red

mound ants (*Formica* sp., Hymenoptera:Formicidae). Western subterranean termites (*Reticulitermes hesperus*, Isoptera:Rhinotermitidae) may be the most common termite within the South Bay, and is responsible for structural damage to buildings. Many beetles are also present in the soil, including dung beetles such as the European dung beetle (*Aphodius fimetarius*, Coleoptera:Scarabidae), which is common wherever livestock is kept; and carrion or burying beetles such as *Nicophorus* sp. (Coleoptera: Silphidae), which are important processors of mammalian carcasses. Although not well known as a group due to their tiny size, entognathous (internal mouth-part) insects (orders Protura, Diplura, and Collembola) are extremely numerous in all non-saturated soil samples, and are concomitantly some of the most important detrivores. Springtails (Collembola) are among the best-known entognathous insects, including lawn springtails (*Bourletiella arvalis*, Collembola), which can be found almost anywhere in California, and obese springtails (*Morulina multatuberculata*, Collembola), which prefer hilly, wooded areas. There are also large, common, non-hexapodous invertebrates such as earthworms, millipedes, centipedes and pillbugs.

Phytophagous invertebrates in the Study Area include numerous insect species in the Coleoptera (e.g., weevils, leaf beetles, bark beetles), Homoptera (hoppers, cicadas, aphids, whiteflies and scale insects), Hemiptera (e.g., seed bugs and leaf bugs), Thysanoptera (thrips), larval Lepidoptera (caterpillars), Orthoptera (grasshoppers, crickets, and katydids), Phasmida (walking sticks and leaf insects), Psocoptera (woodlice and booklice), and Neuroptera (lacewings), as well as arachnid mites (Acarina) and terrestrial gastropods (snails and slugs). This terrestrial group is important as a major ecosystem pathway for converting low-protein, high-cellulose plant tissue into high-protein, easily-digestible animal tissue. While these groups can be pests when dealing with gardens, lawns, or crops, they also control and structure plant populations. This group is very speciose, as physical and chemical plant defenses against invertebrate pests are often formidable and require specific adaptations. Many phytophagous insects are resticted to particular plant families, genera, or even species, and other groups are further resticted to certain plant parts, such as the thrips, which feed only within flower blossoms.

Zoophagous invertebrates include both those groups that feed on other invertebrates, as well as those adapted to be parasitics of larger animals such as birds and mammals (e.g. ticks, lice, and fleas). Invertebrates that predate upon other invertebrates are important for structuring invertebrate communities and controlling numbers of insect pests. This group includes many species within the Diptera (e.g., asilid and tabanid flies), Neuroptera (e.g. snakeflies, antlions, and dobsonflies), Hymenoptera (parasitic and predatory wasps, ants, and bees), Strepsiptera (twisted wing parasites), Mantoidea (mantises), Hemiptera (assassin bugs and toe biters) and Coleoptera (e.g., ladybugs and tiger beetles). Another categorization within the zoophagous invertebrates includes those species that are parasites of birds and mammals, such as biting lice (Mallophaga), which specialize on bird hosts; sucking lice (Anoplura), which typically specialize on mammalian hosts; Siphonaptera (fleas); dipterans such as mosquitos (Diptera:Culicidae) and biting gnats (Diptera:Ceratopoginidae); and Acarina (ticks). These species are important vectors of mammalian and avian diseases.

Those invertebrates that serve as potential pollinators in the upland habitats of the South Bay include insects in the Orders Hymenoptera, Diptera, Lepidoptera and Coleoptera. Not all flower-visiting insects are competent pollinators, as they must sequentially visit flowers of the same species, and have

compatable behavior and morphology with the floral parts so that pollen picked up and deposited on receptive stigmatic surfaces. Bees (Apiodea) are hymeopterans specifically apdapted to collecting pollen and nectar from plants, and are often, although not always, competent pollinators of the plants that they visit. European honeybees (*Apis mellifera*, Hymenoptera:Apidae) are extremely important naturalized pollinators of many South Bay plants. Native bees include bumblebees (*Bombus* sp., Hymenoptera:Apidae), the short leafcutter bee (*Megachile brevis*, Hymenoptera:Megachilidae), loosely colonial minute sweat bees (*Halictus* and *Lasioglossum* sp., Hymenoptera:Halictidae), and common burrowing bees (*Andrena* sp., Hymenoptera:Andrenidae). Wasps (Vespidae, Specidae, Tiphidae) are other hymenopterans that may pollinate plants, but also predate upon or parasitize other insects for their larva. Several flies in the Syrphidae (flower flies) and Bombyliidae (bee flies) are also pollinators, although these are often generally considered less competent at pollen movement than bees. Lepidopteran adults are also often observed visiting flowers, although their morphology is such that they also tend to carry less pollen than bees. Coleopteran pollinators include beetles in the Meloidae (blister beetles) and Cerambycidae (longhorn beetles), including the special status species the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*, Coleoptera:Cerambycidae). Flower-visiting beetles consume a large proportion of the pollen produced by the plants they visit, and only incidently move pollen while foraging.

Invasive Invertebrates of the South Bay. According to Cohen and Carlton (2003), the San Francisco Estuary is the most invaded aquatic ecosystem in North America. This study is the most recent and most inclusive compilation of information on aquatic invasive species in the San Francisco Estuary. Previous lists and/or descriptions of introduced aquatic species include works on fish fauna by Moyle (1976) and McGinnis (1984), freshwater mollusks by Hanna (1966) and Taylor (1981), marine mollusks by Nichols et al. (1986), and introduced marine and estuarine invertebrates by Carlton (Carlton 1975; Carlton 1979a; Carlton 1979b; Carlton et al. 1990). Collectively, these non-native species have significant impacts on the San Francisco Estuary through aggressive predation, highly efficient filter feeding, and competition, which, when magnified by the great abundance of some of these species, has the potential to change (or already has changed) the trophic structure and dynamics of the Bay ecosystem (Josselyn et al. 2004).

Cohen and Carlton (2003) note that at least 212 species, 69% of which are invertebrates, have been introduced to the Bay and Delta since 1850. The most important include a number of clams, many of which were introduced into the Bay via releases of ballast water (Cohen and Carlton 1995), such as the introduced Asian species of *Venerupis* and *Musculista*, and the Atlantic clam *Gemma*. With the exception of the Baltic clam, the numerically dominant mollusks of the South Bay are all non-native species (Nichols and Pamatmat 1988). Collectively, these introduced clam species are capable of filtering the entire volume of the South Bay daily, in addition to having dramatic impacts on the Bay's phytoplankton populations. Cohen and Carlton (2003) suggest that the phytoplankton populations of the northern reaches of the San Francisco Bay may be continuously and permanently controlled by introduced clams.

The Asian clam *Potamocorbula amurensis*, the most abundant clam in the San Francisco Bay, was introduced via ballast water around 1986 (Cohen 1998). Since then, this filter feeder has impacted phytoplankton populations in the North Bay (Alpine and Cloern 1992), preventing summer phytoplankton blooms since its introduction and altering the trophic structure of the North Bay. Although similar large-

scale impacts on the South Bay have not yet been detected, the species is present in the South Bay. This clam was found by a CDFG study to be the most important prey of scoters in Suisun Bay (Harvey et al. 1982). The gem clam (*Gemma gemma*) occurs throughout the South Bay, in both deep subtidal and high intertidal habitats. It occurs in lower-salinity salt ponds as well. This clam is eaten by a variety of shorebirds (Recher 1966) and waterfowl (Painter 1966), and thus benefits some native wildlife species. The Atlantic ribbed marsh mussel (*Arcuatula demissa*) was introduced in the late 1800s, and is now common throughout much of the Bay. Although it is apparently "a major food source" for the clapper rail, rails have been known to drown after getting their beaks or toes caught in the open valves of the mussel (Takekawa 1993). The soft-shell clam (*Mya arenaria*) was introduced for commercial purposes, and maintained an important fishery in the Bay in the late 1800s and early 1900s (Skinner 1962). Although it is still present in the Bay, most individuals are small (Thompson and Shouse 2004). It is an important prey item for bat rays, flounder, and in the Suisun Bay, canvasbacks (Harvey et al. 1982). Thompson (1999) found that it disappeared rapidly from areas where it recruits, suggesting that it is preyed upon heavily by these fish, and possibly by birds and other invertebrates.

A carnivorous opisthobranch, *Philine auriformis*, invaded the South Bay in 1982, and has been noted in abundance in bottom trawls by the Marine Sciences Institute (Thompson and Shouse 2004). This species, which has been found most frequently in deeper water, preys on bivalves. The polychaete worm *Streblospio benedicti* was first detected in the Bay in 1932. This species readily colonizes the Bay in both deep and shallow intertidal habitats, and is consistently one of the dominant species on South Bay mudflats.

The dominant crustaceans of the South Bay are all introduced as well. The tube-dwelling amphipod *Ampelisca abdita* was first detected in the Bay in the 1950s. Since then, it has increased in abundance, and can achieve very dense beds at a variety of depths. This species was a dominant species on Palo Alto mudflats until the 1990s, when abundance declined (though it has remained common) (Thompson and Shouse 2004). The other dominant crustaceans in the South Bay include several burrowing amphipods, including *Grandidierella japonica* and several non-native *Corophium* species. Both of these genera tolerate poor water quality, and readily colonize available habitat throughout the South Bay. These crustaceans are important prey species for shorebirds on intertidal mudflats.

The European green crab (*Carcinus maenas*) became established in the San Francisco Bay in 1989-1990. This opportunistic omnivore eats a variety of plant and animal matter, including bivalves and shore crabs, and has the potential to impact native species considerably (Josselyn et al. 2004). After its invasion of Bodega Bay in 1993, a 90-95% decline in the abundance of native bivalves and grapsid shore crabs was observed (Grosholz et al. 2000).

Two non-native species could physically impact South Bay marshes, levees, streambanks, and other structures. The Australian-New Zealand boring isopod (*Sphaeroma quoyanum*) burrows into mud banks and levees throughout the Bay, potentially weakening these features and making them prone to erosion (Talley et al. 2001). Another burrowing species that may cause the same problem is the Chinese mitten crab (*Eriocheir sinensis*), which has been known to accelerate bank erosions in Germany. First detected in the Bay in 1992, the mitten crab has undergone rapid population increases throughout the Bay and its

tributaries. This catadramous species migrates upstream (in virtually all of the Bay's tributaries) year-round, peaking in spring. Downstream migration to saltwater (approximately 25 ppt) breeding areas occurs primarily August-January, with a peak in September-October (Veldhuizen and Stanish 1999). The Chinese mitten crab is common in the South Bay. Halat (1996) has reported that the burrows of this crab reach densities of 30 burrows/m^2 along San Francisquito Creek. Halat did not report any bank erosion even at this density of mitten crab borrows but suggested that if bank erosion does occur it is likely to occur along steep clay banks in tidally influenced alluvial controlled reaches of the Bay. Thompson and Shouse (2004) noted abundant Chinese mitten crab burrows in a salt marsh bank in Palo Alto, possibly due to its proximity to San Francisquito Creek, and speculated that the erosion of the salt marsh bank observed since the mitten crab's invasion in the early 1990s may have been caused by the crab's burrowing. Surveys by the Marine Science Institute recorded burrow densities as high as 6.2/m^2 in December 1995 and 8.9/m^2 in March 2000 along Alviso Slough. These densities are three to 4.5 times greater than the next highest density for the South Bay.

Mosquitoes. There is an extensive body of literature on mosquitoes associated with tidal and seasonal wetlands of the South Bay region, as summarized by Bohart and Washino (1978), Durso (1996), and Maffei (2000d; 2000e; 2000f; 2000g; 2000h). More than 20 species occur in the San Francisco Bay area, but five of these, the summer salt marsh mosquito (*Aedes dorsalis*), winter salt marsh mosquito (*Aedes squamiger*), Washino's mosquito (*Aedes washinoi*), western encephalitis mosquito (*Culex tarsalis*), and winter marsh mosquito (*Culiseta inornata*), are routinely controlled by the mosquito and vector control agencies within each of the counties of South San Francisco Bay. Within the Shoreline Study Area, the Alameda County Mosquito Abatement District and the Santa Clara Vector Control District are responsible for managing the populations of mosquitoes for their respective communities.

The Goals Project's Baylands Ecosystem Species and Community Profiles (Maffei 2000d; 2000e; 2000f; 2000g; 2000h) included a detailed discussion of the ecology of mosquitoes in the South Bay, including preferred habitats, salinity tolerances, reproductive rates, flight characteristics, adult hosts and vector/nuisance potential. Adult females feed on blood; the hosts vary depending on the species, but include mammals, birds, reptiles, and amphibians. Adult males feed on plant juices, while larvae generally feed on particulate matter, unicellular algae, and other microorganisms. Larvae serve as prey for a variety of aquatic organisms, shorebirds, and waterfowl, while birds such as the swallow and other insects feed on adult mosquitoes. Larval survivorship is typically low, with most losses attributable to predation. The rate of larval development is often a function of water temperature and food availability.

The summer salt marsh mosquito is widespread throughout most of the United States and southern Canada, and is found in Europe and Asia as well (Carpenter and LaCasse 1955; Darsie and Ward 1981). In California, it inhabits coastal salt marshes and brackish marshes of the Sacramento/San Joaquin River Delta (Bohart and Washino 1978). In the San Francisco Bay area, this species occurs primarily in temporarily flooded tidal marsh pannes, heavily vegetated ditches, and brackish seasonal wetlands, while adults occur in open habitats such as grasslands, salt marsh, and woodland edges (Maffei 2000d). The summer salt marsh mosquito lays its eggs on mud at the edges of tidal pools or brackish seasonal wetlands, with larvae often occupying the same pools occupied by the tidal pool brine fly (*Ephydra millbrae*) and reticulate water boatman (Maffei 2000d). Eggs may hatch in the spring, but they can

remain viable for years, and subsequent hatching can occur when the larval habitat is reflooded. Although survivorship may be highest in water having a salinity near seawater (Washino and Jensen 1990), larvae have successfully completed development at the Great Salt Lake in water with salinities as high as 120 ppt (Rees and Nielsen 1947). Up to 12 broods and eight generations were found to occur during a single breeding season in Marin County (Telford 1958). Adults are highly mobile, aggressive, day-biting mosquitoes that may be able to disperse more than 30 miles (Rees and Nielsen 1947).

The winter salt marsh mosquito occurs along the Pacific Coast from Sonoma County south to Baja California, including much of the immediate area around Southern and Northern protions of San Francisco Bay (Maffei 2000h). Tidal and diked pickleweed marshes with salt marsh pools diluted by rains provide the preferred habitat of this species. This species has not been found in freshwater marshes, instead occurring in brackish and salt marshes having salt concentrations from 1.2 to 35 ppt, with optimal conditions for larval development at salinities of five to 15 ppt. Egg laying occurs in spring on plants and on mud close to the edges of marsh pools. The eggs lie dormant until fall rains inundate them, although hatching as early as late September has been noted due to water diversion into a marsh. Some eggs do not hatch until later re-floodings. Most adults emerge from salt marsh pools in late February and March and disperse widely into surrounding areas, sometimes dispersing as far as 15 miles or more from larval areas. Feeding occurs from March through June, with biting occurring during daytime and early dusk.

Washino's mosquito occurs from Oregon south to Santa Barbara, California, including the entire San Francisco Bay area (Maffei 2000e). In the Bay area, shallow pools and fresh to slightly brackish sites in uplands near salt marshes or in riparian areas, often dominated by willow, cottonwood, or blackberry, provide this species' preferred habitat. Females deposit eggs in mud along the receding water line of larval habitat. The eggs hatch when these pools are reflooded the following winter. Adults emerge from the larval depressions in late winter and early spring, and are present into June. Females are day-biting mosquitoes, and may travel up to 1.5 miles from their larval habitat along artificial canals (Maffei 2000e).

The western encephalitis mosquito is widespread in a variety of habitats and locations in western North America, with larvae occurring in most freshwater habitats (Maffei 2000f). Typical larval habitat includes poorly drained fields and pastures, rice fields, marshes, ponds, and seeps, although most artificial waterbodies in urban areas provide potential habitat for this species as well. The species has been found in salt marsh pools with salt concentrations up to ten ppt (Telford 1958). Adults may be present year-round but enter facultative diapause in winter. Females lay eggs in groups directly into the water. Adult females usually feed at night. This species seems to be able to disperse readily with wind, and dispersal distances of 20-25 miles are suspected for some Sacramento Valley populations (Bailey et al. 1965). The western encephalitis mosquito is the main vector of western equine encephalitis and St. Louis encephalitis in most of the western United States (Maffei 2000f), and is a vector of avian malaria.

The winter marsh mosquito occurs in a wide range of habitats throughout much of western North America. Larval habitat includes a variety of pools, ponds, marshes, and other water bodies, in salinities ranging from eight to 26 ppt (Maffei 2000g; Telford 1958). Adults are present from fall through spring, entering facultative diapause in summer. Females lay groups of eggs directly on the water. San Francisco Bay populations tend to remain within two miles of their larval source, although they may

disperse up to 14 miles (Clarke 1943). Larvae of the summer salt marsh mosquito, winter salt marsh mosquito, and winter marsh mosquito are often found in the same locations (Maffei 2000h). Mosquito species occurring in the major habitats in the Shoreline Study Area are listed in Table 4 below.

Table 4 – Mosquito Species Found in Marsh Habitats in the Shoreline Study Area.

Habitat	Mosquito Species
Open salt pond with vigorous wave action	none
Fully tidal salt marsh: Higher ground with pools or borrow channels that do not flush	*Aedes squamiger* (winter), *Aedes melanimon* (fall), *Aedes dorsalis* (summer), *Aedes taeniorhynchus* (summer), *Culiseta inornata* (winter)
Muted tidal salt marsh: Pools and channels that do not flush vigorously	*Aedes squamiger* (winter), *Aedes melanimon* (fall), *Aedes dorsalis* (summer), *Aedes taeniorhynchus* (summer), *Culiseta inornata* (winter)
Seasonal wetland: Brackish to nearly freshwater pools with vegetated margins	*Aedes squamiger* (winter), *Aedes melanimon* (fall), *Aedes dorsalis* (summer), *Aedes taeniorhynchus* (summer), *Aedes washinoi* (winter fresh water), *Culex tarsalis* (spring, summer), *Culex erythrothorax* (summer in tules), *Culex pipiens* (foul fresh water), *Culiseta incidens* (spring, fall fresh water), *Culiseta inornata* (winter)
Vernal pools, upland freshwater marsh	*Aedes washinoi* (winter), *Culex tarsalis* (spring, summer), *Culex erythrothorax* (summer in tules), *Culex pipiens* (foul fresh water), *Culiseta incidens* (spring, fall fresh water), *Culiseta inornata* (winter)

Marshes that lack vigorous tidal flow can provide suitable mosquito breeding habitat. Salt marshes at the southern end of the San Fransisco Bay produce a single seasonal brood of the winter salt marsh mosquito and multiple broods of the summer salt marsh mosquito each season. Because both of these mosquito species can fly considerable distances and are aggressive biters, control of mosquitos at the source (i.e., in salt marshes) is necessary to reduce the inconvenience to humans in the South Bay.

Detailed records are maintained by the local mosquito and vector control districts concerning major mosquito breeding areas, population densities, and control techniques and materials. In Santa Clara County, areas with known or potential mosquito problems include Coyote Reach 1A, New Chicago Marsh, Sunnyvale Baylands Park, the Moffett Field Flood Control Basin, Mountain View Demonstration Marsh, the Palo Alto Flood Basin (Palo Alto Baylands Park), the Zanker Landfill Marsh, Dow-Corning Marsh, Alviso Marshes, ITT Marsh (near the Palo Alto Water Quality Control Plant), the Palo Alto Municipal Airport, and the Palo Alto Municipal Golf Course (Strickman 2005). In the Alameda County portion of the Study Area, south of the San Mateo Bridge, sites that can produce large numbers of mosquitoes if not treated include the Perry Duck Club, Alameda Creek Marshes, Union City Marshes, Coyote Hills Marshes, Mayhew's Landing, and the upper ends of major sloughs (Mowry, Newark, Plummer, Albrae, and Mud Sloughs). Fully tidal marshes such as Hook Island (Palo Alto), Triangle Marsh (Coyote Creek), and Greco Island, do not produce significant numbers of mosquitoes.

Mosquito control techniques employed by these agencies emphasize minimization and disruption of suitable habitat, and control of larvae through chemical and biological means, as opposed to spraying of adults. Control techniques most often include source reduction, source prevention, larviciding, use of

mosquito fish (*Gambusia affinis*) as larval predators, and monitoring of mosquito populations and vector-borne diseases (Alameda County Mosquito Abatement District 1999). Larvicides employed by the San Mateo County Mosquito Abatement District include Golden Bear 11 11 (a short-lived petroleum distillate that is applied to the surface of the water and causes mosquito larvae to drown), methoprene (a juvenile growth hormone that specifically targets mosquito larvae and prevents their maturation), *Bacillus thuringensis israelis* (a bacteria that is toxic to mosquito larvae), and *Bacillus sphaericus* spores and toxin (for *Culex* species) (http://www.smcmad.org/preventative_approach.htm).

In salt marshes, attempts to control mosquito populations by ditching have resulted in marsh degradation. Ditching is not necessary to reduce mosquito populations in tidal marshes. Rather, functional tidal marshes do not provide high-quality habitat for the most troublesome mosquito species in the Bay area, and maintenance and restoration of natural tidal flushing in these marshes is effective at limiting mosquito populations while sustaining the natural hydrology of the marsh (San Francisco Bay Joint Venture 2004).

Mosquitos serve as vectors for several diseases that pose health concerns for humans and domestic animals. The western encephalitis mosquito is a vector of avian malaria and the main vector of western equine encephalitis and St. Louis encephalitis in the western United States (Maffei 2000f). Anopheles mosquitos carry the organism that causes malaria. The West Nile virus is a mosquito-borne disease that has been found in parts of Asia, Eastern Europe, Africa and the Middle East. First detected in the U.S. in 1999 in New York City, West Nile virus has since spread through most of the U.S. West Nile Virus is typically spread from an infected mosquito, usually in the genus *Culex*, to a bird that then disperses or migrates, spreading the virus after being bitten by other mosquitos. Most people and domestic animals that become infected with the virus have few or no symptoms, but in rare cases they can become seriously ill. In 2006, West Nile virus was detected in 54 of 58 California counties, with 276 human infections from 30 counties in California (http://westnile.ca.gov/latest_activity.htm). In 2006, 58 infections of horses from 23 counties in California were reported, along with 1446 dead birds that tested positive for the virus.

4.3.2 Fishes

Fishes play very important ecological roles in the South Bay system. Information on South Bay fish communities is somewhat limited, likely due to the lack of a commercial fin-fishing industry in this part of the Bay. However, a dataset from the CDFG and several other studies provide information on fishes of the South Bay's tidal habitats, while several studies have identified the fish present in South Bay salt ponds (Anderson 1970; Carpelan 1957; Lonzarich 1989; Takekawa et al. 2005) and freshwater streams (summarized in Buchan et al. 2002). Information on key species is also available in the Goals Project's Baylands Ecosystem Species and Community Profiles (Goals Project 2000).

Fish Communities of Tidal Habitats. More than 100 fish species have been recorded in the tidal waters of the South Bay (Laine, pers. comm.). The California Department of Fish and Game has conducted a fish survey within the San Francisco Bay since 1980, with monthly surveys in deeper subtidal areas and some beach seine sampling in shallow water habitats (CDFG data in Life Science 2004). These surveys

include data from three open-water stations (Stations 102, 101, and 140) located near the San Mateo and Dumbarton Bridges, and two beach seine stations (171 and 172) that are also located in the South Bay. Three sampling methods were used in the open-water stations: the otter trawl (which was towed on the bottom for five minutes against the current, then retrieved), midwater trawl (which was towed with the current for 12 minutes then retrieved obliquely), and plankton net (which was towed on the bottom for five minutes then retrieved obliquely).

A total of 65 fish species was captured at Stations 102, 101, and 140 during CDFG's surveys between 1980 and 2002, with 51 species captured by the otter trawl, 48 species by the midwater trawl, and 27 by the plankton net. Table 5 summarizes the most abundant fish species captured during these surveys. Numerically, the dominant fish were the northern anchovy (*Engraulis mordax*), shiner surfperch (*Cymatogaster aggregata*), longfin smelt (*Spirinchus thaleichthys*), white croaker (*Genyonemus lineatus*), Pacific staghorn sculpin, bay goby (*Lepidogobius lepidus*), plainfin midshipman (*Porichthys notatus*), English sole (*Parophrys vetulus*), cheekspot goby (*Ilypnus gilberti*), and Pacific herring (*Clupea pallasi*). The dominant fish captured at the beach seine stations were topsmelt (37.3%), arrow goby (*Clevelandia ios*, 22.6%), yellowfin goby (16.9%), jacksmelt (*Atherinopsis californiensis*, 16.2%), and Pacific staghorn sculpin (3.3%), with 22 other species representing <2% of the catch at Station 171, and topsmelt (54.4%), jacksmelt (23.4%), Pacific herring (9.7%), Pacific staghorn sculpin (3.0%), and northern anchovy (2.0%), with 28 other species representing <2% of the catch at Station 172.

Kinnetics (1987) collected fish from two locations in Coyote Creek and one location in Guadalupe Slough between 1982 and 1985. The dominant species collected from these sloughs included the staghorn sculpin, northern anchovy, starry flounder (*Platichthys stellatus*), shiner perch, yellowfin goby, threadfin shad (*Dorosma petenense*), and longfin smelt. Fish sampling in the nearby open waters of the Bay revealed species composition similar to that in the sloughs, with white croaker and striped bass (*Morone saxatilis*) also occurring as dominants. Sampling fish in lower San Francisquito Creek and the Palo Alto Water Quality Control Plant outfall channel, Cressey (1997) recorded the northern anchovy, topsmelt, yellowfin goby, staghorn sculpin, and threespine stickleback (*Gasterosteus aculeatus*).

Surveys of South Bay tidal sloughs by the USGS (Takekawa et al. 2005) from March 2004 to June 2005 recorded a total of 16 fish species in Alviso Slough, Coyote Creek, and Stevens Creek. Northern anchovies and topsmelt were by far the most abundant species caught; the American shad (*Alosa sapidissima*), threadfin shad, longjaw mudsucker, longfin smelt, common carp (*Cyprinus carpio*), starry flounder, rainwater killifish, bat ray, leopard shark (*Triakis semifasciata*), Sacramento sucker (*Catostomus occidentalis occidentalis*), striped bass, staghorn sculpin, shiner surfperch, and yellowfin goby were also recorded.

Many of the fish recorded in the South Bay, including the bat ray, leopard shark, northern anchovy, gobies, and many others, occur in tidal channels within marshes, in sloughs, and/or on mudflats at high tide when they are inundated. Thus, these tidal channels and mudflats are productive foraging habitats for estuarine fish in this system (Harvey 1988).

The spatial and temporal distribution of different estuarine fish in the South Bay, vary widely among species, as does the degree to which different specied use the Bay for breeding and foraging. The South Bay is particularly important to the leopard shark. Pupping (live birth) in the San Francisco Bay occurs almost exclusively in the South Bay (CDFG Bay Trawl data cited in McGowan (2000a)). This species appears to be most abundant in the areas on either side of the Dumbarton Bridge, where it forages in shallow mud and sand flats (Compagno 1984). Leopard sharks occur in the Bay year-round, although individuals may move in and out of the Bay (McGowan 2000b). The Bay is also important for northern anchovies, which spawn in the South Bay, including areas south of the Dumbarton Bridge (McGowan 1986). Spawning occurs in marsh channels; larvae forage over shallow flats after hatching (McGowan 2000b). Adult anchovies generally leave the Bay for the open ocean in fall, but some late-spawned juveniles remain in the Bay throughout the winter. Jacksmelt likely spawn in the South Bay as well. Here, spawning occurs from October to early August (Wang 1986), when adults move inshore from marine habitats and lay eggs on aquatic vegetation and other substrates. Apparently preferring more saline waters, the jacksmelt is most common in the Central and South Bays during years of high freshwater flows from the Delta (CDFG 1987 in Saiki [2000b]).

Table 5 – Summary of the most abundant fish species captured during California Department of Fish and Game South Bay fishery surveys, 1980-2002. Data are from Stations 101, 102, and 140 between the San Mateo and Dumbarton Bridges.

Species	Station 101			Station 102			Station 140		
	Otter Trawl	Midwater Trawl	Plankton Net	Otter Trawl	Midwater Trawl	Plankton Net	Otter Trawl	Midwater Trawl	Plankton Net
Northern Anchovy[1]	34.8	93.5	85.5	24.6	92.8	82.2	7.7	87.7	36.7
Shiner Perch	19.2			17.1			34.7	2.3	
Longfin Smelt	13.9								
White Croaker	9.8			3.5			4.4	3.2	
Pacific Staghorn Sculpin	4.5						7.0		
Bay Goby	4.3			19.1			8.3		
Plainfin Midshipman	3.1						7.9		
English Sole				12.0			7.4		
Cheekspot Goby				5.7					
Speckled Sanddab				4.0			2.1		
Pacific Herring			5.7	3.5		10.3			2.3
California Tonguefish							3.9		
White Seaperch							3.0		
Brown Smoothhound							2.4		
Topsmelt					2.2				
Jacksmelt					2.0				
Walleye Surfperch								2.1	

Arrow/Cheekspot Goby			2.8						21.1
Yellowfin Goby			2.3						
Goby Type II			2.2			2.0			3.8
Unidentified Fish									34.1
Total Species Richness	42	36	22	46	42	24	48	42	27
Other Species (Percent)	10.4	6.5	1.5	10.5	3.0	5.5	11.2	4.7	2.0

[1] Only species that make up at least 2.0% of the catch for a given sampling method at a given station are included. Data are the percentage of the total number of fish caught that were composed of each species.

Adult topsmelt enter shallow sloughs and mudflats to spawn in late spring and summer, which has been observed in the South Bay near the Dumbarton Bridge (Wang 1986). Eggs are laid on submerged vegetation. Locally this species is most abundant in the South Bay; where mudflats and sloughs are used for spawning and feeding, and as nursery areas for juveniles (Saiki 2000c). The Pacific staghorn sculpin is most abundant in central and north San Francisco Bay, but in some years it occurs commonly in the South Bay as well (CDFG 1987 in Tasto (2000b)). This sculpin spawns from November to March in shallow subtidal to intertidal water, and the young gradually shift their foraging areas from shallow intertidal habitats to deeper subtidal habitats as they mature (Tasto 2000b). The arrow goby occurs on shallow intertidal flats and in salt-marsh channels throughout much of the South Bay, where it is often commensal with burrowing invertebrates (Hieb 2000a). This species breeds primarily in spring and early summer, with peak larval occurrence from April through July. The bay goby occurs in somewhat deeper-water habitats than the arrow goby, and is also a common breeding species in the South Bay (Hieb 2000b). The longjaw mudsucker resides on mudflats and in tidal channels and sloughs. Marshes with complex channels provide the highest-quality habitat, although this species also breeds in lower-salinity salt ponds (Hieb 2000c). The longjaw mudsucker spawns from November through June in the South Bay, constructing burrows for breeding.

Other species forage in the South Bay but are not known to breed here. Pacific Herring are present in the North Bay from November through March, when spawning occurs; larvae and juveniles occur more widely, during which time they occur in the South Bay (though abundance decreases southward). Most individuals depart the Bay by August (Tasto 2000a). Longfin smelt spawn in fresh water in the upper end of Suisun Bay and in the Delta, occurring in the South Bay year-round as pre-spawning adults and yearling juveniles (Wernette 2000). Striped bass were introduced into the San Francisco Estuary in 1879, and are now the most important sport fish in the San Francisco Estuary, bringing in approximately $45 million per year into the local economies of the Estuary (Sommer 2000). Adults congregate in the San Pablo and Suisun Bays in fall and move into the Delta to spawn primarily in the Sacramento/San Joaquin Rivers in May and June. Striped bass in the South Bay are likely subadult fish foraging widely in the Bay, as this species is not known to breed in the South Bay. The California halibut (*Paralichthys californicus*) forages to some extent in the South Bay, but is not known to breed anywhere inside San Francisco Bay (Saiki 2000a). Juvenile starry flounders (*Platichthys stellatus*) occur fairly commonly in

South Bay sloughs, tidal marsh channels, and mudflats, although this species is not known to breed in the Bay (Kline 2000).

Adult steelhead (*Oncorhynchus mykiss*; Central California coast DPS) migrate through the Shoreline Study area into freshwater streams within the South Bay typically from December through April. Outmigration of smolts mainly occurs from February through June (Roessler et al. 2001, SCVWD unpublished data). Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley Fall-Run ESU, also migrate through the Study area during adult upstream migration from August through December, and during the downstream migration of juveniles typically from February through June (Roessler et al. 2001, SCVWD unpublished data). Relatively few data are available regarding use of South Bay marshes by salmonids, due to the difficulty of sampling small fish in this habitat. Steelhead were not captured by the CDFG during its South Bay surveys, and Chinook salmon were captured only in very low numbers. These species are discussed in detail in the Special-Status Wildlife Species section below (Section 3.7).

The diets of South Bay fish vary widely (Goals Project 2000; Harvey et al. 1977). Herring, anchovies, perch, and a variety of other fish and shrimp species provide prey for striped bass. The American shad feeds on copepods, larval fish, and *Corophium*. Northern anchovies are filter feeders that capture zooplankton and phytoplankton. Gobies prey on small fish and crustaceans. Jacksmelt eat a variety of copepods, insects, and polychaetes. Longfin smelt feed on zooplankton, shrimp, and copepods. Chinook salmon (*Oncorhynchus tshawytscha*) prey on insects, shrimp, amphipods, and isopods. The Pacific sardine (*Sardinops sagax*) is a filter and particulate feeder. The bat ray feeds on benthic mollusks, polychaete worms, and crustaceans. Leopard sharks eat a variety of crabs, shrimp, and small fish.

The history of the fisheries in the San Francisco Bay area, based on commercial catch data, was well described by Skinner (1962), but information specific to the South Bay in that text is very limited. According to Thomas Laine (pers. comm.), saltwater fish have declined in abundance in the far South Bay, with an apparent decline being particularly noticeable in the Alviso area since the 1970s. Although no commercial fishery for fin-fishes has existed in the Alviso area, this area was important for recreational fishing, particularly for sturgeon and striped bass, when the boat ramp at the Alviso marina was operational, and fishing derbies for sturgeon in the 1970s attracted as many as 700 entrants (Laine, pers. comm.). Large sturgeon and striped bass are still caught in the South Bay, but public boating access is limited to boat launches at the SFBNWR headquarters entrance in Newark and in the Redwood City area (except for the few boats currently moored along Alviso Slough).

Salt Pond Fish Communities. Fish community composition and abundance within the salt ponds of the South Bay are primarily a function of salinity, with more diverse communities and greater abundance in lower-salinity ponds, and generally no fish surviving salinities greater than 100 ppt. Carpelan (1957) found that in the Alviso salt ponds he studied, the primary fish species were topsmelt and threespine stickleback. Stickleback, primarily a freshwater species, occurred in low-salinity ponds, where they were often noted in clear water above macrophytic green algae. Topsmelt were the most abundant fish species, occurring in ponds with salinities up to 55 ppt. These fish feed in the salt ponds primarily on copepods. The longjaw mudsucker and the Pacific staghorn sculpin also occurred in the lower salinity Alviso ponds, but in lower abundance.

Lonzarich and Smith (1997) more recently studied fish assemblages in Alviso ponds A9 through A12, finding topsmelt, threespine stickleback, and longjaw mudsucker to be common in low- to mid-salinity ponds (35-90 ppt). Adult topsmelt occurred in ponds with salinities up to 90 ppt, and juvenile topsmelt occurred in ponds up to 75 ppt. Rainwater killifish (*Luciana parva*) and yellowfin gobies were also resident in most ponds studied. Nine additional fish species recorded in salt ponds by Lonzarich and Smith (1997), including staghorn sculpin, leopard shark (*Triakas semifasciata*), and northern anchovy, were apparently seasonal transients from adjacent Bay waters.

Surveys by USGS (Takekawa et al. 2005) recorded 14 fish species in Alviso salt ponds between March 2004 and June 2005; these results are similar to those of Lonzarich and Smith (1997), with longjaw mudsucker, rainwater killifish, topsmelt, and yellowfin goby being the most abundant fish, although very few sticklebacks were caught by USGS. Other species recorded in the Alviso salt ponds by USGS included northern anchovy, bay pipefish, staghorn sculpin, chameleon goby (*Tridentiger trigonocephalus*), leopard shark, shiner surfperch, striped bass, starry flounder, and bat ray.

Freshwater Stream Fish Communities. Fishes in the freshwater streams entering the Bay in the Shoreline Study Area consist of a moderately diverse assemblage of native species augmented by a number of non-natives. Coyote Creek has been the best studied of the creeks entering the Study Area in terms of its fish communities; such studies were summarized in Appendix C of Buchan et al. (2002). Native species recorded along lower Coyote Creek between 1858 and 2000, and thought to be extant as of 2000, include the splittail (*Pogonichthys macrolepidotus*), Pacific lamprey (*Lampetra tridentata*), steelhead/rainbow trout, California roach (*Lavinia symmetricus*), hitch (*Lavinia exilicauda*), Sacramento blackfish (*Orthodon microlepidotus*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker, threespine stickleback, prickly sculpin, riffle sculpin (*Cottus gulosus*), and staghorn sculpin (Buchan et al. 2002, Buchan and Randall 2003). Other natives, such as the thicktail chub (*Gila crassicauda*), Sacramento perch (*Archoplites interruptus*), coho salmon (*Oncorhynchus kisutch*), speckled dace (*Rhinichthys osculus*) were recorded historically in lower Coyote Creek but may have been extirpated.

Anadromous fish, such as the Central California Coast steelhead and Chinook salmon use the reaches of freshwater streams in the Study Area primarily during movements between upstream spawning areas and estuarine/oceanic habitats. Coho salmon (*Oncorhynchus kisutch*) formerly spawned in the Coyote Creek watershed, but was apparently extirpated by the 1970s.

A variety of non-native fish introduced either unintentionally or intentionally for angling or mosquito control, occurs in South Bay freshwater streams. These include the mosquitofish (*Gambusia affinis*), channel catfish (*Ictalurus punctatus*), brown bullhead (*Ictalurus nebulosus*), yellow bullhead (*Ameiurus natakis*), black bullhead (*Ameiurus melas*), white crappie (Pomoxis annularis), black crappie (*Pomoxis nigromaculatus*), red shiner (*Notropis lutrensis*), inland silverside (*Menidia beryllina*), carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), fathead minnow (*Pimephales promelas*), redear sunfish (*Lepomis microlophus*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), golden shiner (*Notemigonus crysoleucas*), and others (Buchan et al. 2002, Buchan and Randall 2003). Many of these non-natives are widespread in streams throughout central

California, and are fairly tolerant of marginal water quality and a variety of stream conditions. The number of non-native fish species recorded along lower Coyote Creek increased from zero during the period 1858-1940 to 21 during the period 1987-2000 (Buchan et al. 2002).

4.3.3 Reptiles and Amphibians

Relatively few species of reptiles and amphibians occur in the Shoreline Study Area, and consequently, there has been little study of these taxa within the Study Area. The western fence lizard (*Sceloporus occidentialis*), a ubiquitous lizard in California, occurs in a variety of habitats in the Study Area. Other reptile species that occur within the Study Area include garter snakes (*Thamnophis couchi*, *T. elegans*, and *T. sirtalis*), gopher snakes (*Pituophis melanoleucus*), and southern alligator lizards (*Elgaria multicaranata*), all of which occur along edges of well-vegetated levees, in riparian habitats, and in grassland and ruderal habitats.

A small, isolated population of western pond turtles (*Clemmys marmorata*) occurs in brackish habitats near the Sunnyvale WPCP and Moffett Field, and this species is also present in small numbers along the lower reaches of Coyote Creek and the Guadalupe River (see Special-Status Wildlife Species in Section 3.7). Small numbers of a several species of non-native turtles, most likely pets that have been released, are present in South Bay streams as well.

Due to the paucity of freshwater habitats within the immediate Study Area, amphibian use of the Study Area is even more limited. Where fresh water occurs along the inland margins of the Study Area, the Pacific treefrog (*Hyla regilla*), western toad (*Bufo boreas*), and non-native bullfrog (*Rana catesbeiana*) are present. California slender salamanders (*Batrachoseps attenuatus*) and arboreal salamanders (*Aneides lugubris*) occur in moist riparian areas along the margins of the Study Area, but are much more abundant in higher-elevation, more wooded, less urbanized sites outside the Study Area. California tiger salamanders (*Ambystoma californiense*) occur in vernal pool habitats in the Warm Springs area, primarily on SFBNWR lands.

4.3.4 Mammals

Relatively few species of mammals occur in the Shoreline Study Area owing to the intense disturbance and habitat conversion that has occurred within the area. Within the Study Area, most research attention on mammals has focused on the ecology of special-status salt marsh associated species (i.e., the salt marsh harvest mouse and salt marsh wandering shrew, along with other small mammals using salt marshes), the use of South Bay waters and tidal habitats by the Pacific harbor seal, and the presence and impacts of non-native mammals. Upland habitats within the Study Area are primarily ruderal, although some non-native grassland habitat and the riparian corridor of Coyote Creek do support a variety of small mammal species.

Salt marsh harvest mice and salt marsh wandering shrews occur in the Study Area primarily in pickleweed-dominated salt marshes. Harbor seals, the only marine mammals that regularly occur in the

South Bay, forage in Bay waters and sloughs and breed and loaf on the edges of tidal marshes and mudflats. Because these three species are discussed in detail in the Special-Status Wildlife Species section (Section 3.7), they are not discussed further in this section.

Trapping studies for the salt marsh harvest mouse in the South Bay have revealed much about the status of other small mammals in marsh habitats of the region. House mice (*Mus musculus*) and California voles are common in diked and tidal salt marshes, particularly in the pickleweed-dominated high marsh and the peripheral halophyte zone, where the western harvest mouse (*Reithrodontomys megalotis*) also occurs in the high marsh. Deer mice (*Peromyscus maniculatus*), shrews, and both black rats (*Rattus rattus*) and Norway rats (*Rattus norvegicus*) are also recorded in these marshes during salt marsh harvest mouse trapping studies. Table 6 below lists the results of a small sample of such studies to indicate the relative abundance (relative to trapping effort and among species) of these species in South Bay marshes (Environmental Science Associates 1991; H. T. Harvey & Associates 1988; 1989; 1990; 1991; Harvey and Stanley Associates 1985; 1986; Muench 1985; Shellhammer et al. 1988; Wondolleck et al. 1972).

Aside from the introduced house mouse, which occurs commonly in a variety of habitats in the South Bay, the most abundant mammal trapped during the studies listed in Table 6 was the California vole. This species is a common inhabitat of grasslands, ruderal habitats, and wetlands around the South Bay, and is a keystone species in grasslands due to its importance as a prey species to mammals and raptors (Pearson 1985) and the significant effect this species may have on vegetation during populations peaks (Lidicker 1989; Lidicker 2000). Studies of populations in upland areas have demonstrated dramatic fluctuations in abundance, and when it is particularly abundant, the California vole may have adverse effects on other small mammals. For example, western harvest mice are impacted strongly, presumably via competitive interactions, during vole outbreaks, and it is possible that high densities of voles may have the same negative impacts on salt marsh harvest mice, as has been suggested by Geissel et al. (1988).

Several species of bats, such as the Mexican free-tailed bat (*Tadarida brasiliensis*), forage over the salt ponds, marshes, and grasslands of the South Bay. Native mammals such as the California vole, western harvest mouse, deer mouse, Botta's pocket gopher (*Thomomys bottae*), California ground squirrel, black-tailed jack rabbit, Audubon's cottontail, brush rabbit, striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*) occur on salt pond levees, at the margins of marshes, and in upland ruderal and grassland habitats around the periphery of the Study Area.

Several non-native mammal species occur in the South Bay, including the red fox (*Vulpes vulpes regalis*), Norway rat, black rat, feral cat (*Felis felis*), and Virginia opossum (*Didelphis virginiana*). These species have the potential to impact populations of California clapper rails and other native species in the South Bay considerably. The red fox was first reported in the South San Francisco Bay area in 1986 (Foerster and Takekawa 1991), and it has since increased and expanded to become established throughout the Bay area. It dens in a variety of habitats, including salt pond levees (Foerster and Takekawa 1991).

Table 6 – Relative abundance of small mammals captured during selected salt marsh harvest mouse trapping studies in the South Bay.

Site and Habitat	Year(s)	Trap Nights	Species*							Reference
			Salt Marsh Harvest Mouse	Western Harvest Mouse	House Mouse	Deer Mouse	California Vole	Shrew spp.	Black / Norway Rat	
1990 Bay Road, East Palo Alto (tidal salt marsh)	1990-91	1000	20		3	1	3		3	Environmental Science Associates 1991
Dumbarton Marsh (tidal salt marsh)	1990-91	1000	18		8	1	16	1		Environmental Science Associates 1991
Palo Alto Baylands (salt marsh)	1972	2058	196		74		39	3		Wondolleck et al. 1972
Western Alameda and Northeastern Santa Clara Counties (diked marsh)	1983-86	12,800	140	45	717	54	478	10	3	Shellhammer et al. 1988
Western Alameda County (tidal salt marsh)	1983-86	1200	13	7	72		129	2		Shellhammer et al. 1988
Lower Calabazas Creek at Hwy. 237, Alviso (fresh/brackish tidal marsh)	1988	1000		3	46					H. T. Harvey & Associates 1988
Coyote Creek Flood Control Project (ruderal/alkali habitat)	1990	1000	7	4 (harvest mouse sp.)	21	2	1			H. T. Harvey & Associates 1990c
Mayhews Landing (mixed grassland, diked marsh, fresh/brackish marsh)	1988-89	3120	36		101		7			H. T. Harvey & Associates 1989
Warm Spring International Industrial Park (diked pickleweed marsh)	1985	900	1		36					Harvey and Stanley Associates 1985
Warm Springs II/Fremont Airport (diked pickleweed/grassland)	1985	2400	27		≤ 154		1			Harvey and Stanley Associates 1986
Triangle Marsh (tidal salt marsh) and New Chicago Marsh (diked salt marsh)	1985	776	1	1	161		6	1		Muench 1985
Triangle Marsh (tidal salt marsh)	1990	500	10		8	3	18			H. T. Harvey & Associates 1991c

Site and Habitat	Year(s)	Trap Nights	Species*							Reference
			Salt Marsh Harvest Mouse	Western Harvest Mouse	House Mouse	Deer Mouse	California Vole	Shrew spp.	Black / Norway Rat	
Calaveras Point Marsh (tidal salt marsh)	1990	400	22				1			H. T. Harvey & Associates 1991c
Warm Springs Marsh (tidal brackish marsh)	1990	500			35	3	57			H. T. Harvey & Associates 1991c
Coyote Creek Flood Control Project (ruderal/alkali habitat)	2001	800		3	22		4			H. T. Harvey & Associates 2001
Stevens Creek Marsh (tidal salt marsh)	2005	400	2	1	40		5			H. T. Harvey & Associates 2005
Calaveras Point Marsh (tidal salt marsh)	2006	2000	15		4		6			H. T. Harvey & Associates 2007
Triangle Marsh (tidal salt marsh)	2006	2000	28		37		53			H. T. Harvey & Associates 2007
Warm Springs Marsh (tidal brackish marsh)	2006	2000	10		18		29			H. T. Harvey & Associates 2007

* In these studies, species other than salt marsh harvest mice were not uniquely marked for identification, and hence the numbers listed for species other than the salt marsh harvest mouse include an unknown number of recaptures. However, the house mouse and California vole were still found to be the most abundance species in many marshes.

Clapper rail predation by both red foxes and feral cats has been directly documented in the South Bay by the tracking of radio-marked rails that were depredated in 1991 and 1992 (Albertson 1995). In addition, the remains of clapper rails were found at a fox den in a tidal marsh on the SFBNWR (Harding et al. 1998), and at the entrance to a den in the outboard levee along salt pond A9 (Steve Rottenborn, pers. obs.). Norway rats are thought to be one of the main predators of California clapper rail eggs (Foerster et al. 1990; Harvey 1988), and raccoons have also been known to prey on California clapper rail eggs (Foerster et al. 1990). In addition to impacts to clapper rails, red fox predation on nests of the federally threatened western snowy plover has been recorded, and fox predation has resulted in the abandonment of important colonies of Caspian terns (at Mowry and Bair Island) and herons (at Bair Island) in the South Bay in 1991 (Strong 2004a).

The feral cat is fairly common in upland habitats around the South Bay (Foerster and Takekawa 1991; Takekawa 1993), whereas the Norway rat and roof rat occur in most habitat types in the Study Area. Both rats are known nest predators of California clapper rails, and up to one-third of clapper rail eggs in the South Bay may be depredated by Norway rats (BDOC Unpublished; Josselyn et al. 2004). Rats have depredated California Gull nests in the South Bay as well (Jones 1986).

In 1991, the San Francisco Bay NWR implemented a predator management plan directed at the removal of red foxes, raccoons (*Procyon lotor*), striped skunks, and feral cats to protect the federally listed California clapper rail and western snowy plover (Harding et al. 1998). From spring 1991 to fall 1996, the average number of individuals removed from NWR lands per year included 90 red foxes, 27 feral cats, 26 striped skunks, and two raccoons. In addition, 38 non-native opossums and 25 native gray foxes (*Urocyon cinereoargenteus*) were captured and released. The number of red foxes trapped was consistent from 1991 to 1996, but trapping rates declined because more traps were used in successive years. Successful trapping required 46 traps/fox in 1991-1992 and 83 traps/fox in 1995-1996, suggesting that the trapping program was successful in reducing fox populations. More than half of the cats and skunks trapped were in the Warm Springs/Fremont area. In 2003, the CDFG implemented a predator-control program at the Eden Landing Ecological Reserve to reduce predation on listed species (John Krause, pers. comm.).

4.3.5 Birds

The birds of the South Bay have been studied more than any other wildlife group. This focused attention results from the high diversity of birds in the region, the presence of several San Francisco Bay-area endemics and state and federally listed species, the plasticity demonstrated by a number of species in adapting to the anthropogenic changes (including salt pond development and urbanization) that have occurred in the South Bay, and the intensity of interest in the birdlife of the region by professional and amateur ornithologists. The birds of the Bay and associated salt ponds and marshes represent the most significant contribution of the South Bay to the avifauna of the Pacific Flyway, and the following discussion focuses primarily on birds associated with these areas. In addition, riparian habitats in the Study Area, though limited in extent, provide important foraging habitat for migrants and wintering birds and valuable breeding habitat for a few riparian-associated species.

Overview of Baylands Bird Communities. The San Francisco Bay area is extremely important to breeding birds and, particularly, to migratory waterbirds in the Pacific Flyway. The Bay provides important foraging and roosting habitat for more than one million waterbirds each year, supporting large proportions of the populations of some shorebird and duck species (Accurso 1992; Harrington and Perry 1995; Page et al. 1999; Stenzel et al. 1989; Stenzel and Page 1988; Takekawa et al. 2001). With its extensive mudflats, remnant salt marsh, and salt ponds, the South Bay in particular supports very high diversity and abundance of waterbirds (Harvey et al. 1992; Takekawa et al. 2000; Warnock 2004b). More than 250 bird species occur in the greater South Bay area with some regularity, and many of these are common inhabitants of the Shoreline Study Area and its immediate vicinity. More than 75 species of waterbirds use the salt ponds, tidal marshes, mudflats, subtidal habitats, and surrounding managed marshes, water treatment plants, and managed ponds regularly, with more than 50 species more occurring rarely and/or in low numbers. Species richness in the South Bay system is generally highest in fall and lowest in summer and winter, while waterbird abundance is highest in spring and winter (Strong 2003; Takekawa et al. 2001; Takekawa et al. 2004). In Bay-wide surveys, Bollman et al. (1970) found waterbird abundance to be lowest in summer, increasing rapidly in early September and peaking in December.

The high waterbird diversity in the South Bay is a function of the diversity of wetland and aquatic habitats in the region, while high bird abundance is a function of the high productivity of the South Bay estuary and, secondarily, of alternative habitats such as salt ponds. Despite the extensive loss and degradation of the South Bay's tidal marsh, and the invasion of the South Bay benthic invertebrate community by non-native species, this system is still extremely productive. The remnant tidal marshes not only provide habitat for marsh obligates such as the California clapper rail, they also play important roles as sources of nutrients and carbon for the aquatic system, resulting in high abundance of invertebrates on the mudflats and shallow subtidal areas (Warwick and Price 1975), and ultimately high fish populations. These invertebrates and fish in turn serve as prey to the myriad shorebirds, waterfowl, herons, egrets, gulls, terns, grebes, and other waterbirds that use the South Bay.

Salt ponds and other alternative habitats (such as artificial ponds and lakes, water treatment plant settling and oxidation ponds, muted and managed marshes, and managed ponds) also provide important habitat for waterbirds in the South Bay (Hanson and Kopec 1994; Harvey et al. 1992; Stralberg et al. 2003; Takekawa et al. 2000; Takekawa et al. 2001; Warnock 2004b). Though salt ponds are more or less closed systems, providing little input of carbon or nutrients to the estuary itself, the concentration of superabundant invertebrate prey in salt ponds, provision of alternate foraging habitat during high tide, provision of roosting sites, and concentration of fish in lower-salinity ponds results in suitable foraging conditions for a variety of waterbirds. For some species, such as the Wilson's phalarope, red-necked phalarope, black-necked stilt, American avocet, western snowy plover, Bonaparte's gull, American white pelican, and breeding gulls and terns, these ponds provide higher-quality nesting and/or foraging habitat than the existing tidal marshes or intertidal habitats. A number of other species use salt ponds primarily when their preferred intertidal habitats are inundated, or when high densities may cause some birds to forage in less optimal areas (Warnock and Takekawa 1995). For such species, the question of whether salt ponds and other alternate habitats are required for foraging, or whether they are required primarily for high-tide roost sites, varies among species, and possibly among seasons (i.e., being more important for

foraging when densities are high). Alternate habitats such as salt ponds and levees are required for high-tide roosting sites, refugia from strong winds, and foraging sites during prolonged winter storms, when winds, rain, and high water may limit foraging efficiency and limit the availability of intertidal foraging areas (Davidson and Evans 1986; Evans 1976; Pienkowski 1981).

Although birds may be very abundant in salt ponds during high tide, most bird activity is concentrated in small areas within the larger salt pond complexes. For example, Stralberg et al. (2003) reported that 90% of the small shorebirds and dabbling ducks in their South Bay study area were recorded in six of 22 ponds under study, while 90% of the larger shorebirds were recorded in ten of 22 ponds. This concentration is a result of the dispersion of suitable foraging habitat and prey availability, which may be concentrated in relatively few ponds having suitable water depths and salinities. It has been reported that salt ponds close to the edge of the Bay have greater bird use than those farther from the Bay, and that many shorebirds use mudflats and salt ponds in close proximity to one another (Warnock and Takekawa 1996), thus reducing commuting distances between low-tide intertidal foraging habitat and high-tide refugia within the ponds for birds that use both habitats. Studies of color-marked or radio-tagged shorebirds in the South Bay indicate that many individuals have high site fidelity and small home ranges, often using the same roosting and foraging sites consistently (Kelly and Cogswell 1979; Warnock and Takekawa 1996). Wintering western sandpipers in the South Bay were found to have a mean home range size of 22 km^2, and the mean distance between feeding and roosting areas was 2.2 ± 0.1 km, although some birds moved around quite a bit, particularly within pond complexes. Warnock and Takekawa (1996) found less movement from one side of the Bay to the other. While the ponds supporting the greatest use do tend to be closer to the Bay (Takekawa et al. 2005), and many birds may repeatedly use the same small areas, waterbirds in some areas are known to repeatedly travel longer distances (e.g., thousands of shorebirds regularly commuting more than four miles between intertidal foraging areas and high-tide roosting areas near the NWR headquarters in Newark; (Morris 2004)). The sudden appearance of large numbers of shorebirds when salt ponds were drained during ISP implementation (Krause, pers. comm.; H. T. Harvey & Associates Unpublished), or of large numbers of piscivores at prey fish "blooms" (Steve Rottenborn, pers. obs.), is also indicative of these birds' potential for significant local movement to exploit favorable foraging conditions.

A few studies have compared the use of salt ponds with the use of other available habitats (e.g., tidal marsh, mudflats, and subtidal areas) in the South Bay. Within salt ponds and nearby mudflats near Coyote Hills, Swarth et al. (1982) found higher bird species richness in low-salinity ponds than in higher-salinity ponds or mudflats, although relatively few species used the salt ponds at low tide. In contrast, Takekawa et al. (2001) found species richness and diversity in the North Bay to be higher in natural baylands (i.e., tidal marsh and mudflats) than in salt ponds during all seasons, while overall bird density was higher in salt ponds than in baylands in winter and spring (and overall was twice as high in salt ponds than in baylands). During Bay-wide surveys, Bollman et al. (1970) found that salt ponds supported densities of waterbirds (57-73 birds/acre) two to three times higher than mudflats (29-30 birds/acre) and open water (15-18 birds/acre). At any given time, the proportion of a salt pond or mudflat in use by foraging birds may be relatively small, as birds often concentrate in areas providing the most suitable conditions, complicating the comparison of densities among these habitat types. Studies of shorebird use

of different South Bay habitats during high tide, coordinated by SFBBO, are summarized under Shorebirds, below.

Stralberg et al. (2003), comparing use of salt ponds with a limited sampling of tidal marshes (though not including tidal mudflats in the comparison), found that salt ponds had significantly higher species richness than tidal marshes, with a mean of 47 species/pond. However, salt ponds supported high densities of relatively few species, with only occasional use by many of the species contributing to the high species richness in the ponds; in contrast, tidal marsh was used at lower densities by many species. Warnock et al. (2002) confirmed this finding, reporting that ten species (out of 75 recorded) composed >85% of all birds recorded in 22 salt ponds in the South Bay. Thus, tidal marsh provides habitat for more species more consistently; salt pond use by most species is more limited or irregular, but may be very important (to large numbers of individuals of at least some species) at times. Within salt ponds, species richness decreases with salinity, though many species use a wide range of salinities. Of the 50 most common species in salt ponds, the core salinity range for 34 included low-salinity (20-60 ppt) ponds, with 18 found only in this range; mid-salinity (60-120 ppt) ponds were within the core salinity range for 31 species. No species were restricted only to high-salinity ponds (Stralberg et al. 2003).

Stralberg et al. (2003) found waterbird species richness and diversity in tidal marshes negatively associated with the proportion of salt ponds in the surrounding landscape and positively associated with the proportion of surrounding mudflat and marsh. Within marshes, waterbird diversity was higher in marshes with more large channels, and the densities of ducks, larids, and shorebirds increased with increasing amounts of open water within the marsh; waders and other piscivores increased with larger channels in marsh.

The use of individual salt ponds, and foraging locations within those salt ponds, by foraging waterbirds is determined primarily by prey availability, which is mainly a function of salinity and water depth. Warnock et al. (2002) reported bird diversity in South Bay salt ponds to be highest at mid-salinity ponds (±126 ppt), while bird density on salt ponds peaks at higher salinities (±140 ppt). Due to variations in bill and leg length, foraging behavior (i.e., swimming, wading, or diving), and prey preferences, different waterbird species are able to, or prefer to, forage in water of different depths (Isola et al. 2000). Thus, ponds with more topographic heterogeneity, such as islands and uneven bottoms, are important in providing habitat for a greater diversity of foraging guilds by providing a range of foraging depths (Anderson 1970; Takekawa et al. 2004; Velasquez 1993; Warnock 2004b).

The most recent and comprehensive dataset on bird use of the South Bay salt ponds themselves has been compiled by USGS, which has been conducting monthly bird surveys at 53 ponds in the South Bay Salt Ponds complexes (USGS, unpubl. preliminary data). Surveys have been conducted since January 2002 in some of the Alviso Complex ponds (and at all Alviso ponds since January 2003). In addition, the Cargill-managed ponds in the Mowry, Newark, and Coyote Hills pond complexes have been surveyed by SFBBO (using the same methods used by USGS) since 2005. Because management of the salt ponds included in this study may have differed from prior management in anticipation of the purchase of these ponds (and/or their mineral rights) from Cargill (Takekawa, pers. comm.) and because these surveys overlap the implementation of ISP management in some ponds, these data cannot be clearly related to pre-ISP or to

ISP conditions, making it difficult to ascribe mechanisms to the patterns observed. Nevertheless, this dataset is useful in characterizing the general temporal and spatial distributions of birds in the Study Area salt ponds at the present time.

From October 2002 to June 2005, the surveys by USGS had recorded 75 species of waterbirds in the Alviso Complex. Excluding Ponds A19-A23 (since these ponds were not surveyed as many times as the remaining ponds), the number of species/pond ranged from a low of 30 species in the mostly dry Pond A6 to 59 in Pond A9. Ponds A1, A5, A7, A10, and AB2 supported 50-56 species each, while ponds with the lowest species richness included A6, A12, A13, A15, and A17. Although it is likely not possible to determine the mechanisms responsible for these patterns, since ISP conditions were implemented during the study period in some ponds, those ponds having high species richness tended to be large ponds with high topographic variability that included both shallow and deep water, thus providing foraging habitat for a number of foraging guilds. Low-diversity ponds tended to be deep-water ponds with little topographic heterogeneity or ponds that contained little water during the year. Ponds supporting high waterbird abundance during the period October 2002 to June 2005 in the Alviso Complex were Ponds A5 (due largely to high western sandpiper abundance, and high abundance of other species), A6 (due to the large California gull colony in this pond), and A9 (due to high abundance of many species, particularly ducks); Ponds A12, A13, A15, A16, A17, and AB1 supported the lowest bird abundance.

Continued surveys by USGS from July 2005 to August 2006 recorded more than 1.75 million observations of waterbirds representing 67 species in the Alviso Complex salt ponds (Takekawa et al. 2006). These ponds supported higher abundance of certain groups than the Ravenswood and Eden Landing complexes surveyed simultaneously, hosting 96% of the gulls, 84% of dabbling ducks, 83% of diving ducks, 74% of piscivores, and 71% of herons recorded among the three pond complexes. The complex consisting of A1, A2W, A2E, AB1, AB2, A3N, and A3W supported 55% of the diving ducks in the Alviso complex. Ponds A5, A6, and A8 collectively supported 80% of the small shorebirds and 42% of the medium shorebirds in the Alviso complex. The high-salinity ponds, such as pond A13, supported the highest numbers of phalaropes and eared grebes.

The majority of the information on birds of the salt ponds within the Study Area is based on data collected prior to ISP implementation since the ISP has been only recently implemented in some salt ponds (and the effects of this implementation on wildlife use have not yet been fully identified) and has not yet been implemented in other ponds. Ongoing studies by USGS, SFBBO, and others will help to refine the response of wildlife to implementation of the ISP. Already, monitoring data indicates an overall reduction in numbers of salt pond-specialist birds (e.g., eared grebes and phalaropes) as fewer ponds are managed for high-salinity conditions, an increase (at least locally, at the pond or pond complex level) in abundance of small shorebirds in ponds managed for shallow depths, and an increase in abundance of dabbling ducks in ponds that are converted from high-salinity to low-salinity ponds.

Birds in the South Bay overlap considerably in habitat preference and resource use, but general groups of species can be distinguished based on their physical adaptations, habitat associations, foraging behavior, dietary requirements and prey, the ways in which they use salt ponds as habitats (e.g., for nesting, foraging, or roosting), and their temporal occurrence in the Study Area. For the purposes of describing

the existing conditions of the bird community in the South Bay, six general groups of species have been identified: shorebirds; waterfowl (ducks and geese); large waders (herons, egrets, and ibis) and other piscivores (fish-eating grebes, cormorants, and pelicans); larids (gulls and terns); other waterbirds (eared grebes, coots, and rails); and landbirds (including raptors and passerines). Each of these groups is discussed in detail below.

Shorebirds. Perhaps no other group of birds using the South San Francisco Bay has been better studied than shorebirds, which include plovers, sandpipers, stilts, avocets, and phalaropes, and perhaps no other group relies more heavily on the South Bay. Comprehensive shorebird surveys of the Pacific Coast of the U.S., summarized by Page et al. (1999), have documented that the San Francisco Bay supports 41-97% (mean 67%) of estimated totals for key species for the entire West Coast in fall, 38-90% (mean 55.7%) in winter, and 24-86% (mean 52.3%) in spring. No other site on the West Coast of the U.S. supports a mean greater than 8% in any season. For 11 shorebird species, the San Francisco Bay supports >50% of the individuals recorded in all U.S. Pacific Coast wetlands in at least one season. The percentage of the total West Coast population of individual shorebird species that occurs in San Francisco Bay in fall, winter, and spring, respectively, include numbers as high as 62%, 59%, and 56% for black-bellied plovers (*Pluvialis squatarola*); 59%, 68%, and 54% for western sandpipers; 67%, 39%, and 73% for least sandpipers; 78%, 90%, and 58% for black-necked stilts; 97%, 88%, and 86% for American avocets; and 69%, 59%, and 57% for willets (*Catoptrophorus semipalmatus*). The San Francisco Bay supports an average of more than 40% of the West Coast populations over these three seasons for semipalmated plover (*Charadrius semipalmatus*), red knot (*Calidris canutus*), dowitchers (*Limnodromus* spp.), long-billed curlews (*Numenius americanus*), and marbled godwits (*Limosa fedoa*) as well. The San Francisco Bay likely supports more than one million shorebirds in spring and hundreds of thousands in the fall and winter (Stenzel et al. 1989). As a result of these numbers, the San Francisco/San Pablo Bay area has been designated as a site of hemispheric importance by the Western Hemisphere Shorebird Reserve Network (Harrington and Perry 1995), and the Don Edwards San Francisco Bay NWR has been designated a Globally Important Bird Area by the American Bird Conservancy (2004).

The South Bay is the most important part of the larger San Francisco Bay from the perspective of use by breeding, migrant, and wintering shorebirds. Of 838,000 shorebirds counted during a Bay-wide survey 16-18 April 1988, 70% were recorded south of the San Mateo Bridge, with the highest concentration at low tide occurring on the broad intertidal flats on the east side of the Bay between the San Mateo and Dumbarton bridges (Stenzel and Page 1988). Mudflats and salt ponds on the east side of the Bay between these two bridges supported approximately 305,000 shorebirds during this survey, compared to 62,000 on the west side of the Bay between the bridges and 224,000 south of the Dumbarton Bridge. Of nearly 379,000 shorebirds counted during another Bay-wide survey 9-12 September 1988, 75% were recorded south of the San Mateo Bridge; within this area, 128,000 shorebirds were south of the Dumbarton Bridge, compared to 25,000 on the west shore and 77,000 on the east shore between the Dumbarton and San Mateo Bridges (Stenzel et al. 1989). The wintering shorebird population in the South Bay was estimated by Harvey et al. (1988) to exceed 200,000.

Most of the shorebirds that use the South Bay do so only for foraging and roosting but do not breed here. Only four shorebird species breed within the baylands habitats of the South Bay, while 20 species

regularly use the South Bay for foraging and roosting as nonbreeders, and 19 additional shorebird species occur only as rare visitors to the area. Most individuals of most shorebird species in the South Bay forage primarily on intertidal mudflats when these flats are available at low tide. These individuals then seek high-tide refugia in salt ponds, on levees, in other alternative habitats in the area (e.g., water treatment plants, managed ponds, and muted or managed marshes), and to a limited extent in tidal marsh; here, most individuals of the larger shorebird species simply roost until the tide recedes again, while some individuals of the smaller shorebird species forage in their high-tide habitats. A few shorebird species remain in these alternative habitats throughout the tidal cycle, using salt ponds, water treatment plants, and managed ponds and marshes for foraging regardless of tide height.

Shorebird abundance in the South Bay is highest in spring and winter. For most species, the spring migration is rapid and compressed to a relatively brief period from early April to mid-May (Recher 1966; Stenzel and Page 1989), resulting in large numbers of individuals using the South Bay simultaneously. In contrast, the fall migration is more protracted for most species, as different sexes and age classes migrate in fall at different times. Shorebird abundance is lowest during summer, when only breeding individuals of four species and low numbers of non-breeders of other species are present. However, the summer period for shorebirds is very short in the South Bay – late spring migrants may move through the area as late as late May or early June, and the first fall migrants (usually Wilson's phalaropes) begin to arrive in mid-June, with the first southbound arrivals of a number of other species appearing by late June and early July. Fall migration then continues through October.

Breeding. Prior to conversion of tidal marshes to salt ponds in the San Francisco Bay area in the mid 1800s, only one shorebird species, the killdeer likely bred in the South Bay. This species breeds on open ground in a variety of habitats, and open sand, gravel, or soil suitable for breeding was likely present historically. However, the creation of salt ponds in the South Bay has enhanced breeding habitat for several species. The western snowy plover, which nests on salt flats and islands within salt ponds, likely did not breed in the South Bay prior to late 1800s; although salinas were present in the tidal salt marsh, they were not extensive and may not have been large enough to support breeding by this species (Goals Project 1999). This species was first recorded breeding in salt ponds in 1918 (Harvey et al. 1992), and today, snowy plovers nest on levees, islands, and salt flats throughout the South Bay salt ponds, occurring in highest concentrations in the Eden Landing area. This species is discussed in greater detail below in the Special-Status Wildlife Species section (Section 3.7).

The American avocet and black-necked stilt also did not breed in the San Francisco Bay area prior to the creation of salt ponds. These species were first recorded breeding in Bay-area salt ponds in 1926 and 1927, respectively (Gill 1977; Harvey et al. 1992). Since then, their populations have increased considerably, with avocet population estimates of 1800 pairs in 1971 (Gill 1977) and 540 pairs in 1981 (Rigney and Rigney 1981), and stilt population estimates of 400-500 pairs in 1971 (Gill 1977) and 600-650 pairs in 1981 (Rigney and Rigney 1981). More recently, a breeding-season survey of the South Bay by Rintoul and others (2003) counted 1184 black-necked stilts and 2765 American avocets, with the number of breeding pairs estimated at 135-590 for stilts and 440-1380 for avocets. No other coastal site along the Pacific Coast supports such high abundance of these two species (Rintoul et al. 2003).

Both stilts and avocets nest at scattered locations throughout the Shoreline Study Area, although Rintoul et al. (2003) noted particularly large concentrations of both species in New Chicago Marsh in Alviso, with another concentration of avocets in the Warm Springs area along the upper edges of the salt ponds and marshes (Figure 2). Rintoul et al. (2003) noted an increase in the importance of the Eden Landing area for nesting stilts and avocets since 1981 (Rigney and Rigney 1981). It is not clear whether their surveys covered the San Jose/Santa Clara WPCP, where on 10 May 1997, more than 30 stilt nests were found scattered over the sludge ponds during an informal survey (Steve Rottenborn, pers. obs.).

Rintoul et al. (2003) found 21% of 137 black-necked stilt nests in marshes and 69% around salt ponds; of 409 American avocet nests, 3% were in marshes and 93% were around salt ponds. Stilts used salt ponds and marshes in proportion to availability, while avocets favored salt ponds. Within marshes, stilts tended to use more heavily vegetated areas than avocets. Both species used similar habitats for brooding young (mostly salt ponds, with lesser numbers in marshes). Less than 20% of nests found were on levees; most were on islands, as reported by others (Gill 1973; Harvey et al. 1988; Rigney and Rigney 1981; Robinson et al. 1997; Robinson et al. 1999; Swarth et al. 1982). Both species commonly nest among nesting Forster's terns on islands.

Feeding. As noted previously, the South Bay is the single most important area on the west coast, south of Alaska, for use by migrant and wintering shorebirds. Surveys have documented more than 590,000 shorebirds present simultaneously 16-18 April 1988 (Stenzel and Page 1988) and 230,000 present 9-12 September 1988 (Stenzel et al. 1989) in the South Bay. Because these were only snap-shot surveys, and thus capture only a fraction of the shorebirds that use the South Bay as migratory stopover or staging areas, the actual number of birds that use the South Bay for foraging during migration is much higher. The San Francisco Bay is the northernmost location used by large numbers of shorebirds in winter on the West Coast (Warnock 2004a), and wintering shorebird numbers in the South Bay were estimated by Harvey et al. (1988) to exceed 200,000.

Shorebirds tend to forage in habitats, at times, under conditions, and on prey that provide high foraging efficiency while balancing predation risk and other adverse factors (Goss-Custard 1970; Goss-Custard 1979; Goss-Custard et al. 1977; Van de Kam et al. 2004). Shorebirds tend to concentrate foraging activity where suitable prey is most dense (Skagen and Oman 1996) and/or where such prey is most available (i.e., where the birds can reach and obtain food), although they may alter their behavior (e.g., foraging duration or foraging locations) based on competition from other shorebirds or energetic needs. For example, western sandpipers in the South Bay make more use of salt ponds during spring than during other seasons (Warnock and Takekawa 1996), possibly because high spring shorebird densities force some birds to spread out from preferred intertidal mudflats and forage more heavily in less optimal habitats. In winter, shorebirds may spend more time foraging and less time roosting due to decreased daylength, more rapid energy loss due to cool temperatures, and adverse effects of low temperature on food availability and foraging efficiency (Goss-Custard et al. 1977; Heppleston 1971; Kelly and Cogswell 1979; Van de Kam et al. 2004).

Most shorebird species in the South Bay are mudflat specialists, foraging primarily on intertidal mudflats when these flats are available at low tide (Anderson 1970; Kelly and Cogswell 1979; Recher 1966;

Stralberg et al. 2003; Swarth et al. 1982; Warnock et al. 2002; Warnock et al. 1995). These birds move to mudflats as they uncover on an ebbing tide, often concentrating at the edge of the receding tideline. Near the waterline, worms, crustaceans, and bivalves occur close to the surface, whereas these prey species recede deeper into the mud as the water level drops. Near the waterline, microhabitat use often varies among species based on bill and leg length; Semipalmated and black-bellied plovers feed on recently exposed mud, small sandpipers such as western and least sandpipers forage on recently uncovered mud and shallow water, mid-sized birds such as dunlin, red knots, long-billed dowitchers, and short-billed dowitchers forage in slightly deeper water, and larger shorebirds such as willets, long-billed curlews, and marbled godwits probe in deeper water.

Some authors have reported that the greatest concentrations of shorebirds occur at the receding tideline (Recher and Recher 1969; Stenzel and Page 1988; Storer 1951). Gerstenberg (1979) reported that shorebirds forage along the tideline until it reaches its ebb, then spread out over the tidal flats (especially when bird abundance is high), although he also noted that shorebirds may concentrate along the waterline on both the receding and incoming tide. All of these scenarios have been observed in the South Bay, where shorebirds may be observed foraging along the receding and incoming waterline, and often spread out over the flats as well (Steve Rottenborn, pers. obs.). It is likely that shorebirds use more of the tidal flats when densities are higher, as competition for space and food resources requires the birds to spread out over the flats more.

After the mudflat specialists have finished foraging on the mudflats, they may roost temporarily on the upper mudflats before leaving as the tide rises, or fly directly to alternate sites to roost or, to varying degrees, forage during high tide. Although sites such as water treatment plants, managed ponds (e.g., the Coyote Creek Reach 1A pond), managed/muted tidal marshes, and wet fields are used (heavily at times) by mudflat specialists during high tide, most shorebirds move to the salt ponds. Surveys of South Bay high-tide roosting and foraging sites, coordinated by SFBBO between October 1992 and May 1993, documented 51% of shorebirds using salt ponds at high tide, with 10% on levees around and within salt ponds and other habitats, 10% in tidal marsh, 12% in diked marsh, and up to 4% in inactive salt ponds, uplands, freshwater ponds (including sewage treatment ponds), tidal islands, and salt pannes (Hanson and Kopec 1994).

The use of salt ponds for foraging by mudflat specialists varies considerably among species, and for some species, it varies among individuals, seasons, and possibly age classes. Of the mudflat specialist species, most of the individuals observed in salt ponds at high tide are roosting rather than foraging. For example, over all surveys and all shorebird species recorded during SFBBO's 1992-1993 study, roosting composed 68% of activity at these high-tide areas, while foraging composed 26% of shorebird activity (Hanson and Kopec 1994). The percentage of birds in a given location that were foraging at high tide varied considerably among surveys; for example, <1% of more than 24,400 shorebirds in Pond R1 on 22 March 1993 were foraging, whereas 70% of the 6200+ birds (of similar species composition) in the same pond on 3 May 1993 were foraging at high tide. At times, nearly all birds in a given location were observed foraging at high tide, with foraging activity being particularly high in spring.

Long-billed curlews, marbled godwits, and black-bellied plovers roost in salt ponds but do not use them heavily for foraging (Warnock et al. 2002). Black-bellied plovers, willets, and dowitchers make somewhat greater use of salt ponds for foraging, but still do not forage in salt ponds to a great extent. Most western sandpipers and dunlin use salt ponds primarily for roosting, but forage on moist mud and in shallow water to a greater extent. A greater proportion of least sandpipers seems to use salt ponds for foraging than is observed in other mudflat specialists (Steve Rottenborn, pers. obs.).

Telemetry studies by Warnock and Takekawa (1995; 1996) determined that western sandpipers made greater use of salt pond levees and shallows for foraging during spring, when densities in the South Bay were higher, than during winter. These results suggest that birds depositing fat prior to spring migration may need to spend more time foraging (and thus forage in salt ponds during high tide), and that at higher densities (such as occur during spring migration), more birds are relegated to less preferred habitats, such as salt ponds. Some individuals of other mudflat specialists, particularly least sandpipers, dunlin, and semipalmated plovers, may also take advantage of suitable foraging conditions within salt ponds and remain in these ponds throughout the tidal cycle; even within salt ponds, these birds forage primarily at low tide, with most individuals roosting at high tide (Hanson and Kopec 1994; Warnock et al. 2002).

The mild microclimate of the South Bay may help to explain its high bird use during winter (Warnock and Takekawa 1996). Nevertheless, alternate foraging sites may be particularly important for mudflat specialists during the wet season. High winter tides, combined with sustained strong winds and/or flooding, may reduce the extent to which intertidal mudflats are uncovered, temporarily limiting the availability of these preferred foraging habitats (Storer 1951). Flooding may also wash silt onto mudflats, reducing prey availability or foraging efficiency (Gerstenberg 1979; Warnock and Takekawa 1996). Studies have demonstrated that dunlin in coastal areas may move inland to forage after heavy rains (Warnock et al. 1995).

Several species of shorebirds make little or no use of intertidal mudflats, instead preferring the "alternate" habitats for foraging regardless of tide height (Harvey et al. 1988; Stenzel and Page 1988; Storer 1951; Swarth et al. 1982; Warnock et al. 2002). American avocets forage in shallow pools and wet mud on mudflats, and occasionally in deeper water near the tideline (Hamilton 1975; Storer 1951; Warnock et al. 2002), and snowy plovers may use mudflats for foraging as well, but these species are most abundant in the South Bay in salt ponds. Black-necked stilts and Wilson's and red-necked phalaropes also occur in the South Bay primarily in salt ponds, rarely foraging in tidal habitats. Greater yellowlegs and lesser yellowlegs (*Tringa flavipes*) forage in a variety of nontidal habitats in the South Bay, including salt ponds, and occur less frequently on tidal mudflats. While these seven pond specialists may occur by the hundreds or thousands in alternate habitats other than salt ponds, the salt ponds support the vast majority of the South Bay's populations of these species.

Within the salt ponds, water depth and salinity influence the distribution of foraging shorebirds. The abundant invertebrates of the mid- and high-salinity ponds (60-200 ppt), namely brine shrimp, brine flies, and reticulate water boatmen, are important food sources for shorebirds (Larsson 2000; Maffei 2000b; Stralberg et al. 2003; Warnock et al. 2002), but their availability to shorebirds is limited by water depth. Most shorebirds forage in water less than ten to 15 centimeters deep, with depths below four centimeters

being preferred by smaller species such as the western sandpiper, least sandpiper, and dunlin (Isola et al. 2000; Safran et al. 1997). Thus, only the moist soils along the edges of salt ponds, and moist soil or very shallow water within the ponds, provide suitable foraging habitat for these wading species.

The extent of shorebird foraging habitat present within the salt ponds varies considerably among ponds and seasons, but at any given time a relatively small proportion of the salt pond complexes provides suitable conditions (e.g., moist soil or shallow water <ten centimeters deep) for foraging by most shorebirds. Deeper ponds without shallowly sloping sides provide foraging habitat only in a very narrow zone along their immediate periphery. For example, a 12 in-wide strip of moist-soil and shallow-water foraging habitat around the edge of pond A2W (which represent the ponds that lack shallowly sloping sides and are usually flooded) would represent only ±0.1% of the area of this pond.

Calculating the area of suitable foraging habitat for shorebirds over an entire pond complex and across multiple seasons is problematic. Water depth in seasonal ponds may vary considerably among years, seasons, and even months or weeks depending on precipitation levels and temperature. Even in ponds where water levels are managed more actively, the lack of data on microtopography of the pond bottoms and the vagaries of management make it difficult to predict the extent of areas providing water <ten centimeters deep, and floating mats of algae in late summer and fall may provide foraging habitat for birds in ponds >ten centimeters deep. Furthermore, extensive dry flats with thick salt crusts provide only marginal foraging habitat for shorebirds, as prey densities may be low away from the moist-soil and ponded areas. Rough estimates suggest that at any one time, less than 15% of the total salt pond area provides foraging habitat for most shorebirds under ISP management during winter and early spring (when ponds contain the most water), and less than 25% of the salt pond area provides suitable foraging habitat during late summer and fall (when ponds are driest).

In contrast, phalaropes, and American avocets to a lesser extent, can forage while swimming. Thus, these birds are able to use the entire surface area of a pond, taking advantage of prey near the surface of the water. Phalaropes can draw invertebrates from deeper water upward in the water column by spinning on the water's surface. However, much of the invertebrate biomass of the mid- and high-salinity salt ponds may still occur at depths greater than those that can be used by these shorebirds (Laine, pers. comm.). Although brine shrimp account for most of the biomass of the invertebrates within these high-salinity ponds, the nutritive value of brine shrimp to foraging shorebirds may be limited, as Rubega and Inouye (1994) found that red-necked phalaropes could not survive foraging on brine shrimp alone. Brine flies (both adults and larvae), and water boatmen to a lesser extent, are thus very important to shorebirds that forage in South Bay salt ponds (Anderson 1970).

Most vegetated tidal marsh receives little use by foraging shorebirds because of the height and/or density of marsh vegetation. However, more open areas within the marsh are used for foraging by some species. Willets forage in the vegetated portions of tidal marshes (Gerstenberg 1979; Kelly and Cogswell 1979; Long and Ralph 2001), particularly when these areas are flooded during very high tides but occasionally even during low tide (Kelly and Cogswell 1979). Long-billed curlews, marbled godwits, least sandpipers, and other species occasionally forage in vegetated tidal marsh areas as well, usually in more sparsely vegetated areas but occasionally in dense (but short) pickleweed. Large numbers forage on intertidal flats

along the larger sloughs within marshes when the flats are exposed, but most shorebirds avoid areas with dense, tall vegetation, and therefore do not forage in most of the marsh plain. These birds will forage, sometimes abundantly, in shallow marsh ponds and pannes within the high marsh, and in areas where bare mud and shallow water is interspersed with short pickleweed vegetation. Stralberg et al. (2003) reported that the proportion of small shorebirds foraging (rather than roosting) was higher in tidal marsh than in salt ponds. Thousands of individuals of a variety of species use New Chicago Marsh, a managed marsh (i.e., not considered a tidal marsh) in Alviso, for foraging at both low and high tide, as this marsh provides extensive shallow-water marsh pond/panne habitat interspersed with low pickleweed. However, most such areas that formerly occurred within South Bay tidal marshes have been destroyed by fill and diking, and at this time, high marsh habitat within fully tidal marshes is of limited importance for foraging shorebirds in the South Bay.

Birds are often classified by their foraging methods and habitats, which are largely a reflection of their physical adaptations for foraging and their preferred prey, into foraging groups or guilds. As indicated in the USGS unpublished preliminary bird data from Alviso salt ponds, shorebirds in the South Bay are generally grouped into three foraging guilds – shallow probers, deep probers, and sweepers.

Shallow probers are species that pick prey off the surface of the water or sediment (generally after locating the prey visually), or that probe at shallow depths within mud or moist sand to locate prey tactilely. The more common shallow probers in the South Bay include the killdeer, black-bellied plover, semipalmated plover, snowy plover, red knot, dunlin, least sandpiper, and western sandpiper. This guild represents the majority of the migrant and wintering shorebirds in the South Bay, with hundreds of thousands of western sandpipers, tens of thousands of least sandpipers and dunlin, thousands of black-bellied plovers and semipalmated plovers, and hundreds of snowy plovers and red knots using the South Bay at times (Harvey et al. 1992; Stenzel et al. 1989; Stenzel and Page 1988). Warnock and Bishop (1998) have identified the San Francisco Bay as a major staging area for the western sandpiper because individuals are present for longer periods of time and presumably put on more fat than in the stopover areas that are used, but are less important, elsewhere along the central California coast. The western sandpiper is by far the most abundant shorebird species present in the South Bay.

Deep probers include species generally having larger bodies and longer legs and bills than the shallow probers. These species, which probe more deeply into moist sediment and burrows for prey and do less picking of items from the surface (except for yellowlegs), include short-billed dowitchers (*Limnodromus griseus*), long-billed dowitchers, long-billed curlews, marbled godwits, whimbrels (*Numenius phaeopus*), and willets. Though not nearly as abundant in the South Bay as the shallow probers, this guild is still represented by tens of thousands of dowitchers, 10,000+ willets and marbled godwits, and hundreds of long-billed curlews, whimbrels, and greater and lesser yellowlegs during migration and winter (Harvey et al. 1992; Stenzel et al. 1989; Stenzel and Page 1988). The salt pond surveys by USGS identified the highest abundance of both shallow and deep probers (the vast majority of which were likely roosting, rather than foraging, in these ponds) in Alviso Ponds A5 and A7 (Takekawa et al. 2005).

Sweepers include the American avocet, black-necked stilt, Wilson's phalarope, and red-necked phalarope. All of these species forage by picking visually identified prey from the soil surface or water column, but

avocets also forage by sweeping their bills from side to side through water and mud, tactilely detecting prey. Phalaropes may create a vortex by spinning in the water and drawing prey to the surface. In the South Bay, breeding populations of American avocets and black-necked stilts are augmented in winter, when up to 24,500 avocets and 11,500 stilts are present (Harvey et al. 1988). High counts of phalaropes in the South Bay include counts of 37,462 Wilson's phalaropes on 6 August 1984 and 19,000 red-necked phalaropes on 18 August 1981 (Harvey et al. 1992), with combined phalarope counts of as many as 70,000 individuals (Harvey et al. 1988). Both species are much less common in spring than in late summer and fall in the South Bay. Due to the presence of the South Bay salt ponds, the San Francisco Bay is one of five major staging areas for adult Wilson's phalaropes prior to their non-stop migration to South America (Colwell and J.R. Jehl 1994). The salt pond surveys by USGS identified the highest abundance of sweepers in Alviso Ponds A1, A5, A7, A8, A9, A14, A16, and AB2 (Takekawa et al. 2005).

Shorebirds in the South Bay eat a wide variety of invertebrates, and occasionally small fish. Brine shrimp, brine flies, and reticulate water boatmen probably compose the bulk of the prey taken in salt ponds, although *Corophium* spp., annelids, polychaetes, and other invertebrates are known to be taken in salt ponds as well (Anderson 1970). *Corophium* spp., polychaetes, bivalves, and snails likely compose the bulk of the prey taken on mudflats (Harvey et al. 1992; Recher 1966; Swarth et al. 1982). Shorebirds are very flexible and opportunistic in their diets, with considerable dietary overlap among species and foraging guilds (Skagen and Oman 1996). They often take prey in accordance with availability, concentrating where prey is most dense (Goss-Custard 1970; Goss-Custard 1977; Goss-Custard 1979). Thus, the hydrologic regimes and ecosystem processes that maintain abundant invertebrate populations are more important than the specific invertebrate taxa available. As a result, shorebirds are still abundant in the South Bay, and still show a preference for foraging on intertidal mudflats, despite the widespread and pervasive invasions of the South Bay benthic invertebrate community by nonnative species.

Roosting. Shorebirds generally roost, resting and preening, when they are not foraging. Many mudflat specialists roost on the upper flats after initially foraging on the receding tide, then fly to alternate habitats to roost as the mudflats flood. In the South Bay, the most commonly used high-tide roosts for both pond specialists and mudflat specialists are shallows and bare sediment within salt ponds, levees surrounding and (especially) between salt ponds, and islands and artificial structures such as boardwalks within these ponds (Warnock et al. 2002). Surveys coordinated by SFBBO in 1992 and 1993 (Hanson and Kopec 1994) found that 28% of all birds were in shallow water of salt ponds at high tide (most roosting), with an additional 23% on islands within salt ponds and another 10% on levees around a variety of habitats, including salt ponds. Islands within salt ponds were found to be used primarily for roosting, whereas shallow water within salt ponds was used by similar numbers for foraging and roosting. Levees were used for roosting more in spring than in winter, and infrequently in fall.

Although some shorebirds forage at high tide within salt ponds, most birds, including both pond specialists and mudflat specialists, roost during high tide (Hanson and Kopec 1994; Warnock et al. 2002). Major high tide shorebird roosts in the South Bay, based on the unpublished preliminary USGS bird survey data and SFBBO's 1992-1993 study (Hanson and Kopec 1994), are indicated on Figure 3, which also depicts the sites of major western sandpiper roosts in the South Bay identified by Warnock and Takekawa (1995).

Shallowly flooded marsh ponds, marsh pannes, managed marshes, managed ponds, and water treatment plant drying ponds are also used for roosting, and American avocets, willets, long-billed curlews, marbled godwits, dunlin, and dowitchers roost to some extent in tidal marshes with short vegetation (PRBO Conservation Science 2004; Storer 1951). Diked and tidal marshes along the Foster City/Redwood Shores shoreline provide roosting sites for large numbers of birds at times, particularly larger species such as willets, marbled godwits, and black-bellied plovers (Hanson and Kopec 1994).

Due to their proximity to foraging habitat, protection from predators, and protection from wind and wave action, some high-tide roosts are used consistently, and studies of color-marked or radio-tagged shorebirds in the South Bay indicate that many individuals use the same roosting sites consistently (Kelly and Cogswell 1979; Warnock and Takekawa 1995). Other shorebird roosts, however, may be more ephemeral or inconsistently used (Colwell et al. 2003). For foraging shorebirds, site fidelity is tied to consistently suitable conditions at certain locations (e.g., certain ponds that consistently provide shallow foraging habitat for shorebirds) rather than the locations themselves. While the same is likely true of shorebird roost sites, fidelity to a roost site is less easily explained given the abundant, widespread nature of ostensibly suitable roosting habitat on salt pond levees throughout the South Bay.

Waterfowl. Historical accounts of waterfowl numbers in the San Francisco Bay area attest to the abundance of ducks and, to a lesser extent, geese using the Bay area during migration and winter; for example, more than 300,000 ducks were sold in San Francisco markets during the 1911-1912 waterfowl season (Skinner 1962). The South Bay undoubtedly supported large wintering waterfowl populations, as reported by Skinner (1962) for the Alvarado area and the Santa Clara Valley, and the town of Drawbridge near Alviso "became a resort solely for duck hunters arriving from San Francisco by regular trains in the 1880s" (Harvey et al. 1992). The loss of 90% of the Bay's wetlands, along with hunting pressures, contamination, and other factors led to a decline in waterfowl populations, although this decline is not well documented for the South Bay. Currently, the South Bay supports fairly large migrant and wintering populations of ducks, with several breeding species as well.

More than 32 species of waterfowl use the baylands and immediately adjacent habitats of the South Bay. Of these, eight species breed regularly (with populations augmented considerably during the nonbreeding season), nine additional species occur regularly during migration and winter, and at least 15 more occur irregularly and/or in very low numbers in the baylands as nonbreeders. Harvey et al. (1988) reported that wintering waterfowl in the South Bay (south of the San Mateo Bridge) in 1981 exceeded 75,000 individuals, with more ducks on salt ponds than in the Bay, especially from January through April. Surveys in 1987-1990 revealed approximately 57,000 dabbling ducks (ducks that feed without submerging their entire bodies) and 220,000 diving ducks (Goals Project 1999) in the Bay area. The South Bay salt ponds were found to support up to 76,000 wintering waterfowl, representing more than one-quarter of the Bay's waterfowl population, including 89% of the Bay's northern shovelers, 67% of the ruddy ducks, half of the buffleheads, and 17% of the canvasbacks wintering in the Bay (Accurso 1992; Takekawa et al. 2000).

Breeding. Though not nearly as important to nesting waterfowl in the Bay Area as the Suisun Bay (Goals Project 1999; Harvey et al. 1992), the baylands habitats of the South Bay support eight regularly nesting waterfowl species: the mallard, gadwall, and Canada goose (breeding populations of which are introduced) are fairly common breeders, while the cinnamon teal, northern pintail (*Anas acuta*), ruddy duck, lesser scaup, and northern shoveler breed in smaller numbers. Several other species, including the green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), canvasback (*Aythya valisineria*), and redhead (*Aythya americana*), have been recorded breeding only a few times in the Study Area (Santa Clara County Bird Data Unpublished).

Few data exist on breeding population estimates for these waterfowl species in the South Bay. The most comprehensive survey and population estimate for this area was by Gill (1977). During the 1971 breeding season, he found 21 nests or broods of the northern pintail, 19 of the gadwall, eight of the mallard, five of the ruddy duck, four of the cinnamon teal, and one of the northern shoveler in the South Bay. Based on his observations, Gill estimated breeding populations of these species at 50-100 pairs of pintails, 100-150 pairs each of gadwalls and mallards, 50-100 pairs of ruddy ducks, 75-100 pairs of cinnamon teal, and one to five pairs of shovelers in the South Bay. Based on breeding bird atlas work and other observations by birders, current populations of these species likely exceed Gill's 1971 estimates. For example, 650 gadwalls (including 25 broods of young) on 24 July 1993 at the Sunnyvale WPCP (Steve Rottenborn, pers. obs.) attest to much higher breeding abundance than was estimated by Gill. In addition, the lesser scaup has become a regular breeder (albeit in low numbers, likely ten to 20 pairs or more) in the South Bay since Gill's studies (Santa Clara County Bird Data Unpublished).

None of the 41 nesting attempts observed by Gill in salt marsh was successful, leading him to postulate that breeding populations in the South Bay were limited by the availability of freshwater habitats. The nesting microhabitats of these waterfowl within the South Bay are poorly known since nests are usually well hidden, and most breeding is detected by the observation of adults with broods of precocial young. Nesting by most of these species likely occurs in dense herbaceous vegetation in the upper tidal marsh, managed wetlands, upland transition areas, ruderal vegetation on levees, and upland areas surrounding ponds, sloughs, and ditches, such as weedy lots and fields. In contrast, the ruddy duck builds its nests in emergent vegetation in freshwater marshes and the marshy borders of freshwater ponds and ditches.

Important breeding areas for waterfowl in the South Bay combine freshwater or brackish seasonal wetlands with extensive grassy or ruderal vegetation for nesting and fresh, brackish, or low-salinity ponds and marshes for brooding of young. Such areas occur in the Study Area in the Palo Alto Flood Control Basin and vicinity, the Moffett Field/Crittenden Marsh area, the Sunnyvale and San Jose-Santa Clara WPCPs, the Sunnyvale Baylands, and the Coyote Creek Reach 1A waterbird pond.

Foraging and Roosting. The South Bay is an important foraging area for migrant and wintering waterfowl. All of the breeding species are present in much greater abundance during the nonbreeding season than during summer, and they are joined by other species that occur in the South Bay solely as nonbreeders. Duck abundance in the South Bay increases in August and September as migrants, particularly northern shovelers, arrive in salt ponds and marshes. Numbers of other dabbling ducks and

several species of diving ducks increase through the fall and into winter, and remain high into March (Santa Clara County Bird Data Unpublished; Takekawa et al. 2005).

Dabbling ducks forage in a variety of habitats in the South Bay, including mudflats, shallow subtidal habitats, tidal sloughs and marsh channels, marsh ponds, managed and muted tidal marsh, seasonal wetlands, managed ponds, and water treatment plants. In these areas, dabbling ducks feed on a variety of aquatic plants and invertebrates. Because these species do not typically dive for food, dabbling ducks usually forage in water less than 30 centimeters deep (Page 2001). Within salt ponds, salinity is also important for these birds. The plants on which many dabbling ducks feed cannot tolerate high salinities, and thus dabbling duck abundance tends to be highest on lower salinity ponds (20-63 ppt) ponds, with few in ponds >154 ppt (Accurso 1992).

The most abundant dabbling ducks wintering in the South Bay are the northern shoveler, American wigeon (*Anas americana*), northern pintail, mallard, and gadwall (Takekawa et al. 2005). Shovelers are both abundant and flexible in habitat use in the South Bay, although they do not use tidal habitats frequently (Swarth et al. 1982). The northern shoveler was the third most abundant species recorded at the Coyote Creek Reach 1A waterbird pond during monitoring from 1992 to 2003, composing 81% of the waterfowl recorded there (Strong 2003), and counts of 4750 (19 Dec 1999) at the San Jose-Santa Clara WPCP and 5500 (20 December 1996) at the Sunnyvale WPCP have been recorded (Santa Clara County Bird Data Unpublished). Swarth et al. (1982) found shovelers to be much more abundant on salt ponds than in tidal habitats, with 16,500 shovelers counted on two salt ponds during a census in early November. In contrast, these observers found American wigeon, canvasback, scaup, and surf scoters to be much more abundant on the Bay than in salt ponds. Ruddy ducks and northern pintails were common in both habitats.

Diving ducks are the most abundant wintering waterfowl in the South Bay. Common species include the lesser scaup, greater scaup (*Aythya marila*), ruddy duck, canvasback, bufflehead (*Bucephala albeola*), surf scoter, common goldeneye (*Bucephala clangula*), and red-breasted merganser (*Mergus serrator*). These species may "tip up" for food in shallow water, but more frequently dive completely underwater to obtain food. Bivalves, including large numbers of Baltic clams, are a favored food item for diving ducks such as scaup, canvasbacks, and surf scoters, and canvasbacks often congregate over bivalve beds (Miles 2000b; Takekawa and Marn 2000; White et al. 1988). Ruddy ducks forage on aquatic vegetation (such as wigeon grass), which grows primarily in lower-salinity ponds, and invertebrates, including mollusks and water boatmen (Anderson 1970; Miles 2000a). Brine fly larvae/puparie are important to lesser scaup foraging on South Bay salt ponds (Anderson 1970).

Diving ducks are common in the open waters of the Bay, where large flocks of lesser and greater scaup, canvasbacks, and other species often congregate to roost. Although diving ducks may forage in water up to ten meters deep (Miles 2000b), these birds forage primarily in water only a few meters deep (John Takekawa, pers. comm.), and therefore much of the Bay is not available to (or does not provide high-quality foraging conditions for) these birds for foraging, and foraging flocks of diving ducks tend to congregate over shoals and over intertidal flats when they are inundated at high tide. Diving ducks are

also common on salt ponds, in larger sloughs, and on some artificial lakes, such as Shoreline Lake in Mountain View.

Surveys conducted between October 1987 and March 1988 found that scaup composed 41%, scoters 21%, northern shovelers 11%, ruddy ducks 9% and canvasbacks 6% of all waterfowl on the open waters of the Bay (Takekawa et al. 1988). A large percentage (up to 25% or more) of the Bay's wintering populations of scaup and surf scoters occur in the South Bay, but most forage on the Bay itself, whereas buffleheads and ruddy ducks forage more extensively in salt ponds (Takekawa et al. 1988). Conducting winter censuses (November 2000 – February 2001) of the Bay south of the Bay Bridge, Ford et al. (2002) estimated more than 168,000 scoters, 164,000 scaup, and 53,000 ducks of other species on the open waters of the Bay. Although the center of abundance moved around somewhat among surveys, the greatest concentrations of scoters were north of the San Mateo Bridge, while several centers of abundance for scaup included areas between the Dumbarton and San Mateo Bridges and south of the Dumbarton Bridge.

Although total numbers of waterfowl are higher on the Bay than in salt ponds in the South Bay, lower-salinity salt ponds (20-63 ppt) of moderate size (50-175 ha) support the highest densities of waterfowl in the Study Area (Siegel and Bachand 2002). Ponds A9 and A10 in Alviso, and the Sunnyvale WPCP ponds, have been identified as being particularly important to northern pintail populations in the South Bay (Casazza and Miller 2000). Results of the salt pond surveys by USGS (Takekawa et al. 2005) indicate that in the Alviso Complex, Ponds A1, A2E, A2W, A5, A7, A9, and AB2 support high numbers of dabbling ducks, with the higher salinity Ponds A12, A13, and A19-A23 supporting few dabblers. Ponds A1, A2W, A9, and A10 support large numbers of diving ducks, primarily ruddy ducks and scaup, with fewer buffleheads and canvasbacks.

On decommissioned salt ponds in the North Bay, Takekawa et al. (2004) found that diving benthivores, primarily diving ducks, dominated the bird community on the salt ponds. Diving duck densities were four times higher in salt ponds than in the natural baylands in winter and spring, as contrasted with dabbling ducks, which were consistently higher in baylands habitats than in salt ponds. In South Bay salt ponds, dabbling ducks tend to dominate the salt pond bird communities, with northern shovelers accounting for 41-46% of all birds in ponds at low tide (Warnock et al. 2002). Ruddy ducks are the next most abundant duck wintering on South Bay salt ponds (primarily on low-salinity ponds), with up to 19,000 recorded on these ponds (Accurso 1992). In contrast to shorebirds, the vast majority of which use salt ponds primarily at high tide, duck numbers on South Bay salt ponds are similar at high and low tides (Warnock et al. 2002).

Stralberg et al. (2003) found that dabbling duck species richness in the South Bay tended to be higher in marshes than in salt ponds, and that dabbling ducks were more abundant in marshes at low tide, while diving ducks were more abundant at high tide. Dabbling ducks reached peak densities in salt ponds in fall and early winter, while diving ducks peaked in early spring. Dabbling duck densities tended to be higher in salt ponds with more natural upland, less tidal marsh, and less development surrounding the pond, while diving ducks tended to be higher in ponds closer to the Bay. Ninety percent of the dabbling ducks

recorded during this study were recorded in just six of 22 ponds, while 90% of the diving ducks were recorded in nine ponds, indicating that the majority of ponds support few ducks.

Diving ducks, and many dabbling ducks, often roost while swimming in the open waters of the Bay, on sloughs, and in salt ponds. Dabbling ducks, and diving ducks to a lesser extent, also roost on the edges of mudflats and marshes, on islands and levees within ponds, and on mud and shallow water within the bottoms of salt ponds.

Large waders and other piscivores. This category includes a diverse group of approximately 20 species of piscivorous (i.e., fish-eating) waterbirds that occur in the South Bay, including pied-billed grebes (*Podilymbus podiceps*), western grebes (*Aechmophorus occidentalis*), Clark's grebes (*Aechmophorus clarkii*), loons (which are uncommon to rare visitors), double-crested cormorants, American white pelicans, brown pelicans (*Pelecanus occidentalis*), and large waders (i.e., herons, egrets, and ibis). Several other species, including gulls, terns, mergansers, and belted kingfishers (*Ceryle alcyon*) also forage for fish in the Study Area but are treated in other categories.

While a number of piscivores breed in the South Bay, numbers of most of these species are highest during the nonbreeding season. Western and Clark's grebes do not nest in the baylands of the South Bay but may occur in the area, particularly on salt ponds and in the open Bay, year-round (being most abundant in winter). Brown pelicans typically occur in San Francisco Bay as post-breeding dispersants during summer and fall (Ainley 2000a). American white pelicans are most abundant from June through December.

Breeding. Several piscivorous species in this category nest in the South Bay. Pied-billed grebes nest in freshwater wetlands, building floating nests of vegetation, in scattered areas surrounding the salt ponds and tidal wetlands in the Study Area. Double-crested cormorants nest on electrical transmission towers at several locations in the Study Area, and on the levee between Ponds A9 and A10 in Alviso (see Figure 5); this species and the white-faced ibis (*Plegadis chihi*) are discussed in greater detail in the Special-Status Wildlife Species section below (Section 3.7).

Herons and egrets nest in the Study Area as well (Figure 4). A sizeable colony of waders was detected at Mallard Slough in Alviso in the mid 1970s (Harvey et al. 1992). This colony steadily increased in size, peaking at over 800 nests, through the 1990s. Ten nesting pairs of great egrets were discovered in 1977, increasing to 30 pairs in 1990, when an estimated 266 pairs of snowy egrets and 115 pairs of black-crowned night-herons were present. Up to nine pairs of cattle egrets (*Bubulcus ibis*) and one or more pairs of little blue herons (*Egretta caerulea*) and white-faced ibis also nested in the Mallard Slough colony in the early 1990s. However, this colony was abandoned for unknown reasons in 1999. That year, a small colony of great egrets, containing up to 30 adults and eight nests, became established nearby along lower Coyote Creek near the Reach 1A waterbird pond. Twelve great egret nests were found here in 2000, and seven pairs of great blue herons nested at this location in 2001 (Santa Clara County Bird Data Unpublished). However, this colony has since been abandoned.

Since 1998, small heron rookies have appeared on islands in inland reservoirs in the South Bay (e.g., Lake Cunningham, Almaden Lake, and Vasona Reservoir), and several other small colonies have appeared in the immediate Study Area. Currently, heron rookeries in the vicinity of the Alviso Complex include a colony of snowy egrets and black-crowned night-herons at the Palo Alto Baylands duck pond; small numbers of great blue herons nesting on transmission towers in Ponds A2W, A2E, A3N, and A19 (and on a duck blind in Pond A2E); great egrets, snowy egrets, and black-crowned night-herons nesting in California bulrush at the west end of the Coyote Creek Lagoon near Newby Island (first noted in 2000); and great egrets, snowy egrets, black-crowned night-herons, and little blue herons in Guadalupe Slough between ponds A4 and A5 (Santa Clara County Bird Data Unpublished; Strong 2004a). Green herons (*Butorides virescens*) nest at low densities in scattered locations throughout the South Bay, including mixed-species heronries but also as isolated pairs or in small monospecific groups on duck blinds, along sloughs, and in trees and brush.

Foraging and Roosting. The piscivorous birds of the South Bay forage in a variety of habitats and locations where prey fish are available. The low-salinity salt ponds that support fish, tidal sloughs and channels, edges of intertidal mudflats, nontidal ponds and channels, and artificial lakes such as Shoreline Lake provide the highest-quality foraging areas, and large frenzies of feeding activity may be observed at these locations, presumably when conditions result in large fish concentrations. Brown pelicans usually plunge-dive for fish and therefore require water several feet deep, but American white pelicans and cormorants swim while feeding and can thus feed in shallower water. Although double-crested cormorants, western and Clark's grebes, and brown pelicans forage to varying degrees within the open waters of the Bay, American white pelicans apparently do not, instead preferring nontidal waterbodies (Cogswell 2000; Harvey et al. 1988). Large wading birds are constrained by water depth, and are usually seen foraging from the edges of a body of water or wading within the shallows. Pied-billed grebes and most of the herons and egrets often forage along freshwater streams and in smaller ponds in the South Bay, and great blue herons and great egrets occasionally forage for small mammals in upland fields and ruderal areas.

The larger piscivores move around the South Bay in search of suitable foraging conditions, allowing them to exploit particularly large concentrations of fish. Cormorants and pelicans exhibit movements between foraging areas at inland reservoirs and the South Bay, although most foraging likely occurs within the baylands habitats (Steve Rottenborn, pers. obs.). Piscivore density tends to be lower in salt ponds at low tide than at high tide, as some birds move to intertidal flats to forage (e.g., herons and egrets) or roost (e.g., pelicans) at low tide (Stralberg et al. 2003).

Within salt ponds, the fish commonly taken by piscivores include the mudsucker, topsmelt, sculpin, and stickleback (Cogswell 2000; Harvey et al. 1988). These fish are usually found in water having salt concentrations up to 70-80 ppt, and most cannot tolerate salinity >40 ppt (Carpelan 1957; Lonzarich 1989). As a result, most piscivore use of salt ponds is concentrated in ponds with lower salinities (Anderson 1970; Swarth et al. 1982).

Swarth et al. (1982) reported that loons and western and Clark's grebes were much more abundant on the Bay than in the salt ponds west of the Coyote Hills (Swarth et al. 1982), noting that piscivorous species

were more common in the Alviso ponds than in the Coyote Hills ponds. Approximately 94% of the pelicans and double-crested cormorants recorded by Swarth et al. (1982) were in low-salinity ponds, though most of the cormorants used these ponds only for roosting (primarily on wooden pilings and platforms within the ponds). Although cormorants may take advantage of local concentrations of fish within salt ponds, most apparently feed in the Bay (Ainley 2000b; Anderson 1970). Herons and egrets forage primarily in sloughs and marshes, with only some birds moving to salt ponds at high tide (Anderson 1970; Swarth et al. 1982). However, where temporary concentrations of fish were present (generally in low-salinity ponds in fall), these waders occurred in large concentrations. Takekawa et al. (2001) reported that piscivores were more abundant in natural baylands than in salt ponds in the North Bay during all seasons, while Stralberg et al. (2003) determined that the species richness of large waders tended to be higher in the tidal salt marsh than in salt ponds, although piscivore abundance was higher in salt ponds.

Aerial surveys of the South Bay salt ponds have recorded counts of up to 3147 (on 6 August 1984) American white pelicans using these ponds (Harvey et al. 1992). These surveys only found white pelicans using ponds with salinities between 25 and 90 ppt, with the highest densities in ponds with low salinities (25-30 ppt). Harvey et al. (1992) suggested that the conversion of tidal marsh to salt ponds has benefited white pelicans, and that populations of nonbreeders in the Bay have increased as a result of the provision of sheltered foraging areas that concentrate fish and undisturbed levees for roosting.

Surveys of the South Bay salt ponds by USGS (Takekawa et al. 2005) indicate that species richness of piscivores is more or less constant throughout the year, though abundance is highest in late summer and fall due to the presence of high numbers of herons, egrets, and American white pelicans foraging in salt ponds at this time. Within the Alviso Pond Complex, piscivore abundance is highest in Ponds A1, A2W, A3W, A5, A7, A9, A10, and AB2 and very low in Pond B6 (which contains little water) and the high-salinity ponds A19-A23.

grebes and loons roost entirely on the water, and other swimming piscivores (e.g., pelicans and cormorants) may form floating roosts as well. However, most roosting by pelicans and cormorants occurs on salt pond levees (particularly interior levees between ponds), islands, and artificial structures such as boardwalks. Cormorants often roost in flocks on transmission towers as well. Herons and egrets roost on salt pond levees and in dense marsh vegetation along tidal sloughs.

Larids. Although larids (i.e., birds in the family Laridae, such as gulls, terns, and skimmers) have always used the South Bay for foraging during winter and migration, the use of this area has undoubtedly increased as a result of salt pond creation and, for gulls, the provision of food at landfills, and several species have begun nesting in the South Bay over the last century as a result. Currently, larid populations in the Bay are highest in winter due to the presence of tens of thousands of (if not 100,000+) wintering gulls. However, terns are generally more abundant in the South Bay during the breeding season. Information on special-status larids in the South Bay, including the California gull, California least tern, and black skimmer, can be found in the Special-Status Wildlife Species section below (Section 3.7).

Breeding. In the early 1900s, the Caspian tern was the only larid known to nest in the San Francisco Bay area, with a colony of more than 100 pairs nests present as early as 1916 in marshes near the east end of the Dumbarton Bridge (Grinnell and Miller 1944; Grinnell and Wythe 1927). This colony was reported to occur on a dike between salt ponds as of 1952 (Sibley 1952). As this colony grew to a size of 200 pairs, it split into two colonies in the Newark/Eden Landing area, and a third colony became established on salt pond levees near Mowry Slough in the late 1960s. By 1981, a colony of 1000 pairs was present on Bair Island as well, with approximately 2350 nesting birds present in the South Bay (Rigney and Rigney 1981). However, predation and disturbance by red foxes caused the abandonment of both the Mowry and Bair Island colonies in 1990 and 1991. Subsequently, Caspian terns nested in small numbers at Bair Island in 1993 and 1994 (Harding et al. 1998). Since 1990, breeding within the Study Area has also occurred in Pond A7 (breeding 1997-2006, peaking at 195 individuals in 2001 but with only 30 in 2006) and Ponds A9/A10 (70 individuals present in 1992 only). All nesting in the South Bay currently occurs on isolated portions of levees and islands with little or no vegetation within salt ponds. Although South Bay populations have declined precipitously since the early 1980s, the establishment of a large colony on Brooks Island in the North Bay has allowed Bay-area populations to remain fairly constant, with approximately 2300 individuals breeding in the Bay area in 2003 (Strong 2004a).

Forster's terns were not reported to be nesting in the San Francisco Bay area as of 1944 (Grinnell and Miller 1944), but a colony containing approximately 100 nests was discovered near the east end of the San Mateo Bridge in 1948 (Sibley 1952). Another colony was detected near the east end of the Dumbarton Bridge in 1952, and since then, Forster's tern colonies have appeared at scattered locations throughout the South Bay, with populations peaking at 4386 birds in 1992. However, local populations of Forster's terns have declined significantly since 1984, and a 2003 estimate of the Bay-wide population stands at 2450 individuals (Strong 2004a). In 2003, the 1958 Forster's terns thought to be nesting in the South Bay represented 80% of the total San Francisco Bay population, and represented nearly 25% of the Pacific Coast population and 10% of the North American population estimated in 2001 (McNicholl et al. 2001; Strong et al. 2004a).

Since 1990, Forster's tern colonies have been recorded in the Study Area at the following locations (Figure 4): Charleston Slough and the Palo Alto Flood Control Basin; Alviso Ponds A1, A5, A6, A7, A8, A9/A10, A16, A17, A18, and AB2. These colonies are located on small islands having little or no vegetation (and no tall vegetation) within salt ponds, tidal flats (at Charleston Slough), and managed marsh (Palo Alto Flood Control Basin), with small numbers on duck blinds. In 2006, the largest colonies within the Study Area were at Pond A7 (170 nests) and Pond A16 (132 nests; Strong 2006).

Predation by red foxes, and by avian predators such as California gulls and common ravens (*Corvus corax*), may be impacting tern populations to some extent. In addition, encroachment on Forster's tern nesting sites by an ever-increasing California gull breeding population in the South Bay has taken its toll on nesting terns; for example, islands in Alviso Pond AB2 that were formerly used by nesting Forster's terns have been largely, or entirely, taken over by nesting gulls (Strong 2004a). Because nesting on islands is so important to Forster's terns and black skimmers (and secondarily to the other breeding larids in the South Bay) to deter mammalian predation, population sizes may be limited by available breeding sites.

Least terns, black skimmers, and California gulls are also recent additions to the breeding avifauna of the South Bay; these species are discussed in detail in the Special-Status Wildlife Species section below (Section 3.7). Western gulls (*Larus occidentalis*) nest in very low numbers in the Study Area, with one to three pairs nesting in Pond A6 and on the levee between Mowry Ponds M4 and M5, both within large California gull colonies (Strong 2004a, Strong 2006). The western gull breeds much more commonly near the mouth of the Bay and along the coast.

Foraging and Roosting. Terns and skimmers in the South Bay, which include not only the aforementioned species, but also post-breeding elegant terns (*Sterna elegans*) and occasionally common terns (*Sterna hirundo*), feed primarily on small fish. Foraging occurs commonly within the open waters of the Bay and in low-salinity salt ponds, as well as tidal sloughs and freshwater and brackish channels and ponds. Caspian and Forster's terns often forage at inland ponds and lakes as well, even during the breeding season. Terns may roost on intertidal mudflats at low tide, whereas at high tide and at night they roost primarily on isolated levees, islands, and exposed mud surrounded by water within shallow ponds.

During the nonbreeding season, nesting populations of western and California gulls within the South Bay are augmented not only by nonbreeders of those species (likely including 10,000+ more California gulls and hundreds to 1000+ western gulls), but also by large numbers of herring (tens of thousands), Thayer's (*L. thayeri*; thousands), ring-billed (*L. delawarensis*; thousands to 10,000+), mew (*L. canus*; thousands), glaucous-winged (*L. glaucescens*; hundreds to 1000+), and Bonaparte's (thousands) gulls. With the exception of the Bonaparte's gull, which forages primarily on invertebrates in salt ponds and sewage treatment plants, these gulls are opportunistic foragers. They eat a wide variety of animal matter, including invertebrates, fish, small mammals and birds, and carrion, as well as processed food in landfills. Many gulls forage or roost on intertidal mudflats at low tide (Warnock et al. 2002).

The Newby Island landfill north of Coyote Creek near Alviso in the Study Area and the Tri-Cities Recycling and Disposal Facility located in Fremont immediately adjacent to the Study Area provide food for tens of thousands of wintering gulls, and are likely primarily responsible for the large wintering (and possibly breeding) populations of gulls in the South Bay. Gull abundance is much higher in the vicinity of these landfills than elsewhere in the Study Area, and particularly large concentrations of roosting birds occur in the Alviso and Fremont salt ponds. For example, the location of Ponds A22 and A23 between these two large landfills makes them a particularly attractive roosting location for gulls in winter. California gulls forage extensively at landfills in the South Bay, but they (and mew gulls to some extent) also forage in large numbers on brine flies and other invertebrates within mid- and high-salinity salt ponds, like the Bonaparte's gull (Steve Rottenborn, pers. obs.). Up to 10,000 Bonaparte's gulls forage in the South Bay, primarily on brine shrimp and brine flies in salt ponds having salinities of 90-200 ppt (Harvey et al. 1992). The recent surveys of South Bay salt ponds by USGS (Takekawa et al. 2005) found Bonaparte's gull abundance highest on Alviso Pond A8.

Most of the gulls in the greater South Bay area roost on the Bay or salt ponds/levees at night and large numbers roost in these areas during the day as well. Thousands of gulls disperse inland from the Bay area

during the day to forage at inland landfills, on agricultural fields and seasonal wetlands, on athletic fields, and in urban areas, particularly in winter.

Carpelan (1957) indicated that Forster's terns are the main predator on topsmelt in South Bay salt ponds, and Anderson (1970) also suggested that the topsmelt was likely the main prey item of Forster's terns in the South Bay. A study of the diet of breeding Forster's terns in the South Bay in 1972 (Anonymous Unpublished) found that their diet consisted primarily of fish; many were caught in the Bay, but a large percentage was caught in lower-salinity salt ponds as well. Fish most frequently taken at these ponds included small (<six centimeters) Pacific herring (which were often fed to chicks), topsmelt, and anchovies. Observations of adults with prey at four Forster's tern colonies in the South Bay indicated that threespine stickleback outnumbered all other fish combined by an order of magnitude, with several thousand sticklebacks observed as prey. The next five most abundant fish brought to colonies were northern anchovy (90 individuals), topsmelt (82), staghorn sculpin (64), shiner surfperch (50) and dwarf surfperch (*Micometrus minimus*, 45). Ten other fish species, all represented by 27 individuals or fewer, were also used as prey, as well as four individuals of two genera of bay shrimp.

Gill (1976) recorded 21 species of fish found at the Mowry colony of Caspian terns during the 1971 breeding season. The eight species representing greater than 2% of the total number of fish recorded were jacksmelt (33%), shiner perch (16%), staghorn sculpin (16%), longjaw mudsucker (9%), Oriental goby (5%), northern anchovy (6%), rainbow trout (4%), and topsmelt (3%). While the vast majority of fish recorded at this colony were estuarine species, seven species were primarily freshwater fish. The observation of Caspian terns with tagged trout that had been released at Del Valle Reservoir, 25 miles away from the Mowry tern colony, exemplifies this terns' propensity for foraging widely during the breeding season.

Other Waterbirds (eared grebes, coots, and rails). The eared grebe and South Bay members of the family Rallidae, which includes the American coot (*Fulica americana*), common moorhen (*Gallinula chloropus*), and several species of rails, are combined into a separate group for the purposes of this existing conditions report.

The eared grebe is a small diving bird that breeds only occasionally and in small numbers in the South Bay, occurring much more abundantly as a nonbreeding forager from October to April. Eared grebes nest in California on freshwater wetlands in the Central Valley and Great Basin regions fairly commonly, but in the South Bay, breeding has occurred only in a flooded, diked pickleweed marsh in the Moffett Field/Crittenden Marsh area, where nesting occurred in 1983, 1986, 1993, and 1995 (Cogswell 2000; Santa Clara County Bird Data Unpublished).

Nonbreeding eared grebes in the South Bay are closely tied to deeper, higher-salinity salt ponds, where they feed on brine shrimp, brine flies, and reticulate water boatmen (Anderson 1970). Censuses of eared grebes on South Bay salt ponds have exceeded 40,000 individuals (Harvey et al. 1992), and Cogswell (2000) suggested that the total Bay Area wintering/migrant population could be as high as 50,000 to 100,000 birds. The recent surveys of South Bay salt ponds by USGS (Takekawa et al. 2005) found eared grebe abundance highest on Alviso Ponds A8 and A11-A17.

American coots and, in much lower abundance, common moorhens breed in freshwater wetlands, channels, and ponds in and around emergent vegetation in a number of locations throughout the South Bay. These birds are omnivorous, eating a wide variety of plant and animal (particularly invertebrate) material. Coot populations are augmented substantially during winter, when this species occurs by the hundreds or low thousands on lower-salinity salt ponds (Anderson 1970), sewage treatment plant ponds, and other open-water locations.

The status of the California clapper rail and California black rail in the South Bay is described in detail in the Special-Status Wildlife Species section below (Section 3.7). Two other rails occur regularly in the South Bay. Both the sora (*Porzana carolina*) and Virginia rail (*Rallus limicola*) may breed in very small numbers in freshwater wetlands around the South Bay, although they occur much more commonly as nonbreeders from August to May. During the nonbreeding season, these secretive species occur in a wide variety of tidal and nontidal salt, brackish, and freshwater marsh habitats, being most abundant in freshwater and brackish areas. Here, these species forage primarily on invertebrates. Significant depredation of these rails by egrets and herons has been observed during exceptionally high tides in winter, particularly in areas where high tide refugia (such as upland transitional zones in the high marsh or along tidal channels) are lacking.

Terrestrial/Riparian Birds. Although riparian habitats in the Study Area have been highly degraded by vegetation removal, stream channelization, and encroachment by agriculture and urbanization, the riparian habitats within the Study Area still support high abundance and diversity of terrestrial birds. In particular, the remnant mature riparian woodland along lower Coyote Creek, augmented by the habitat restoration efforts of the Santa Clara Valley Water District, provides important breeding and foraging habitat for birds. These bird communities are dominated by insectivorous passerines during summer; representative breeding species include permanent residents such as the song sparrow, saltmarsh common yellowthroat, bushtit, chestnut-backed chickadee (*Poecile rufescens*), downy woodpecker (*Picoides pubescens*), and Anna's hummingbird and summer residents such as the California yellow warbler (*Dendroica petechia brewsteri*), Pacific-slope flycatcher (*Empidonax difficilis*), and black-chinned hummingbird (*Archilochus alexandri*). Breeding raptors include the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), Cooper's hawk (*Accipiter cooperii*), and American kestrel (*Falco sparverius*). During spring and fall migration, large numbers of insectivores such as the Swainson's thrush, orange-crowned warbler, Wilson's warbler (*Wilsonia pusilla*), and warbling vireo (*Vireo gilvus*), forage in the riparian trees and shrubs. Seed-eating birds that frequent more open habitats during migration and winter include the white-crowned sparrow, golden-crowned sparrow, Lincoln's sparrow (*Melospiza lincolnii*), and fox sparrow (*Passerella iliaca*), in addition to resident American goldfinch (*Carduelis tristis*) and house finch. The Coyote Creek Field Station of the SFBBO (formerly Coyote Creek Riparian Station) monitors numbers of birds along lower Coyote Creek.

The lower Guadalupe River has fairly well-developed woody riparian habitat in some areas, and supports extensive emergent and ruderal vegetation that provides cover and food for high densities of a few species such as sparrows, red-winged blackbirds, and saltmarsh common yellowthroats. Riparian bird communities are more poorly developed (i.e., supporting fewer taxa and generally lower densities) along

other streams within the Study Area due primarily to degradation (or absence) of woody riparian habitat and encroachment of urbanization. For example, the portions of Calabazas, San Tomas Aquinas, Stevens, Matadero, and many other creeks in the Study Area are highly channelized, narrow corridors that support little woody riparian vegetation. Birds present in these areas are generally common stream-associated birds such as the mallard, green heron, and killdeer or common, widespread terrestrial bird, with few riparian-associated passerines.

Only a few passerines breed at all commonly in tidal salt, brackish, and freshwater marsh in the South Bay. Within most tidal salt marsh, the only nesting passerines are the Alameda song sparrow and marsh wren (in the lower marsh dominated by cordgrass and gumplant) and the savannah sparrow, which nests in pickleweed and peripheral halophytes in the upper portions of tidal and diked saltmarsh, along vegetated levees, and in adjacent upland transitional zones. South Bay population estimates for these species in 1971 by Gill (1977) included 1000-1200 pairs of marsh wrens (in cordgrass, but more abundantly in freshwater marshes, especially at Alviso and Guadalupe Sloughs, Coyote Creek and Mud Slough, and the Palo Alto Flood Control Basin), 800-1000 pairs of savannah sparrows, and 1800 pairs of Alameda song sparrows. The saltmarsh common yellowthroat may also nest in South Bay salt marshes in small numbers (Ray 1919; Steve Rottenborn, pers. obs.), although it nests primarily in brackish and freshwater marsh; this species, and the Alameda song sparrow, are discussed in detail in the Special-Status Wildlife Species section below (Section 3.7). Northern harriers, and formerly (or rarely) the short-eared owl (*Asio flammeus*), also nest within tidal salt marshes in broad vegetated marsh plains; these species are also discussed in the Special-Status Wildlife Species section (Section 3.7).

In addition, the red-winged blackbird nests in freshwater marsh in the Study Area, and scattered small trees and shrubs along salt pond levees and upland edges provide nesting sites for white-tailed kites, loggerhead shrikes, California towhees, and other species in limited numbers. Barn and cliff swallows breeding on artificial structures within and adjacent to the baylands forage commonly for flying insects over marshes and salt ponds in the South Bay.

Transmission towers within the marshes and salt ponds in the South Bay provide nesting sites for red-tailed hawks, common ravens, and peregrine falcons. Both species may prey on small mammals, rails, waterfowl, and shorebirds in the South Bay, and common ravens are particularly notorious predators of eggs and young of a variety of birds. Populations of ravens and American crows have increased markedly in recent decades throughout the Bay area, feeding heavily at the landfills around the South Bay but also preying on other wildlife species. Few data are available on the impact of ravens and crows on breeding populations of other species, but it is likely that ravens nesting on towers within tidal marshes and salt ponds have at least some impact on populations of California clapper rails, snowy plovers, and other breeding bird species.

During the nonbreeding season, additional landbirds occur in the baylands, including large numbers of sparrows of several species and several raptors. Short-eared owls occur regularly in small numbers in the more extensive marshes in winter, foraging on small mammals and birds, and merlins (*Falco columbarius*), peregrine falcons (*Falco peregrinus*), and other raptors forage for waterfowl and shorebirds throughout the South Bay.

Other upland habitats include grasslands and developed settings. Non-native grasslands in the South Bay support limited and declining populations of burrowing owl. A variety of birds use annual grasslands as foraging habitat, including savannah sparrows, horned larks (*Eremophila alpestris actia*), American pipits, western meadowlarks (*Sturnella neglecta*), lesser goldfinches, barn swallows, and various raptors. Western meadowlarks and mourning doves may nest in this habitat as well. Birds in developed areas face not only regular human disturbance, but also unique foraging and nesting opportunites. Those that are well adapted to such habitats commonly breed here. These species include the house finch, mourning dove, barn swallow, cliff swallow, and black phoebe and non-native European starling, rock pigeon (*Columba livia*), and house sparrow (*Passer domesticus*).

4.3.6 Notable Wildlife Resources in the Shoreline Study Area

Based on recent monitoring conducted by the USGS, SFBBO, and others, the most prominent wildlife resources and patterns of wildlife distribution in the Shoreline Study Area are as follows:

- Mixed heronries are located along Guadalupe Slough and at the west end of the Coyote Creek Lagoon near Newby Island, and small numbers of great blue herons nest on transmission towers in or adjacent to several salt ponds in this complex.
- Breeding concentrations of black-necked stilts and American avocets occur in New Chicago Marsh, in the vicinity of Pond A22, in Pond A8, and in the Palo Alto Flood Control Basin, with additional concentrations of avocets at the Warm Springs Marsh and Reach 1A waterbird pond, and stilts in the San Jose-Santa Clara WPCP.
- Moderate numbers of western snowy plovers breed in Pond A22 and Pond A8. In the past, western snowy plovers have bred in Pond A6, although they have not nested in this pond years, likely due to the gull colony there. Western snowy plovers have also recently nested in a small impoundment north of the Alviso marina.
- Large numbers of shorebirds forage on the intertidal mudflats ringing the South Bay south of the Dumbarton Bridge during low tide.
- Large numbers of shorebirds roost, and forage to varying degrees, in Ponds AB2, A5, and A7, with high numbers also present in Ponds A3N, A6, A9, A14, and A8, in New Chicago Marsh, in Crittenden Marsh, and at the San Jose-Santa Clara Water Pollution Control Plant at times.
- Several California gull colonies, including the state's second largest colony in Pond A6, are present in the Alviso pond complex.
- Double-crested cormorants nest on transmission towers in Pond A2W, in the AB1/AB2/A3N area, and in Pond A18, and on the levee between Ponds A9 and A10.
- Red-tailed hawks and common ravens nest on transmission towers in several ponds, and in 2007 two pairs of peregrine falcons nested in old raven nests on towers in the Alviso Complex.
- Forster's terns nest on small islands in a number of locations (primarily in salt ponds), and black skimmers nest in the Palo Alto Flood Control Basin and in Ponds A1, AB1, AB2, A8, and A16. Caspian terns nest, or have recently nested, in Pond A7, and on the levee between Ponds A5 and A7.

- The main post-breeding staging area for California least terns is within the Alviso pond complex, primarily in the ponds north of Moffett Field but with birds regularly using a number of other ponds in this pond complex for foraging and roosting. California least terns also forage over the Bay off the Alviso salt ponds.
- California clapper rails occur in a number of locations, although high-quality habitat is limited. The highest numbers are likely in the more extensive tidal salt marshes along Coyote Creek and near Palo Alto, although this species is also present in brackish marshes in the Warm Springs area, along Guadalupe Slough and Alviso Slough, and in smaller marsh remnants along sloughs and the Bay edge.
- Ponds A1, A2E, A2W, A5, A7, A9, and AB2 support high numbers of dabbling ducks, whereas Ponds A1, A2W, A9, and A10 support large numbers of diving ducks.
- Tens of thousands of gulls roost in the Alviso ponds and levees, with many foraging at landfills near Milpitas and in Fremont.
- Within the Alviso pond complex, piscivorous bird abundance is highest in Ponds A1, A2W, A3W, A5, A7, A9, A10, and AB2.
- Ponds A19, A20, and A21 have been restored to tidal action under the ISP. These ponds initially provide intertidal foraging habitat for shorebirds and other waterbirds at low tide, and tidal foraging habitat for waterfowl at high tide. As sediment accumulates (and the gypsum layer is buried and/or deteriorates), tidal marsh vegetation will become established, providing breeding and foraging habitat for the California clapper rail and other marsh species.
- Steelhead occur in San Francisquito Creek, Stevens Creek, the Guadalupe River, and Coyote Creek.
- Chinook salmon occur in the Guadalupe River and Coyote Creek.
- Salt marsh harvest mouse habitat in the Alviso pond complex is limited. Most of the marshes are brackish marshes, areas that are little used by salt marsh-dependent species such as the salt marsh harvest mouse and salt marsh wandering shrew, and the salt marsh that does exist has little to no high marsh or escape cover.
- A small population of western pond turtles (*Emys marmorata*) is present along the northern edge of Moffett Field and the Sunnyvale WPCP, with a few individuals present along the lower Guadalupe River and Coyote Creek as well.
- The Warm Springs portion of the SFBNWR supports vernal pool tadpole shrimp (*Lepidurus packardi*) and California tiger salamanders.
- Burrowing owls occur in grassland habitats fringing the South Bay, with higher concentrations at Shoreline Park, Moffett Field, and the San Jose WPCP buffer lands.
- The riparian corridor of Coyote Creek supports a variety of migrant and resident landbirds.

4.4 Special-Status Wildlife Species

Special-status animal species that occur in the Study Area and adjacent habitats are described below. The legal status and likelihood of occurrence of these species are given in Table 7. Expanded descriptions are included for species for which potentially suitable habitat occurs in the Study Area, or for which the resource agencies have expressed particular concern.

A number of special-status species occur in the Study Area as visitors, migrants, or foragers, but are not known or expected to breed in the immediate area. Expanded species accounts are not provided for these species. Animals that occasionally occur within the Study Area and breed in upland habitats in the greater South Bay Area, but occur only in the Study Area as uncommon to rare foragers, include the bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), Vaux's swift (*Chaetura vauxi*), bank swallow (*Riparia riparia*), yellow-breasted chat (*Icteria virens*), and pallid bat (*Antrozous pallidus*). Species that occur in the Study Area regularly as foragers, but have special status only at nesting sites elsewhere in California, include the common loon (*Gavia immer*), American white pelican, sharp-shinned hawk (*Accipiter striatus*), osprey (*Pandion haliaetus*), Barrow's goldeneye (*Bucephala islandica*), long-billed curlew, and elegant tern.

Expanded species accounts are provided below for key special-status wildlife species. More information on most of these species can be found in the Goals Project Baylands Ecosystem Species and Community Profiles (Goals Project 2000).

Table 7 – Special-status animal species, their status, and potential occurrence in the Shoreline Study Area.

Name	Status*	Habitat	Potential For Occurrence On Site
Federal or State Threatened or Endangered Species			
Bald Eagle (*Haliaeetus leucocephalus*)	FPD, SE, SP	Occurs mainly along seacoasts, rivers and lakes; nests in tall trees or in cliffs. Feeds mostly on fish.	Occasional visitor, primarily during winter, to the Study Area. May occasionally forage, but does not nest, in the Study Area.
American Peregrine Falcon (*Falco peregrinus anatum*)	SE, SP	Forages in many habitats; nests on cliffs and similar human-made structures.	Regular forager (on other birds) in the Study Area, primarily during migration and winter. Nested in 2006 and 2007 (two nests) in old raven nests on transmission towers in the Alviso pond complex.
California Clapper Rail (*Rallus longirostris obsoletus*)	FE, SE, SP	Salt and brackish marsh habitat usually dominated by pickleweed and cordgrass.	Resident in many tidal marshes in the Study Area.
California Least Tern (*Sterna antillarum browni*)	FE, SE, SP	Nests along the coast on bare or sparsely vegetated flat substrates.	The South Bay is an important post-breeding staging area for least terns, although this species does not currently breed within the Study Area. Recent breeding by small numbers has occurred at Hayward Regional Shoreline and Eden Landing Pond E8A. Forages and roosts in a number of South Bay ponds, especially Alviso ponds in the vicinity of Moffett Field.
California Brown Pelican (*Pelecanus occidentalis californicus*)	FE, SE, SP	Occurs in nearshore marine habitats and coastal bays. Nests on islands in Mexico and southern Calfiornia.	Regular during nonbreeding season (summer and fall) in Study Area. Roosts on levees in the interiors of pond complexes, forages in salt ponds and Bay.
Salt Marsh Harvest Mouse (*Reithrodontomys raviventris raviventris*)	FE, SE, SP	Salt marsh habitat dominated by pickleweed.	Occurs in pickleweed marshes within the Study Area. Also occurs in brackish marshes.
Steelhead – California Central Coast ESU (*Oncorhynchus mykiss*)	FT	Cool streams with suitable spawning habitat and conditions allowing migration, as well as marine habitats.	Known to be present in several South Bay creeks (including Coyote, Stevens, and San Francisquito Creeks, and the Guadalupe River) and associated marshes and small channels in the Study Area, especially as habitat for smolts as they transition to life in a marine environment. Suitable spawning habitat is not present in the Study Area, but this species moves through the area to spawn upstream.
California Black Rail (*Laterallus jamaicensis coturniculus*)	ST, SP	Breeds in fresh, brackish, and tidal salt marsh.	Non-breeding individuals winter in small numbers in tidal marsh within the Study Area, but the species is not currently known to breed in the South Bay.
Western Snowy Plover (*Charadrius alexandrinus nivosus*)	FT, CSSC	Nests on sandy beaches and salt panne habitats.	Breeds and forages at several sites within the Study Area, primarily Ponds A8 and A23. Additional birds occur in the Study Area during winter.
Bank Swallow (*Riparia riparia*)	ST	Colonial nester on vertical banks or cliffs with fine-textured soils near water.	Observed in the study ara as rare transient. No suitable breeding habitat in the Study Area.

Name	Status*	Habitat	Potential For Occurrence On Site
California Tiger Salamander (*Ambystoma californiense*)	FT, CSSC	Vernal or temporary pools in annual grasslands, or open stages of woodlands.	A population is present on SFBNWR lands in the Fremont/Warm Springs area within the Study Area.
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	FE	Freshwater vernal pools in grasslands.	Present in small numbers in vernal pools on SFBNWR lands in the Fremont/Warm Springs area.
California Species of Special Concern			
Central Valley Fall- and Late Fall-run Chinook Salmon (*Oncorhynchus tshawytscha*)	CSSC (Late Fall-run only)	Cool rivers and large streams that reach the ocean and that have shallow, partly shaded pools, riffles, and runs.	Centrail Valley Fall-Run Chinook salmon are known to be present in several South Bay creeks (including Coyote Creek, Alameda Creek, and the Guadalupe River) and associated marshes and small channels in the Study Area, especially as habitat for smolts as they transition to life in a marine environment. Suitable spawning habitat is not present in the Study Area, but this species moves through the area to spawn upstream.
Western Pond Turtle (*Clemmys marmorata*)	CSSC	Permanent or nearly permanent fresh or brackish water in a variety of habitats.	Uncommon along the inshore side of pond A3W; a few are occasionally recorded along lower Coyote Creek and the Guadalupe River. May occur rarely in freshwater and brackish creeks and sloughs elsewhere in the Study Area.
Common Loon (*Gavia immer*)	CSSC (nesting)	Nests in freshwater marshes, winters in coastal marine habitats.	Occasional winter visitor; does not breed in the Study Area.
American White Pelican (*Pelecanus erythrorhnchos*)	CSSC (nesting)	Forages in freshwater lakes and rivers, nests on islands in lakes.	Common non-breeder, foraging primarily on salt ponds in the Study Area. Regular visitor from late summer to spring. Not known to breed in the Study Area.
Double-crested Cormorant (*Phalacrocorax auritus*)	CSSC (nesting)	Colonial nester on coastal cliffs, offshore islands, electrical transmission towers, and along interior lake margins. Feeds on fish.	Breeds on electrical transmission towers and on levees within the Study Area, and forages in ponds and other open water habitats in the Study Area.
White-faced Ibis (*Plegadis chihi*)	CSSC (nesting)	Forages in freshwater marshes, and to a lesser extent, brackish areas.	Occasional visitor in fall and winter. Has bred in heron rookery on Mallard Slough, but no current nesting known.
Barrow's Goldeneye (*Bucephala islandica*)	CSSC (nesting)	Nests in freshwater marshes, winters in coastal marine habitats.	Occasional winter visitor; does not breed in the Study Area.
Northern Harrier (*Circus cyaneus*)	CSSC (nesting)	Nests and forages in marshes, grasslands, and ruderal habitats.	Breeds in small numbers in marsh habitats in the Study Area, forages in a variety of habitats.
Sharp-shinned Hawk (*Accipiter striatus*)	CSSC (nesting)	Nests in woodlands, forages in many habitats in winter and migration.	Observed on site as a migrant and winter resident. No breeding habitat in Study Area.
Cooper's Hawk (*Accipiter cooperii*)	CSSC (nesting)	Nests in woodlands, forages in many habitats in winter and migration.	Breeds in limited numbers in upland habitats fringing the South Bay; forages throughout the Study Area.

Name	Status*	Habitat	Potential For Occurrence On Site
Osprey (*Pandion haliaetus*)	CSSC (nesting)	Nests in tall trees or cliffs on freshwater lakes and rivers and along seacoast; feeds on fish.	Occasional forager, primarily during the nonbreeding season. No breeding records in the Study Area.
Golden Eagle (*Aquila chrysaetos*)	CSSC	Breeds on cliffs or in large trees or electrical towers, forages in open areas.	Occasional forager, primarily during the nonbreeding season. No nesting records within the Study Area.
Merlin (*Falco columbarius*)	CSSC	Uses many habitats in winter and migration.	Regular in low numbers during migration and winter. Does not nest in California.
Long-billed Curlew (*Numenius americanus*)	CSSC (nesting)	Nests on prairies and short-grass fields; forages on mudflats, marshes, pastures, and agricultural fields.	Forages on mudflats, marshes, and grasslands and roosts on levees, diked marshes, and ponds within the Study Area as a migrant and winter resident. Does not nest in the Study Area.
California Gull (*Larus californicus*)	CSSC (nesting)	Nests on lakes inland and, around S. F. Bay, in salt ponds.	Common resident, breeding on several salt ponds in the Study Area. The colony in Pond A6 is the second largest colony in California. Forages throughout Study Area.
Black Skimmer (*Rynchops niger*)	CSSC (nesting)	Nests on abandoned levees and islands in salt ponds and marshes.	A few pairs breed and forage in the Study Area, on islands in salt ponds.
Short-eared Owl (*Asio flammeus*)	CSSC (nesting)	Nests on ground in tall emergent vegetation or grasses, forages over a variety of open habitats.	Uncommon. Has bred in small numbers within the Study Area, although current breeding status unknown. Most numerous in area in migration and winter.
Western Burrowing Owl (*Athene cunicularia hypugea*)	CSSC	Flat grasslands and ruderal habitats.	Breeds at several upland sites within the Study Area.
Vaux's Swift (*Chaetura vauxi*)	CSSC (nesting)	Nests in snags in coastal coniferous forests or, occasionally, in chimneys; forages aerially.	Forages over Study Area. No nesting habitat within area.
Loggerhead Shrike (*Lanius ludovicianus*)	CSSC (nesting)	Nests in dense shrubs and trees, forages in grasslands, marshes, and ruderal habitats.	Resident in low numbers within the Study Area.
California Horned Lark (*Eremophila alpestris actia*)	CSSC	Short-grass prairie, annual grasslands, coastal plains, and open fields.	Present in low numbers in the Study Area, nesting on salt pond levees, salt flats, and ruderal habitats.
California Yellow Warbler (*Dendroica petechia brewsteri*)	CSSC (nesting)	Breeds in riparian woodlands, particularly those dominated by willows and cottonwoods.	Nests in riparian corridor of Coyote Creek.
Saltmarsh Common Yellowthroat (*Geothlypis trichas sinuosa*)	CSSC	Breeds primarily in fresh and brackish marshes in tall grass, tules, willows; uses salt marshes more in winter.	Common resident, breeding in freshwater and brackish marshes (and possibly to a limited extent in salt marshes), and foraging in all marsh types during the nonbreeding season.
Yellow-breasted Chat (*Icteria virens*)	CSSC	Riparian brush and woodlands.	Rare nonbreeding visitor to riparian habitats during migration.

Name	Status*	Habitat	Potential For Occurrence On Site
Alameda Song Sparrow (*Melospiza melodia pusillula*)	CSSC	Breeds in salt marsh, primarily in marsh gumplant and cordgrass along channels.	Uncommon resident, breeding and foraging in tidal salt marsh.
Tricolored Blackbird (*Agelaius tricolor*)	CSSC (nesting)	Breeds near fresh water in dense emergent vegetation.	Has bred in the Study Area at the San Jose-Santa Clara Water Pollution Control Plant, but occurs in the Study Area primarily as a nonbreeding forager.
Salt Marsh Wandering Shrew (*Sorex vagrans halicoetes*)	CSSC	Medium high marsh with abundant driftwood and pickleweed.	May occur in salt marshes throughout the Study Area, although numbers have declined, and current status is unknown.
State Protected Species or CNPS Species			
White-tailed Kite (*Elanus caeruleus*)	SP (nesting)	Nests in tall shrubs and trees, forages in grasslands, marshes, and ruderal habitats.	Common resident; breeds within the Study Area where suitable nesting habitat occurs.

FE = Federally-listed Endangered
FT = Federally-listed Threatened
FPD = Federally Proposed for Delisting
SE = State-listed Endangered
ST = State-listed Threatened
CSSC = California Species of Special Concern
SP = State Fully Protected Species

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4.4.1 Federal or State Threatened or Endangered Species

Vernal Pool Tadpole Shrimp (*Lepidurus packardi*). Federal Listing Status: Endangered; State Listing Status: None. The vernal pool tadpole shrimp is a small crustacean that occurs in ephemeral pools in California. The known range of the species is limited to the Central Valley, and a limited area in, and adjacent to, the Warm Springs Seasonal Wetland Unit of the SFBNWR. Due to the continuing loss of habitat, the vernal pool tadpole shrimp was listed by the USFWS as Endangered in 1994. Critical habitat was designated for the species in 2006 (USFWS 2006a); the Study Area includes two Critical Habitat Units, 14A and 14B, within the Warm Springs Seasonal Wetland Unit of the SFBNWR.

Vernal pool tadpole shrimp spend the majority of their lives as dormant cysts, which may remain viable for up to ten years. When these cysts are inundated in vernal pools, some hatch into shrimp, which live only as long as the pool retains water. Ahl (1991) found that egg cysts hatch within 11 to 26 days (mean = 17 days) after pools refill with water. In contrast to most fairy shrimp, juvenile vernal pool tadpole shrimp develop slowly and require a minimum hydroperiod of about seven to eight weeks to reach reproductive maturity in the field (Gallagher 1996, Helm 1998). Juveniles look like the adults but are merely smaller in overall size and are not reproductively mature. There is only one generation per year. Adults have hard carapaces, and may attain a length of one inch or more.

This shrimp is generally found in sparsely vegetated, grass-bottomed swales on old alluvial soils that are underlaid by hardpan, or in mud-bottomed pools containing highly turbid water. The pools are usually deep (≥ six inches) and typically retain water longer than shallower vernal pools. Unlike fairy shrimp, which actively swim in the water column, tadpole shrimp move about primarily by crawling, but will swim for brief periods. Vernal pool tadpole shrimp are not expected to occur in the Shoreline Study Area outside the area of known distribution in the mixed vernal pool/grassland habitat north/northwest of Pond A22 in the Warm Springs Seasonal Wetland Unit of the SFBNWR.

California Tiger Salamander (*Ambystoma californiense*). Federal Listing Status: Threatened; State Listing Status: Species of Special Concern. The California tiger salamander breeds in temporary (lasting at least 12 weeks) or small permanent ponds in grassland habitats during the winter rainy season. During dry summer months, they aestivate in small mammal burrows in grasslands adjacent to breeding ponds. Adults often emerge from the burrows at night during the first moderate to heavy winter rains and migrate to breeding ponds where they lay their eggs.

The eggs are attached singly or in small clumps to vegetation under water, or directly on the bottom of the pool if emergent vegetation is lacking. The eggs hatch approximately one week after they are deposited. The larvae prey upon invertebrates and other amphibian larvae for between three and six months, during which time they metamorphose into juveniles. Juveniles typically leave the pools in mass during a one to two week period, usually as the ponds dry. The juveniles then search for available burrows. Juveniles feed and grow in these burrows until the following winter. California tiger salamanders take several years to reach maturity and do not necessarily breed every year, even if sufficient habitat is available.

The range of the California tiger salamander is restricted to the Central Valley and the South Coast Range of California from Butte County south to Santa Barbara County. Tiger salamanders have disappeared from a significant portion of their range due to habitat loss from agriculture and urbanization and the introduction of non-native aquatic predators. The California tiger salamander was listed as Threatened under the FESA by the USFWS in July 2004. The USFWS designated Critical Habitat for the California tiger salamander in August 2005 (USFWS 2005). No portion of the Study Area is within Critical Habitat for this species.

California tiger salamanders occur in the mixed vernal pool/grassland habitat north/northwest of Pond A22 in the Warm Springs Seasonal Wetland Unit of the SFBNWR, the only location in the South Bay that they occur adjacent to tidally influenced marsh habitat.

Steelhead (*Oncorhynchus mykiss*), Central California Coast ESU. Federal Listing Status: Threatened; State Listing Status: None. The steelhead is an anadromous form of rainbow trout that migrates upstream from the ocean to spawn. Steelhead in the South Bay usually migrate upstream to spawning areas from late December through early April, with the greatest activity in January through March, when flows are sufficient to allow them to reach suitable habitat in far upstream areas. Spawning occurs between December and June. Steelhead eggs remain in gravel depressions, known as redds, for 1.5 to four months before hatching. After hatching, young-of-the-year steelhead tend to use riffles with cover, while older juveniles use deeper water (such as pools) as rearing habitat, remaining in fresh water for one to four years before migrating to the ocean. This downstream migration of juveniles generally occurs between February and June. After migration, steelhead typically grow rapidly for two to three years before returning to freshwater streams to spawn. Unlike other anadromous salmonids, steelhead do not necessarily die after spawning. Adults may survive and return to the ocean after spawning, coming back to spawn for one or more additional seasons; however, it is unknown if this phenomenon occurs in the South Bay streams.

Steelhead usually spawn in gravel substrates in clear, cool, perennial sections of relatively undisturbed streams. Preferred streams typically support dense canopy cover that provides shade, woody debris, and organic matter, and are usually free of rooted or aquatic vegetation. Steelhead usually cannot survive long in pools or streams with water temperatures above 70 °F, but they can use warmer habitats if food is available, such as at fast water riffles where fish can feed on drifting insects. Steelhead in some coastal estuaries in central California apparently make extensive use of estuarine habitats for foraging (Bush, pers. comm.), although the extent of the use of estuarine habitats by steelhead in many areas, including the South San Francisco Bay area, is virtually unknown.

Steelhead populations in many areas have declined due to degradation of spawning habitat, introduction of barriers to upstream migration, over-harvesting by recreational fisheries, and reduction in winter flows due to damming and spring flows due to water diversion. Steelhead and other salmonids have been categorized into subpopulations, or Distinct Population Segments (DPSs). In 1997, the National Marine Fisheries Service (NMFS) listed the Central California Coast DPS as a threatened species under FESA; threatened status was reaffirmed in 2006. The Central Coast DPS includes all runs from the Russian

River in Sonoma County south to Aptos Creek in Santa Cruz County, including all steelhead spawning in streams flowing into San Francisco Bay streams. In 2005, NMFS designated critical habitat for this and other DPSs as occupied reaches of all rivers and estuaries within the range of each listed DPS. A recovery plan is being developed but has not yet been approved for this DPS.

Steelhead are known to occur in several stream systems in the South San Francisco Bay Area (Figure 5), and this species could potentially spawn in virtually any reach of a stream offering suitable spawning habitat and lacking downstream barriers to dispersal. Information on the fine-scale distribution of steelhead in South San Francisco Bay streams is limited, but steelhead are currently known to run in the Coyote Creek, Guadalupe River, Stevens Creek, and San Francisquito Creek watersheds (Foxgrover et al. 2004, Leidy et al. 2005). Few steelhead are present in any of these South Bay streams (Leidy et al. 2005). Within the Study Area, no suitable steelhead spawning habitat exists. Steelhead may use tidal channels in marshes as well, as such channels (particularly in brackish marshes) may provide habitat for juveniles during the process of smoltification (i.e., physiological adaptation to the saltwater environment). The use of larger sloughs within the Study Area by juvenile salmonids may be limited by the relatively high density of predators, including harbor seals and striped bass (Jerry Smith, pers. comm.).

Chinook Salmon (*Oncorhynchus tshawytscha*), Central Valley Fall- and Late Fall- Run ESU. Federal Listing Status: None; State Listing Status: Species of Special Concern (Late Fall-Run only). Like the steelhead, the Chinook salmon is an anadromous salmonid. Adults of the Central Valley Fall-Run ESU migrate from the ocean to spawning streams in fall and begin spawning in beds of coarse river gravels between September and December. Adults die after spawning. After the eggs hatch, juvenile salmon typically migrate downstream to the Bay or ocean within a few months. Young fish remain in the ocean for several years before returning to freshwater streams and rivers to spawn. Chinook salmon generally spawn in cool waters providing incubation temperatures no warmer than 55 °F.

Much more is known regarding the use of estuarine habitats by Chinook salmon than steelhead, and in at least some areas, juvenile Chinook make heavy use of estuarine habitats. Juvenile Chinook salmon may spend a significant amount of time, up to 189 days (Simenstad et al. 1982), foraging in estuarine habitats, showing significant growth in some estuaries (MacDonald et al. 1987), as they adapt physiologically to higher-salinity environments (Maragni 2000). In at least some areas, tidal marshes are important habitats for Chinook salmon. Fry forage throughout shallower tidal sloughs and channels, even foraging within the marsh during flood tides, while larger smolts forage in larger primary and secondary channels and subtidal habitats (Maragni 2000).

Fall-run Chinook salmon populations have suffered the effects of over-fishing by commercial fisheries, degradation of spawning habitat, added barriers to upstream migration, and reductions in winter flows due to damming. Approximately 40-50% of the spawning and rearing habitats in Central Valley streams have been lost or degraded. Hatchery-raised fish considerably enhance present populations. Because long-term population trends have been generally stable, NMFS determined that the Central Valley fall- and late fall-run evolutionarily significant unit (ESU) was not a priority for listing as threatened or endangered.

Chinook salmon did not historically spawn in streams flowing into South San Francisco Bay. Since the mid-1980s, however, small numbers of fall-run Chinook salmon have been found in several such streams, including Coyote Creek, Los Gatos Creek, and the Guadalupe River (Leidy et al. 2003). Genetic analysis indicates that fish from Guadalupe River and Coyote Creek are closely related to Central Valley Fall-run Chinook salmon (Garcia-Rossi and Hedgecock 2002).

These fall-run Chinook salmon typically arrive in South San Francisco Bay streams in October or later, although on rare occasions, adult Chinook salmon have been detected in these streams in summer, and spawning has been observed on Los Gatos Creek as early as September (Salsbery, pers. comm.). Seasonal stream flow and temperature conditions in these streams may not be suitable for successful spawning by Sacramento River winter-run Chinook salmon, which typically spawn in late spring and summer, or by Central Valley spring-run Chinook salmon, which typically spawn in late summer and early fall. Therefore, any adult Chinook salmon found in the South San Francisco Bay in the summer are presumed to be Fall-run fish with ancestry to the Central Valley. The use of tidal channels and sloughs within the Study Area by Chinook salmon is unknown. Predation pressure may limit the use of larger sloughs as more than transit habitat, as noted above for steelhead, but it is possible that Chinook salmon use tidal marshes in the South Bay as extensively as has been reported in other areas.

California Brown Pelican (*Pelecanus occidentalis californicus*). Federal Status: Endangered; State Status: Endangered. Brown pelicans are large seabirds found in coastal and nearshore marine habitats along the Atlantic, Gulf and Pacific coasts of North America. In the middle of the 20th century, brown pelican populations were severely reduced. The primary cause of this decline was eggshell thinning related to ingestion of the pesticide DDT, which entered the marine food chain through agricultural runoff and industrial discharge (Anderson and Gress 1983). The brown pelican was listed by the USFWS as Endangered in 1970 and by the state of California in 1971, and the state considers it a fully protected species. A recovery plan for the species was completed in 1983 (U.S. Fish and Wildlife Service 1983); critical habitat has not been designated for the brown pelican. DDT was banned in the United States in 1972, and brown pelican populations began recovering. In 1985, the brown pelican was delisted in the southeastern U.S. as recovered, but west coast populations did not recover as quickly (Shields 2002). However, west coast numbers have increased substantially in the past two decades, and the U.S. Fish and Wildlife Service is considering a proposal to delist the California brown pelican (USFWS 2006b).

The California brown pelican nests in Mexico, on the California Channel Islands, and at the Salton Sea in early spring, approximately January to May (Anderson and Gress 1983; Shields 2002). Much of the postbreeding dispersal occurs northward (as far north as Canada), and by June, many post-breeding birds are present in central California. Local abundance in central California usually peaks from August to October (Briggs et al. 1987; Jaques 1994). Although a small number of non-breeding birds may be found locally year-round, most pelicans return to their southern breeding grounds by January. California brown pelicans feed on northern anchovies and other small fishes, which they capture by plunge-diving. Brown pelicans require secure night-roosts, free of terrestrial predators (Jaques 1994).

Several hundred brown pelicans typically occur in San Francisco Bay during summer and fall, but numbers are variable (Ainley 2000a). Post-breeding dispersants typically begin to arrive in the South Bay

in June and July, with most individuals departing by late fall. However, a few may also be found in the South Bay in winter and spring as well (Santa Clara County Bird Data Unpublished). California brown pelicans occur regularly in some South Bay salt ponds, and often roost on salt pond levees. Recent surveys by USGS included 225 individuals in the Alviso Complex in September 2004, although more typical counts number less than 100 at Alviso Ponds (Takekawa et al. 2005). Several ponds in the Alviso Complex are used for roosting by brown pelicans, with the greatest use in the vicinity of Alviso Slough and Guadalupe Slough (Takekawa et al. 2005), although local concentrations may occur in any of the lower-salinity ponds (which provide fish) throughout the Alviso Complex. Although information on daily activity patterns, habitat use, and key foraging areas of brown pelicans in the South Bay is limited, this species uses salt ponds both for foraging (which takes place in the less saline ponds supporting fish) and for roosting (on levees between ponds).

American Peregrine Falcon (*Falco peregrinus anatum*). Federal Listing Status: Delisted; State Listing Status: Endangered, Fully Protected. The peregrine falcon occurs throughout much of the world, and is known as one of the fastest flying birds of prey. Peregrine falcons prey almost entirely on birds, which they kill while in flight. These falcons nest on ledges and caves on steep cliffs, as well as human-made structures like buildings and power towers. In California, they are known to nest along the entire coastline, the northern Coast, and the Cascade Ranges and Sierra Nevada. During winter and migration, this species can be found throughout the state. Peregrine falcons are most likely to be encountered in coastal or inland marsh habitats where large numbers of waterfowl and shorebirds concentrate, as occurs at the Study Area.

A severe decline in populations of the widespread North American subspecies *Falco peregrinus anatum* began in the late 1940s. This decline was attributed the accumulation of DDE, a metabolite of the organochlorine pesticide DDT, in aquatic food chains (Thelander and M. 1994). When concentrated in the bodies of predatory birds such as the peregrine falcon, Bald Eagle, brown pelican, and Osprey, this contaminant led to reproductive effects, such as the thinning of eggshells. The American peregrine falcon was listed as Endangered by the USFWS in 1970 and by the State of California in 1971. Recovery efforts included the banning of DDT in North America and captive breeding programs. The USFWS removed the American peregrine falcon from the Endangered Species List in 1999, though the State of California still lists the species as endangered, and as a fully protected species.

Peregrine falcons are uncommon in the Study Area, but nonbreeders are present in small numbers in fall and winter. These birds often use electrical transmission towers as perches, hunting waterbirds over salt ponds, marshes, and the open bay. Prior to 2006, this species was not known to breed in the Study Area. However, in 2006 a pair nested in an old raven nest on a transmission tower in the Alviso pond complex, and two nests approximately 1.3 kilometers apart were occupied in 2007.

California Clapper Rail (*Rallus longirostris obsoletus*). Federal Listing Status: Endangered; State Listing Status: Endangered. The California clapper rail is a secretive marsh bird currently endemic to the marshes of San Francisco Bay. It formerly bred at several other locations, including Humboldt Bay, Elkhorn Slough (Monterey County), and Morro Bay, but is now extirpated from all sites outside of San Francisco Bay. California clapper rails nest in salt and brackish marshes along the edge of the bay, and

are most abundant in extensive salt marshes and brackish marshes dominated by cordgrass, pickleweed, and marsh gumplant, and containing complex networks of tidal channels (Harvey 1980). Shrubby areas adjacent to or within tidal marshes are important for predator avoidance at high tides.

California clapper rails breed from February through August in the vegetation along tidal sloughs. Breeding generally occurs in two pulses, one in April/May, and a second in June/July. Clapper rails lay up to 14 eggs, which are incubated by both parents for just under a month. The young are precocial, but are dependent on their parents for food for five to six weeks (Eddleman and Conway 1998). California clapper rails are non-migratory, although juveniles disperse around the Bay during late summer and autumn. Adults are territorial, and maintain territories throughout the year. Most California clapper rails studied via radio-telemetry had home ranges of about 115 meters in radius (Keldsen 1997). They forage on crabs, clams, and other invertebrates, which they find in exposed mud along tidal channels (usually secondary channels) or in vegetation at the edges of such channels (Shuford 1993).

Since the mid-1800s, about 90% of San Francisco Bay's marshlands have been eliminated through filling, diking, or conversion to salt evaporation ponds (Goals Project 1999). As a result, the California clapper rail lost most of its former habitat, and the population declined severely. The subspecies was listed by the USFWS as Endangered in 1970, and by the State of California as Endangered in 1971, and the state considers it a fully protected species. The USFWS approved a joint recovery plan of the salt marsh harvest mouse and the California clapper rail in 1984 (U.S. Fish and Wildlife Service 1984), and an updated Tidal Marsh Species Recovery Plan is currently under development. Critical habitat has not been proposed for the California clapper rail.

In the 1970s, the Bay-wide population estimate for California clapper rails was 4000-6000 birds, with 55% in the South Bay, 38% in Napa marshes, and the remaining 8% in other North Bay and outer coast marshes (Gill 1979). Based on surveys of most suitable marshes in the San Francisco Bay area in the late 1970s and early 1980s, Harvey (1988) estimated a population of 1500 individuals. The difference between the estimates of Gill (1979) and Harvey (1988) may have reflected a population decline, but was also likely a result of more accurate surveys by Harvey. Nevertheless, density estimates in three South Bay marshes were found to decline from 1.47, 0.89, and 0.69 rails/hectare in 1980 (Harvey 1988) to 0.64, 0.26, and 0 rails/ha, respectively in 1989 (Foerster et al. 1990), indicating an actual, considerable population decline. Populations of rails in five South Bay marshes declined by as much as 85%, apparently as a result of depredation by the non-native red fox (Albertson 1995). By the mid 1980s, approximately 1200-1500 California clapper rails remained, with greater than 80% occurring in the South Bay. By 1988, populations were estimated at 700 rails, and by 1991 the bay-wide total was estimated at 300-500 individuals (Alberston and Evens. 2000).

Clapper rail predation by both red foxes and feral cats has been directly documented in the South Bay by the tracking of radio-marked rails that were depredated in 1991 and 1992 (Albertson 1995). In addition, the remains of clapper rails were found at a fox den in a tidal marsh on the SFBNWR (Harding et al. 1998), and at the entrance to a den in the outboard levee along salt pond A9 (Steve Rottenborn, pers. obs.). Norway rats are thought to be one of the main predators of California clapper rail eggs (Foerster et

al. 1990; Harvey 1988), and raccoons have also been known to prey on California clapper rail eggs (Foerster et al. 1990).

A predator management plan implemented by the SFBNWR since 1991 has met with some success in reducing the effects of mammalian predators on clapper rails, resulting in an increase in rail populations (Harding et al. 1998). Between 1991 and 1996, clapper rail population size within a given marsh showed a significant negative relationship with the number of red foxes removed the prior year, and rail population growth rates were significantly related to red fox trapping success the prior year. The most recent population estimate for California clapper rails was approximately 1040 to 1264 birds in 2000 (Alberston and Evens. 2000). Although management of mammalian predators has helped boost clapper rail populations, avian depredation by raptors, common ravens, and possibly gulls still poses a threat, and may be increasing (Alberston, pers. comm.). In 2003, the CDFG implemented a predator-control program at the Eden Landing Ecological Reserve to reduce predation on listed species (John Krause, pers. comm.).

Other ongoing threats to clapper rails include loss of habitat to sea-level rise (Keldsen 1997), human disturbance, and accumulation of mercury and other contaminants. Few data are available regarding the effects of human disturbance on California clapper rails. Clapper rails are typically shy and reclusive, and avoid areas of high human use. Construction-related disturbance has been found to result in abandonment of territories, but in one instance, use of a jack-hammer within 50 feet of a territory did not result in abandonment of that territory (Wetlands Research Associates 1994).

California clapper rail eggs collected from several sites around the San Francisco Bay in 1975, 1986, and 1987 were found to have elevated levels of PCBs, selenium, and mercury (Lonzarich et al. 1992). Analysis of unhatched eggs from the Central Bay by Schwarzbach and Adelsbach (2003) detected mean mercury concentrations of 0.81 ppm on a fresh wet weight basis, concentrations that were considered embryotoxic. The levels and effects of mercury concentrations in South Bay birds are the subjects of ongoing study.

Breeding-season surveys of South San Francisco Bay marshes for California clapper rails through the early 1990s, summarized by Foin et al. (1997), indicated that the most substantial populations of clapper rails in the South Bay were, predictably, in the largest sections of tidal salt marsh: at Mowry Marsh and Dumbarton Marsh (in the east Bay between the Dumbarton Bridge and Mowry Slough), at the Faber/Laumeister Tracts and other marshes in the Palo Alto/East Palo Alto area, and at Greco Island in Redwood City. Mean counts from these areas include 68 birds at Mowry Marsh, 57 at Faber-Laumeister, and 44 at Dumbarton (Foin et al. 1997). Nest searches by San Francisco Bay NWR personnel detected 40 nests in the Faber/Laumeister Tracts, 33 on Greco Island, and 13 in North Mowry Marsh in 1992 (Keldsen 1997). Clapper rails occurred in many other marshes as well, including Ideal Marsh (adjacent to Cargill pond N5), Calaveras Marsh (adjacent to Cargill Ponds M2 and M3), and Triangle Marsh in Alviso. Clapper rails have been found to occasionally use salt pond dredge locks as high-tide refugia (Wetlands Research Associates 1994b). Although site-specific surveys have not been conducted in all suitable habitat for clapper rails in the South Bay, this species is likely to occur in tidal salt marsh habitats in a number of additional areas as well (Figure 5).

Although California clapper rails are typically found in tidal salt marshes, they have also been documented in brackish marshes in the South Bay. Breeding-season surveys conducted in marshes bordering Coyote Creek in 1989 documented breeding California clapper rails in a wide variety of plant associations. Surveys conducted during the 1990 breeding season (H. T. Harvey & Associates 1990d) and winter season (H. T. Harvey & Associates 1990c) found a number of California clapper rails occupying salt/brackish transitional marshes and several brackish, alkali bulrush-dominated marshes, including Warm Springs Marsh (immediately east of Pond A19) and the marshes along upper Coyote Slough even farther east. In addition, California clapper rails were found in nearly pure stands of alkali bulrush along Guadalupe Slough in 1990 and 1991 (H. T. Harvey & Associates 1990c; H. T. Harvey & Associates 1990d; H. T. Harvey & Associates 1991c). Although it has been suggested that habitat quality may be lower in brackish marshes than in salt marshes (Shuford 1993), further studies comparing reproductive success in different marsh types are necessary to determine the value of brackish marshes to California clapper rails.

On rare occasions, California clapper rails have been recorded even farther upstream, in brackish/freshwater transition marshes, particularly during the nonbreeding season. In the Alviso/Sunnyvale area, such individuals have been recorded along upper Alviso Slough near the Gold Street bridge (14 February 1997; Scott B. Terrill, pers. obs.), in nontidal freshwater ponds between Calabazas and San Tomas Aquino Creeks north of Highway 237 in Sunnyvale (16 August 1998; Steve Rottenborn, pers. obs.), and along Artesian Slough near the Environmental Education Center in January 1999 and January-February 2001 (Santa Clara County Bird Data Unpublished).

No Bay-wide breeding-season surveys have been conducted for clapper rails since the 1990s. However, the USFWS, in conjunction with other agencies, conducts annual winter high-tide surveys using an airboat. These surveys attempt to cover all South Bay marshes at least once every two years (although areas with dense cordgrass cannot be surveyed with this method except on the highest tides). Recent winter surveys indicate that clapper rail populations in the Mowry/Dumbarton Slough area appear to be fluctuating, but populations in other areas seem to be more stable, see Table 8 (Alberston, pers. comm.). This may be the result of higher avian predation rates in the Mowry/Dumbarton area, but this hypothesis has not been studied.

Table 8 – High and low winter counts of clapper rails from major tidal salt marshes in the South Bay, 1994-2000 and 2002 (USFWS unpubl. data).

Location	High Count (Year)	Low Count (Year)
Dumbarton	104 (1994)	28 (2000)
Mowry	126 (1997)	4 (2000)
Hooks Island	46 (1997)	16 (2000, 2002)
Palo Alto Harbor	16 (1997)	5 (2002)
Faber	60 (1997)	29 (1995)
Laumeister	48 (1997)	24 (1995)
Greco Island	96 (2002)	87 (2000)

Both winter and breeding season surveys suggest that there is substantial annual variability in local distribution and abundance of clapper rails in the South Bay. For example, at one of the sites where rails were found in brackish marshes in Guadalupe Slough (discussed above), no rails were found during protocol-level surveys the year before (H. T. Harvey & Associates 1990c; H. T. Harvey & Associates 1990d; H. T. Harvey & Associates 1991c). Table 8 shows the high variability in winter counts, and suggests that populations may be particularly high in certain years, such as 1997, presumably following high breeding success.

California Black Rail (*Laterallus janaicensis coturniculus*). Federal Listing Status: None; State Listing Status: Threatened. The California black rail is a small rail that inhabits tidal salt, brackish, and freshwater marshes. This small bird is very secretive, and is most often seen during high tides when it is forced into high marshes. Little information is available regarding the biology of California black rails. They are most abundant in tidal marshes with some freshwater input (Evens et al. 1991). They nest primarily in pickleweed-dominated marshes with patches or borders of *Scirpus*, often near the mouths of creeks. They build nests in tall grasses or marsh vegetation during spring, and lay about six eggs. Nests are usually constructed of pickleweed, and are placed directly on the ground or slightly above ground in vegetation. Black rails feed on terrestrial insects, aquatic invertebrates, and possibly seeds (Trulio and Evens 2000).

The California black rail reportedly bred in the Alviso area in the early 1900s (Wheelock 1916), but currently it is not known to breed in the South Bay. In the San Francisco Bay area, this small rail currently breeds primarily in marshes in the north San Francisco Bay Area (i.e., San Pablo Bay and Suisun Bay). After breeding, some black rails disperse into the South Bay, accounting for most records of the species in this area. Here, the abundance of the black rail during the nonbreeding season is unknown due to its very small size and highly secretive nature. Most observations of black rails in the South Bay consist of only a few birds observed seeking high-tide refugial cover at the edges of the salt marsh in a few areas during spring tides from November to February. Nearly every winter, small numbers (up to ten or more in a day, but usually four or fewer) are seen during such spring tides at the Palo Alto Baylands, and occasionally individuals are observed in the East Palo Alto marshes as well. This species is likely present in small numbers at other scattered locations as well (e.g., there are unconfirmed reports from the Alviso marina during high winter tides), but the inaccessibility of most suitable areas to look for black rails during spring tides, and the species' silence in the South Bay during winter, makes it virtually impossible to survey the species in the Study Area during this season.

Late-season (April) calling black rails have been reported at the Palo Alto Baylands (26-27 April 1993; Santa Clara County Bird Data) and near the east end of the Dumbarton Bridge. There is also a 30 August 1995 record from the vicinity of the Sunnyvale Water Pollution Control Plan (presumably along Guadalupe Slough) (Santa Clara County Bird Data Unpublished). However, there are no records of black rails breeding in the South Bay since at least the 1920s (Trulio and Evens 2000).

The absence (or scarcity) of breeding black rails in the South Bay is presumably a result of habitat loss. Tidal marsh habitat has been lost, but perhaps more important to winter survival is loss of high-tide

refugia habitat. Upland transition habitat, both on natural levees within marshes and on landward edges of marshes, has been lost as a result of fill for development, and reductions in marsh size and resultant reductions in natural levees along higher-order channels. Predation by egrets, herons, gulls, and harriers has been observed in these marshes during winter high tides, as black rails are forced into the open by rising water. The importance of this predation on a population level, especially in light of impacts to high tide refugia, is unknown, but it may be a significant factor in the extirpation of breeding populations of the species from the South Bay.

Western Snowy Plover (*Charadrius alexandrinus nivosus*). Federal Listing Status: Threatened; State Listing Status: Species of Special Concern. The snowy plover is a small shorebird that occurs on almost every continent. In North America, there are two races of snowy plover: the western snowy plover (*C. a. nivosus*) occurs west of the Mississippi River, primarily in the Great Basin and along the Pacific coast, and the Cuban snowy plover (*C. a. tenuirostris*) occurs in the southeastern United States (Page et al. 1995). On the Pacific coast, snowy plovers nest on sandy beaches and salt panne habitat from Washington to Baja Mexico. Because they nest during the summer, primarily on beaches in a temperate climate, western snowy plovers are susceptible to nest disturbance and other negative interactions with humans. Much of their nesting habitat, particularly in southern California, has been lost to development and high human use. In addition, introduced predators, especially the non-native red fox, have had dramatic effects on snowy plover nesting success (Neuman et al. 2004). In response to severe population declines, the USFWS listed the Pacific coast population of the western snowy plover as Threatened in 1993. Critical habitat was designated for this population in 1999, and a draft recovery plan was released in 2001 (U.S. Fish and Wildlife Service 2001). None of the breeding sites within San Francisco Bay are considered critical habitat. The State of California lists the western snowy plover as a species of special concern.

In the South San Francisco Bay, snowy plovers nest on low, barren to sparsely vegetated salt pond levees and islands, at pond edges, and on salt panne areas of dry ponds (Page et al. 2000), and preferentially use light-colored substrates such as salt flats (Feeney and Maffei 1991; Marriott 2003). Nesting areas are located near water, where prey (usually brine flies and other insects) are abundant. In some areas, snowy plovers nest within dry salt ponds; in other areas where ponds typically hold water through the summer (e.g., the Newark salt ponds), nests are located primarily on levees. Often, nests are located near disruptive objects such as rocks or surface irregularities, and may be constructed in depressions created by footprints and vehicles (Marriott 2003; Page et al. 1995). Nests consist of a depression scratched into the substrate sometimes lined with shell fragments, pebbles, or similar local materials (Page et al. 2000; Page et al. 1995). Eggs are oval and buff-colored with small, brown- and black-colored spots and scrawls.

According to Page et al. (1995), pairing begins as early as mid February; egg-laying commences in early March, and may continue with multiple broods into early August. The incubation period ranges from 26 to 32 days. Three eggs are typically laid two to five days apart. Replacement clutches are initiated approximately six to eight days after the destruction of a completed clutch. Young birds are precocial, leaving the nest within hours of hatching. Chicks are usually cared for exclusively by the male parent, until they fledge at 28-33 days. Chicks feed themselves, but require the protection of an adult for brooding and evasion of predators. The breeding season of the western snowy plover in California, from

nest initiation to fledging of chicks, is considered to be 1 March to 31 September. Although snowy plovers can nest as early as 1 March, damp nesting substrate in salt ponds, from flooding or normal spring rains, may delay nesting in this habitat until the substrate dries.

Some snowy plovers remain in their coastal breeding areas year-round, while others are migratory. Some individuals that nest in the San Francisco Bay Area probably migrate south as far as Mexico (U.S. Fish and Wildlife Service 2001). There is overlap between the San Francisco Bay population and the adjacent coastal nesting population. Birds banded at Monterey Bay and in Oregon have been seen in the San Francisco Bay salt ponds (Feeney and Maffei 1991). Snowy plovers typically live three to four years (Page et al. 1995).

Snowy plovers in the South Bay forage primarily on small flies, especially brine flies (*Ephydra cinerea* and *Lipochaeta slossonae*; (Feeney and Maffei 1991). They also feed on other small invertebrates, including beetles and small marine invertebrates. Snowy plovers forage visually, and often run after prey which they capture in their bills. In the South Bay, western snowy plovers are likely to forage anywhere where prey is available. Brine flies are usually found in greatest densities at the shallow margins of shallow salt ponds or puddles, but snowy plovers also forage in open salt flats, and occasionally, on mudflats adjacent to salt ponds.

It is not known whether this species nested inside San Francisco Bay before conversion of salt marsh to salt evaporation ponds. Breeding habitat may have been present in natural salinas prior to the creation of salt ponds, but such features would have provided limited breeding habitat for snowy plovers, at best. Salt ponds have provided suitable nesting and foraging habitat since the beginning of the 20th century, and as of 1990, about 10% of the California population of snowy plovers bred within San Francisco Bay salt ponds, mostly in the southern part of the Bay (Page et al. 2000; Page et al. 1991). Surveys conducted by PRBO, SFBBO, and others since the 1970s have shown that the breeding population in the South Bay may be declining. Window surveys in the South Bay, which cover most available breeding habitat in a one-week period, detected 351 breeding birds in 1978, 270 in 1984, and 216 in 1989 (Page et al. 2000). In 2004, the results of breeding-season monitoring of the Eden Landing, Alviso, and Ravenswood pond complexes resulted in a maximum of only 113 snowy plovers (Strong et al. 2004b); this total was down to 99 birds in 2006 (Robinson et al. 2006). Numbers of snowy plovers in the South Bay may be considerably higher in winter, when the local population is augmented by wintering birds that likely breed in the Great Basin. In contrast, recent surveys by USGS (Takekawa et al. 2005) found lower abundance in winter in the Alviso pond complex.

Figure 6 depicts the areas where snowy plovers have been recorded breeding in the South Bay since 1989 (although no recent data are available from the Newark and Redwood City salt ponds). During both the winter and breeding seasons, the greatest concentration of snowy plovers in the San Francisco Bay area has consistently occurred in the Eden Landing/Hayward area, with a lower but moderate level of use at Ravenswood and Alviso ponds.

Within the Study Area, substantial breeding populations occur in the Warm Springs salt ponds (Ponds A22 and A23) in the Alviso complex. At Warm Springs, Ponds A22 and A23 are used, with > ten adults

found during the 2003 nesting season, a high count of 32 plovers at A22 in 2004 (Strong et al. 2004b), and 13 plovers at A22 in 2006 (Robinson et al. 2006). Low densities of snowy plovers have been recorded during the breeding season, sometimes with nests or chicks, at some other Alviso salt ponds, primarily at A6 and A8 (Ryan and Parkin 1998b; Strong et al. 2004b); the species also nested in the late 1990s in Alviso Pond A3N and in a small impoundment immediately east of Pond A12 (Santa Clara County Bird Data Unpublished). In 2006 and 2007, Pond A8 in Alviso has been used extensively by snowy plovers, after several years with very little plover activity in Alviso. In 2006, up to 36 snowy plovers were seen in A8, and 11 nests were found here (Robinson et al. 2006). In addition, the presence of snowy plover chicks and adults at an impoundment east of the Alviso Marina indicated that snowy plovers nested here, although no nest was found (Robinson et al. 2006).

Habitat conditions (including water depth and predator density) change over time at each of these nesting areas, so the numbers cited above are not necessarily representative of the current distribution of snowy plovers in the South Bay. The snowy plover is opportunistic, capable of moving around among potential breeding areas and breeding where conditions are suitable. The abundance and distribution of snowy plovers in the South Bay shifts annually, and is also dynamic within a given nesting season. Early in each breeding season, many ponds may not be suitable for nesting due to late rains creating muddy substrates, and nesting may be concentrated at a few ponds with suitable conditions. Later in the season, as more ponds dry out and become available for nesting, snowy plovers may be more dispersed among many nesting locations, and nest in lower densities.

Primary threats to the western snowy plover are mammalian and avian predators, and human disturbance (Page et al. 1995). Non-native predators, such as red fox, have had major effects on populations in California; in the South Bay, two snowy plover nests were known to have been depredated by red foxes in 1993 and 1994 in the Coyote Hills and Dumbarton areas (Harding et al. 1998), and such events have probably occurred much more frequently than is known. Efforts to curtail nest depredation by mammalian predators have greatly enhanced nesting success by snowy plovers in some areas (Neuman et al. 2004). In the South Bay, no strong increase in nest success was noted between 1991 and 1996, after a predator management plan was implemented, except at a few nests where exclosures were used; such nests had generally high success rates (Harding et al. 1998). Overall nest success in the South Bay has been fairly high in some recent years, with 80% nest success in 2001 (N=78 nests) and most of 2004 (N=54 nests as of July) (Wilson 2004). However, fledging success is unknown, and may be far less due to predation by avian predators.

Avian predators, particularly California Gulls and corvids (crows and ravens), are increasingly becoming an issue for snowy plover reproductive success (Wilson 2004). California gulls at Mono Lake are known to prey on snowy plover eggs and chicks (Page et al. 1983), and given the abundance of California gulls in the South Bay during the breeding season, even low levels of predation may be important to nesting plovers. American Crows (*Corvus brachyrhynchos*) and common ravens are adept at finding snowy plover nests and preying on eggs. Corvid numbers may be increasing throughout California, at least partially in response to increased availability of food from anthropogenic sources, such as garbage dumps. Other avian predators, including Loggerhead Shrikes, American Kestrels, and Northern Harriers have been documented taking snowy plover chicks, and in some areas, have dramatically reduced fledging

success (Neuman, pers. comm.). Human disturbance can also be a serious factor limiting nesting and fledging success. Human disturbance (including disturbance from domestic dogs) can lead to nest abandonment or direct trampling of eggs or chicks (Page et al. 1995). In addition, because young chicks are dependent on adults for protection, human disturbance resulting in the separation of chicks from adults can lead to the death of the chicks.

California Least Tern (*Sterna antillarum browni*). Federal Listing Status: Endangered; State Listing Status: Endangered. Least terns are small fish-eating birds that nest primarily on beaches. The California least tern nests during summer from Baja California north to San Francisco Bay. Least terns are migratory, and spend winter months in coastal areas of Mexico and Central America. Most breeding colonies are located in southern California. The California least tern is listed as endangered on the state and federal levels, and the state considers it a fully protected species.

Currently, the breeding colony at Alameda is one of the most important breeding colonies in the state. In 2003, this colony had 301 breeding pairs (Hurt 2004). This total is up considerably from prior decades: 128 pairs were found in 1993, and only 70 pairs nested in 1982 (Collins 1994). Least terns nesting at Alameda typically arrive at the colony in late April, and fledge chicks from late June to early August. They forage for small fish in shallow coastal waters near the colony, mainly around Alameda Point (Hurt 2004). Adults and juveniles typically start dispersing south from the Alameda colony in early July.

Least terns also nested in 2000 and 2001 at Albany (near Alameda), with up to 12 pairs in 2000. At Pittsburg, on Suisun Bay, 13 pairs nested in 2001 and eight pairs nested in 2003. Historically, small numbers of birds have nested at the Oakland International Airport (last reported in 1995), Bay Farm Island (last reported 1975), Bair Island (last reported 1984), Port Chicago (last reported in 1988), the Bay Bridge Sand Spit (one-time attempt in 1985), and tern Island (one-time attempt in 1990) (Takekawa et al. 2005).

In addition, South Bay salt ponds have been used historically for sporadic and limited nesting attempts. These include attempts on levees at Ponds E10/E11 at Eden Landing (last reported 1985), Ponds N5/N7 (last reported 1983) and N1A in the Newark salt ponds, and Pond R3 in the Ravenswood Compex (Hurt 2004; Wetlands Research Associates 1994). In the South Bay, recent breeding has occurred only at Hayward Regional Shoreline, where eight pairs nested in 2005 and 15 pairs in 2006 (Strong 2006), and at Pond E8A in Eden Landing, where at least five pairs nested in 2007.

Currently, least terns use the Shoreline Study Area only as a post-breeding staging area from about late June through late August, prior to their southward migration. Here, both adult and juvenile least terns roost on salt pond levees (both outboard levees and interior levees between ponds) and boardwalks, and forage both in the salt ponds and over the open waters of the Bay. At the Alameda colony, least terns forage primarily on silversides (e.g., topsmelt), northern anchovies, Pacific herring, and surfperches (Elliott et al. 2004). Although data are unavailable regarding diet during the post-fledging period in the South Bay, diet is likely similar. Least terns have often been observed foraging in South Bay salt ponds, but they also forage heavily in adjacent open Bay waters. For example, 50 of 58 least terns observed foraging in the SBSP project area on 14 July 2004 were doing so over the Bay, with only eight

individuals actively foraging in salt ponds (Steve Rottenborn, pers. obs.). However, the relative importance of salt ponds versus Bay waters for foraging by least terns in the South Bay is largely unknown.

In recent years, the main post-breeding (late summer/fall) staging area for least terns in the South Bay has been in the complex of salt ponds immediately north of Moffett Field (Ponds AB1, A2E, and AB2; Figure 5), located in the Study Area. For example, 276 least terns were seen in these three ponds on 27 July 2004 (Steve Rottenborn, pers. obs.). This site is used predictably for roosting and foraging by both adult and juvenile least terns in July and August each year, with typical counts of 20-100 birds. Least terns have also been recorded at a number of other ponds in the Study Area, including A1, A2E, A3N, A3W, A4, A5, A7, A9, A10, A11, and A14 (Hurt 2004).

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris raviventris*). Federal Listing Status: Endangered; State Listing Status: Endangered. The salt marsh harvest mouse is a small mouse endemic to salt marshes of San Francisco Bay. The USFWS listed the salt marsh harvest mouse as an Endangered Species under the authority of the Federal Endangered Species Act on 13 October 1970, based on population declines and loss of habitat. The State of California listed the salt marsh harvest mouse as an Endangered Species on 27 June 1971, and considers it a fully protected species. The USFWS approved a joint recovery plan for the salt marsh harvest mouse and the California clapper rail on 16 November 1984 (U.S. Fish and Wildlife Service 1984). Critical habitat has not been established for either the California clapper rail or salt marsh harvest mouse.

The salt marsh harvest mouse's current distribution includes salt marshes in San Francisco, San Pablo, and Suisun Bays. The species no longer occurs on the Peninsula north of Coyote Point (Shellhammer 2000a). *Reithrodontomys raviventris* is separated into two subspecies, *R. r. raviventris* of the South Bay and *R. r. halicoetes* of the North Bay. *R. r. raviventris* is restricted along both sides of San Francisco Bay to an area from San Mateo County on the west side and Alameda County on the east side, south to Santa Clara County; this subspecies was one of the pivotal species upon which the decision to initially establish a National Wildlife Refuge in the South San Francisco Bay was based (H.R. Bill 17047, (1970), and Senate Bill 2291, (1969)).

These mice are dependent on dense vegetative cover, usually in the form of pickleweed and other salt dependent or salt tolerant vegetation in both tidal and diked salt marshes (Fisler 1965; Shellhammer 1982; Shellhammer 2000a; Shellhammer et al. 1988; Shellhammer et al. 1982). Pickleweed provides more horizontal branches (and therefore more cover) than other halophytic species. Closely tied to the cover of dense pickleweed, salt marsh harvest mice were thought to make little use of pure alkali bulrush or pacific cordgrass stands (Shellhammer 1977; Wondolleck et al. 1976). More recent trapping (H. T. Harvey & Associates 2007) detected salt marsh harvest mice in brackish marshes dominated by alkali bulrush. The extent of their distribution in, and use of, this habitat is not yet known. Grasslands adjacent to pickleweed marshes are generally used only in the spring when new growth affords suitable cover and possibly forage (Johnson and Shellhammer 1988). Salt marsh harvest mice may also use adjacent grasslands on a daily basis to avoid high tide events, but only a small percentage of the edge of the South Bay has grassland or even much in the way of escape cover adjacent to it, hence the salt marsh harvest mice have almost

nowhere to go to escape from high tides. Refugial vegetation, especially peripheral halophytes, is necessary in tidal marshes and in diked marshes that flood seasonally. On the highest spring tides in winter, the lack of high-tide refugia exposes salt marsh harvest mice to intense predation, and numerous small mammals (many of which are likely salt marsh harvest mice) have been observed being depredated by gulls, herons, egrets, and raptors on such high tides in the South Bay. Marshes without appropriate cover, and narrow marshes without refugial zones into which the mice can escape during flooding or high tides, generally lack salt marsh harvest mice. Figure 7 depicts areas currently providing pickleweed habitat that is known to support, or could potentially be supporting, salt marsh harvest mice within the Study Area and adjacent areas, as well as locations where this species has and has not been detected during survey efforts, and locations providing suitable escape cover; relatively few areas provide high-quality habitat.

Salt marsh harvest mice build loose nests of dry grasses (Shellhammer 1982). Average litter size ranges from 3.7 to 4.2 mice/litter and most animals are thought to have only one litter/year (Fisler 1965). However, recent evidence shows more frequent reproduction (Geissel et al. 1988), with Grizzly Island Wildlife Area populations reproducing as often as three times per year (Krause, pers. comm.). Reproduction occurs from March through November (Fisler 1965). There are few data on foraging by harvest mice, but they probably subsist on leaves and stems of plant species, primarily pickleweed, found in tidal and diked salt marshes. Fisler (1965) reported a high seasonal variation in stomach contents. In winter, fresh green grasses were preferred, while in the rest of the year, pickleweed and other halophytes such as salt grass were the main food sources. The salt marsh harvest mouse is capable of drinking pure seawater, but it generally prefers brackish water (Fisler 1965).

Historically, the marshes in San Francisco Bay were a complex mosaic of vegetation zones, generally consisting of low marsh adjacent to mudflats dominated by cordgrass, high marsh plains dominated by pickleweed, and broad transitions of peripheral halophytes (salt-tolerant plants that cannot tolerate as much inundation by the tides) into upland habitats, with narrower transitional zones on natural levees along larger channels within the marshes. Most of the tidal marshes around the Bay and especially in the South Bay were eliminated, and those remaining have lost the upper portion of their pickleweed zones as well as the higher zone of peripheral halophytes (Shellhammer 1982; Shellhammer and Duke 2004). For example, detailed mapping by H. T. Harvey & Associates for the South Bay Salt Pond Restoration project reveals that pickleweed dominated habitat and peripheral halophyte habitat comprise only 275 acres and 113 acres, respectively, within the 8000-acre Alviso Complex; much of the peripheral halophyte acreage in the Alviso Complex, however, is adjacent to little used brackish vegetation. Most of the tidal salt marshes in the South Bay are small, isolated strip-like marshes along backshores against levees or other hardened structures that promote predation, inhibit further high marsh development, and are threatened by sea level rise (Shellhammer 1989). Similarly, most of the marshes do not have higher order tidal channels within them and hence lack a pattern of natural levees supporting shrubs such as gum plant, and other peripheral halophytes, within them that might act as escape cover for mice within the marshes. Shellhammer and Duke (2004) note that most of the marshes of the South Bay are de facto corridors, likely not wide enough to support viable populations, but wide enough to function as dispersal corridors. Recent mapping is also documenting the fragmentation of the habitat (Figure 7). Cover-dependent salt marsh harvest mice are unlikely to move long distances over bare areas, and thus, isolation of suitable

habitat may lead to genetic isolation of populations. While they are known to swim well, especially in comparison with western harvest mice, they have not been documented to move more than four to five meters across water or more than five meters over bare ground (Bias 1994; Geissel et al. 1988). Based on this information, Shellhammer and Duke (2004) have hypothesized that barren areas of land more than five meters wide, reaches of water more than four meters wide, and brackish or freshwater marsh more than 250 meters wide act as barriers to movement of the southern subspecies of the salt marsh harvest mouse, and hence barriers to gene flow. The more recent (2006) discovery of salt marsh harvest mice in brackish marshes tempers the description of barriers somewhat, but there are still broad areas without vegetation. Areas of bare ground, water, or fresh/brackish marsh less than or equal to these distances may act as filters, reducing the movement of animals (and hence the rate of gene flow) between populations or between portions of a semi-fragmented population. The isolation of populations has contributed to the decline of the species (Shellhammer and Duke 2004) and could lead to local extinctions due to demographic processes or genetic "death." Based on their assessment of potential barriers in the South Bay, Shellhammer and Duke (2004) estimated that there were potentially 25 separate populations of salt marsh harvest mice in the South Bay as of 2002 (not including mice that might be present in very small patches of pickleweed). Figure 7 indicates the locations of major barriers and filters to dispersal of salt marsh harvest mice among the tidal salt marsh remnants in the South Bay.

Habitat degradation has also occurred as a result of the conversion of existing tidal salt marsh to brackish or even freshwater marsh over the past four decades. Within the Alviso Complex, the combination of treated effluent discharge, sedimentation that has reduced the tidal prism, and freshwater flows from rivers and streams (especially in high-rainfall years) has created conditions too fresh for pickleweed to compete and survive (H. T. Harvey & Associates 1994; 2002; 2006; Shellhammer 1982; Shellhammer et al. 1988; Shellhammer et al. 1982). The habitat value of brackish marsh needs reexamination after recent results in the Suisun Marsh and more recently in Alvios. Trapping in salt marsh harvest mouse preserves in the range of the northern subspecies in the Suisun Bay by Barthman-Thompson of CDFG has shown that salt marsh harvest mice do use other species of bulrush and cattail (*Typha* spp.) in the area. Preliminary results from a number of mouse trapping projects (most of which were done in the Suisun Bay) suggest that monocultures of peppergrass, which dominate large areas of brackish marsh in the South Bay, are not used by the mice.

As a result of habitat loss, degradation, and fragmentation, salt marsh harvest mouse populations are small. A database for all salt marsh studies carried out in the South San Francisco Bay, including the entire Study Area, was compiled by H. Shellhammer at H. T. Harvey & Associates (Shellhammer and Duke 2004). Trapping records from permits issued by the USFWS and the CDFG were reviewed and compiled. The database, which includes 198 trapping projects (estimated 95% of all such projects and studies) representing 134,204 trap nights (TN) completed through 2003, shows that 37% of all trapping projects (73 of 198, or 49,481 TN of a total of 134,204 TN) captured 0 salt marsh harvest mice. The average capture efficiency (CE, or total effort in TN divided by the number of mice captured) of all trapping projects was 0.013. In terms of unit effort, it took an average of 79 TN to capture one salt marsh harvest mouse. The approximately 64% of the projects in which at least one mouse was captured (153 of 198) had a capture efficiency equal to or less than 0.019, or it took 77 TN to capture a single mouse.

There were few projects in which numerous salt marsh harvest mice were captured; there were only eight projects with a CE ≥ 0.06.

The Alviso ponds have had 11 projects in the New Chicago Marsh area (mostly from the 1970s and 1980s), and 11 or more in Triangle Marsh and its western extension (north of Alviso), but again most of them date from the 1970s and 1980s. There are nine or more, widely spaced projects in the middle of the Alviso Complex: two were done along Guadalupe Slough, six on or near the northwestern edge of Moffet Field, and one in the southeastern corner of the Sunnyvale Baylands Park. The highest density of trapping projects in the area of the Alviso Complex is just west of the complex, where 13 projects have been carried out between Charleston Slough and San Francisquito Creek. Most of the harvest mouse trapping projects were carried out in the late 1980s and 1990s. A relatively small number of projects have been carried out in these ponds compared to other parts of the South Bay because they were protected from development for most of the last few decades.

Despite the species' small populations, the salt marsh harvest mouse is known to rapidly colonize restored areas. This species quickly moves into areas of appropriate habitat from nearby inhabited areas as has been shown in numerous trapping projects' reports, including many in the South Bay (H. T. Harvey & Associates 1984a; 1985a; 1985b; 1985c; 1987; 1996; 1997a).

4.4.2 Other Special-Status Species

Western Pond Turtle (*Clemmys marmorata*). Federal Listing Status: None; State Listing Status: Species of Special Concern. The western pond turtle is an aquatic turtle found west of the Sierra Nevada from the Columbia River south to northern Baja California, Mexico. This turtle requires some slack or slow water, although it will occur where enough food resources occur in faster moving water; it usually leaves the aquatic site to reproduce, to aestivate, and to over-winter. Typical habitat includes freshwater ponds and backwaters in slow-moving rivers with abundant aerial and aquatic basking sites. Nesting usually occurs in upland areas from March to July, in hard-packed clay soil. Hatchlings disperse from the nest with winter rains. Threats to the western pond turtle include impacts to nesting habitat from agricultural and grazing activities, human development of habitat, and increased predation pressure from native and non-native predators as a result of human-induced landscape changes. Many of the current records for the species are from the greater San Francisco Bay area, including the Santa Clara Valley (Jennings and Hayes 1994).

Western pond turtles are absent from most of the Shoreline Study Area, due to a lack of suitable freshwater habitat. A small population occurs in brackish habitats near Moffett Field and the Sunnyvale WPCP, in the vicinity of Pond A3W (Alderete and McGowan 2003; Figure 5). Here, up to five turtles were found on 31 May 2002, in the Northern Channel on the south side of A3W (Alderete and McGowan 2003). This population is clearly isolated from other pond turtle populations in the South Bay. A review of western pond turtle records in Santa Clara County in 1999 (H. T. Harvey & Associates 1999b) included a single record along lower Stevens Creek near Moffett Field from 1987, but the next closest records to Moffett Field were more than seven miles away at Lagunita at Stanford, along San Francisquito

Creek in Palo Alto, and in a pond along San Tomas Aquino Creek in Santa Clara. Pond turtles are occasionally seen along lower Coyote Creek and the Guadalupe River; these are likely individuals that have dispersed downstream from populations in the upper watersheds of these streams.

Double-crested Cormorant (*Phalacrocorax auritus*). Federal Listing Status: None; State Listing Status: Species of Special Concern (Rookery Site). Double-crested cormorants are large fish-eating waterbirds resident along the entire coast of California and on inland lakes and estuaries. Breeding occurs at undisturbed sites, typically in trees or on man-made structures beside water. Double-crested cormorants are considered Species of Special Concern by the CDFG only at rookery sites. Double-crested cormorants nest during spring and summer (and occasionally into early fall), and are resident in the South Bay year-round. Numbers are augmented considerably in fall and winter, when non-breeding birds from other locations visit San Francisco Bay (Ainley 2000b).

Double-crested cormorants have increased as breeders in the San Francisco Bay area in recent decades. First breeding records for Alameda County, the bayside of San Mateo County, and Santa Clara County were established only as recently as 1984, 1989, and 1992, respectively. As of 1991, there were approximately 2800 double-crested cormorants nesting around San Francisco Bay, primarily on North Bay bridges(Ainley 2000b). Relatively few, however, breed in the Study Area. Here, this species has recently nested on electrical transmission towers at several sites, including towers in ponds A18, AB1, AB2, and A2W ((Strong 2004a); Figure 5). Santa Clara County Bird Data indicate that cormorants were first recorded nesting in the Alviso Complex on electrical towers in Pond A2W in 1992. Nesting by as many as ten pairs/year at this location has continued through 2004, and new colonies appeared on towers in Ponds AB1/AB2 in 1993 (with up to eight nests in subsequent years) and Pond A18 in 1994 (with a high of 27 nests in 1997). In 2006, 34 nests were counted at Pond A2W (Strong 2006). Double-crested cormorants use salt pond levees in the South Bay primarily for roosting, but a colony established in 1998 on the levee between Ponds A9 and A10 has contained up to 70+ nests in years since. In 2006, 29 nests were counted on this levee (Strong 2006).

These birds probably forage primarily in the open Bay, but cormorants also forage for fish in salt ponds. Counts from USGS censuses in South Bay salt ponds from 2002 through 2004 peaked in October and November, with high counts of 1963 at the Alviso Ponds in October 2003 (Takekawa et al. 2005). Numbers during surveys by USGS were lowest from January through March, with high counts typically under 100 birds at the Alviso Ponds. Large foraging flocks occasionally form around high fish concentrations, as indicated by counts of 1550 in Pond A9 on 9 October 2000 and 1200 on Shoreline Lake in Mountain View on 16 November 1996 (Santa Clara County Bird Data Unpublished).

White-faced Ibis (*Plegadis chihi*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting colony). The white-faced ibis is a medium-sized wading bird that is an uncommon breeder in California; it is considered a Species of Special Concern only at nesting colonies. White-faced ibises have nested at only a few locations in California, including the Salton Sea, Honey Lake, isolated locations in the Central Valley, and at Mallard Slough, in the South Bay. Currently, most ibises in California now nest at Kern NWR, in the Central Valley. Nests are built of vegetation, in dense stands of tule, cattail, or similar marsh vegetation.

The only nesting by the white-faced ibis in the South Bay occurred at Mallard Slough (also known as Artesian Slough), between Ponds A16 and A18 (Figure 5). Here, six adults were observed in and around a large mixed-species heronry in 1985, and adults were seen carrying nesting material in 1991 and 1992 (Santa Clara County Bird Data Unpublished). However, successful breeding was not documented, and there has been no subsequent evidence of breeding by this species in the South Bay since that time. White-faced ibises occur irregularly throughout the San Francisco Bay Area during the nonbreeding season.

Northern Harrier (*Circus cyaneus*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting). The Northern harrier is a raptor commonly found in open grasslands, agricultural areas, and marshes. Nests are built on the ground in areas where long grasses or marsh plants provide cover and protection. Harriers hunt for a variety of prey, including rodents, birds, frogs, reptiles, and insects by flying low and slowly in a traversing manner. The Northern harrier is considered a Species of Special Concern in California only at nesting sites.

This species is a common forager over San Francisco Bay marshes and extensive areas of ruderal habitat immediately surrounding the Bay, particularly during the non-breeding season (winter) when migrant and wintering birds augment the local resident population. Northern harriers breed in low numbers within the South Bay, nesting in the larger expanses of tidal marsh that remain, such as Triangle Marsh in Alviso, the Warm Springs marshes, and the Palo Alto/East Palo Alto marshes. This species also nests in extensive tracts of tall ruderal vegetation, moist fields, and nontidal or muted tidal marsh, such as occurs on Moffett Field and in the Palo Alto Flood Control Basin. The minimum patch size needed to support a pair of nesting harriers in the South Bay is unknown, and the narrow strips of marsh along some of the sloughs between salt ponds in the Study Area are likely too narrow to provide suitable nesting habitat for this species. However, nest-building along Guadalupe Slough near the Sunnyvale WPCP in 1993 and a successful nesting along Mountain View Slough, between Ponds A1 and A2W in Mountain View, in 2000 indicates that some of these narrower marshes do provide suitable nesting habitat (Santa Clara County Breeding Bird Atlas Committee Unpublished). Northern harriers may be important predators of nesting shorebirds and terns in the South Bay, with individuals or pairs keying in on certain areas having concentrations of nesting waterbirds. This species has been known to take both adult and young snowy plovers in the Eden Landing Complex (Krause, pers. comm.).

White-tailed Kite (*Elanus leucurus*). Federal Listing Status: None; State Listing Status: Fully Protected Species. This raptor species prefers habitats with low ground cover and variable tree growth. Kite nests are usually built near the tops small trees or large shrubs near open habitats, such as partially cleared or cultivated fields, grassy foothills, and marsh. Kites prey primarily on small rodents (especially the California vole), but also feed on birds, insects, reptiles, and amphibians.

This species occurs in the South Bay commonly throughout the year, primarily in the upland fringes of the Shoreline Study Area. Breeding occurs primarily in spring and early summer, although breeding activity as early as February, with young in the nest as late as October, has been noted in the South Bay (Santa Clara County Bird Data Unpublished). This species breeds in a number of locations around the

Study Area where nest sites (e.g., trees and shrubs) occur adjacent to open fields, ruderal habitats (e.g., active and closed landfills), and marshes. The riparian corridor of Coyote Creek is likely to support several breeding pairs each breeding season.

Merlin (*Falco columbarius*). Federal Listing Status: None; State Listing Status: Species of Special Concern (wintering). The merlin is a medium-sized falcon that breeds in North America primarily in Canada. Merlins do not breed in California, but have been listed as a Species of Special Concern due to concerns over the species' wintering populations here. Non-breeding merlins occur in the San Francisco Bay area from September through April.

Like most falcon species, the merlin feeds primarily on small birds. Merlins are widespread, but in low abundance, throughout the entire Bay area during migration and winter, where they forage aerially. Shorebirds (e.g., sandpipers) provide abundant prey, thus merlins can often be found foraging over salt ponds and mudflats. They also forage on a variety of other bird species, and can be found in virtually all habitats in the Shoreline Study Area.

California Gull (*Larus californicus*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting colony). The California gull breeds colonially throughout the western United States, often in colonies of several thousand birds. They typically start attending colonies in early April, and lay eggs in early May (Winkler 1996). Incubation takes about 27 days, and chicks hatch in the late May to early June. Chicks remain near the nest until fledging about six weeks after hatching. Typical nesting habitat is barren or sparsely vegetated borders of saline lakes. Abundant nesting populations from the Great Basin (e.g., Great Salt Lake) disperse to coastal California after breeding, greatly augmenting the wintering population in the Bay area.

Historically, California gulls bred primarily on saline inland lakes, and this species was declared a Species of Special Concern at nesting colonies by CDFG due to concern over impacts to inland breeding colonies. In 1980, a small group colonized abandoned levees on Pond A6 in Alviso. This colony steadily increased in size over the next two decades, and by 2000 this colony had grown to over 10,000 nesting individuals, making it the second largest colony in California (Shuford and Ryan 2000). Adult California gulls attend the Pond A6 colony year-round, but numbers increase during spring. Egg laying occurs between mid-April and mid-May, and most young are fledged by mid-August (Shuford and Ryan 2000). Adult California gulls breeding in the South Bay forage on natural prey, such as brine flies and their larvae, and brine shrimp, supplemented by food obtained from human sources, including the Newby Island Landfill near Milpitas and the Tri-Cities Landfill in Fremont. It is likely that the availability of food at these landfills has been at least partly responsible for the increase in South Bay breeding populations, both by providing food during the breeding season and by aiding in the survival of younger birds during the nonbreeding season.

California gulls also prey on the eggs and young of other birds, such as snowy plovers, Forster's terns, American avocets, and black-necked stilts, and they likely take small mammals such as salt marsh harvest mice as well. A study by Ackerman et al. (2006) documented that 15% of American avocet nests monitored with cameras in the South Bay were depredated by California gulls; 61% of American avocet

chicks and 23% of black-necked stilt chicks fitted with radio transmitters in this study were determined to be depredated by California gulls. California gulls at Mono Lake are known to prey on snowy plover eggs and chicks (Page et al. 1983), and given the abundance of California gulls in the South Bay during the breeding season, even low levels of predation may be important to nesting waterbirds. Salt marsh harvest mice are particularly vulnerable during extreme high tide events, when most of the pickleweed marsh plains of the South Bay are completely inundated. At these times, salt marsh harvest mice are forced to swim, and gulls (including California gulls) readily forage over the flooded marshes, presumably including salt marsh harvest mice among their prey.

California gulls also nest in smaller numbers at several other sites within the Study Area. As of 2004, they were nesting in at least five colonies in the South Bay. Figure 2 depicts the locations where this species has nested in the South Bay since 1994. In 2006, the largest colonies other than at Pond A6 were at Coyotes Hills ponds 2A/3A (3721 nests) and on the levee between ponds M1 and M2 (2492 nests; Strong 2006). Numbers of California gulls in the South Bay increase during winter, when the local population is augmented considerably by birds moving from interior populations.

Table 9 – Numbers of California gulls at colonies in ponds in the Shoreline Study Area, from 1982 to 2006. All numbers are either total number of adults counted on the colony, or twice the number of nests counted on the colony. Data from Strong (Strong 2004b, Strong 2006).

Year	A1	AB2	A6	A9/10
1982	0	0	412	434
1983	0	0	1342	0
1984	0	0	2000	150
1985	0	0	3000	374
1986	0	0	3000	97
1987	0	0	4000	100
1988	0	0	4600	180
1989	0	0	5310	434
1990	2	0	7600	122
1991	0	0	5250	0
1992	0	0	5500	200
1993	200	82	6912	234
1994	350	556	9000	300
1995	74	300	7236	4
1996	0	282	6558	1410
1997	164	1000	6256	1722
1998	0	400	6562	1628
1999	145	248	9380	2117
2000	0	254	11482	1986
2001	278	624	11216	3056
2002	510	712	11302	3590

Year	A1	AB2	A6	A9/10
2003	862	384	13644	1010
2004*	445	531	8600	1047
2006	190	187	9726	117

* Numbers are based on a single aerial survey, and are likely underestimates.

Black Skimmer (*Rynchops niger*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting colony). The black skimmer is a unique species, with a lower mandible longer than the upper mandible. This extended lower mandible allows these birds to fly over the surface of the water, skimming for small fish. Black skimmers nest primarily on the coasts of the Southeast United States, the Gulf of California, and the Pacific Coast of Baja, California, north to San Diego, and in California, the black skimmer is a Species of Special Concern only at nesting sites.

Black skimmers were first detected nesting in California in 1972, and since that time, this species' populations have increased considerably (e.g., to approximately 1200 pairs in 1995 (Collins and Garrett 1996). Until the mid-1990s, the black skimmer was considered a very rare nonbreeding visitor to the San Francisco Bay area. However, the species was documented nesting in San Francisco Bay in 1994, when one pair nested in Pond AB2 in Santa Clara County, and one pair nested at Hayward Regional Shoreline in Alameda County (Layne et al. 1996). Since 1994, this species has occurred in the South Bay every year and has nested at several additional sites in the Study Area, including ponds A1, A2W, AB1, A8, and A16 ([Strong 2004b]; Figure 5). In these areas, black skimmers have usually nested among Forster's terns, on small dredge-spoil islands (including both bare islands and islands vegetated, sometimes heavily, with pickleweed) in salt ponds. Exact nesting locations vary from year to year.

Skimmer populations in the South Bay have slowly but steadily increased (e.g., to a high count of 27 in Pond A8 on 28 September 2003; [Santa Clara County Bird Data Unpublished]). Because nesting success in the South Bay has apparently been low, judging by the low number of chicks surviving to fledging age, this population increase has likely been primarily the result of immigration from the increasing southern California population. Within the Shoreline Study Area, the species is most abundant in the vicinity of the Alviso Complex and most post-breeding flocks have been recorded in this area (e.g., on Pond A8 and in Charleston Slough).

Burrowing Owl (*Athene cunicularia*). Federal Listing Status: None; State Listing Status: Species of Special Concern. The burrowing owl is a small, terrestrial owl of open country. Burrowing owls occupy grasslands and sparsely vegetated shrubland ecosystems. In California, burrowing owls are found in close association with California ground squirrels. Ground squirrels provide nesting and refuge burrows, and maintain areas of short vegetation height, providing foraging habitat and allowing for visual detection of avian predators by burrowing owls. Burrowing owls are semi-colonial nesters, and group size is one of the most significant factors contributing to site constancy by breeding burrowing owls. The nesting season, as recognized by the California Department of Fish and Game, runs from 1 February through 31 August.

Burrowing owl populations in the South San Francisco Bay have been decreasing rapidly and significantly in recent decades. As of 1990, the South Bay burrowing owl population was thought to have declined at least 50% since 1981 (Barclay et al. 1998). A statewide census, the largest and most comprehensive undertaken to that date or since, suggested that the rate of disappearance of South Bay burrowing owls was greater than the rate found for owls in the Central Valley, and that the rate of decline for both regions was accelerating (DeSante et al. 1993; DeSante et al. 1997). A new statewide census was conducted in 2006. Surveyors on this census counted 595 burrowing owls statewide, of which 56 were in Santa Mateo and Santa Clara County.

Despite recent declines, burrowing owls still breed in a number of locations offering suitable burrows and open foraging habitat around the upland perimeter of the South Bay. Such sites include Byxbee Park in Palo Alto, Shoreline Park and Moffett Field in Mountain View, the Sunnyvale Baylands Park, the San Jose/Santa Clara WPCP buffer lands, and the SFBNWR lands in Fremont, and a few other scattered locations in the Shoreline Study Area (Figure 8). Burrowing owls are occasionally observed in shoreline, rocky, and upland habitats that rim the South Bay, and they are believed to nest at least infrequently in salt pond levees (Trulio 2000).

Short-eared Owl (*Asio flammeus*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting). Short-eared owls occur in open habitats such as grasslands, wet meadows, and marshes. They require tall herbaceous vegetation for nesting or daytime refuge. Short-eared owls once bred much more widely in California, including the San Francisco Bay Area. However, the species now occurs primarily as a migrant and winter visitor, and is a rare and local breeder in the South Bay. The most recent nesting record in the South Bay was of three pairs producing four fledglings at Bair Island in 1994 (Yee et al. 1994). Other breeding-season records in the South Bay include a pair at the Palo Alto Baylands in 1966 (Chase and Chandik 1966) and two nests in the Palo Alto Flood Control Basin in 1972 (Gill 1977). The species is apparently much more abundant in the North Bay, with over 100 fledglings banded at Grizzly Island (Solano County) in 1987 (Campbell et al. 1987). Potential breeding habitat does occur in the Study Area, but the status of this species as a breeder in the Study Area is unknown. If short-eared owls currently breed in the South Bay, they are likely to nest only in the larger tracts of suitable habitat.

During winter, the species is more widespread, though in low numbers, with many records from bayside locations virtually throughout the Study Area. Locations of more regular observations in winter include Byxbee Park and the Palo Alto Flood Control Basin. Short-eared owls are considered Species of Special Concern only at nesting sites.

Cooper's Hawk (*Accipiter cooperii*). Federal Listing Status: None; State Listing Status: Species of Special Concern. The Cooper's hawk is a medium-sized raptor that preys upon smaller birds (e.g., jays, doves, and quail) and occasionally takes small mammals and reptiles. The Cooper's hawk prefers landscapes where wooded areas occur in patches and groves which facilitates the ambush hunting tactics employed by this species. Breeding pairs in California are often found in stands of live oak woodland or riparian areas, although this species has adapted well to suburban habitats and tolerates human activity. Cooper's hawks typically nest between March and August. During winter, local Cooper's hawks may

migrate south, while the local population may increase with immigration of migrants that breed farther north.

Within the Study Area, Cooper's hawks have been found nesting in surburban areas fringing the South Bay. They may nest in a variety of trees in this area, and may also nest in the riparian corridor of Coyote Creek.

Loggerhead Shrike (*Lanius ludovicianus*). Federal Listing Status: None; State Listing Status: Species of Special Concern (nesting). These predatory songbirds are year-round residents in grassland and scrub habitats in California. Shrikes generally build their nests in shrubs and trees in fairly open areas, and nest in spring and early summer. They hunt in open areas, usually from a low perch, such as a fence post or overhead wire. They forage primarily on large insects, lizards, and small mammals, but some individuals also prey on snowy plover chicks and other young shorebirds. Loggerhead shrike numbers have declined dramatically in eastern North America, but populations in California may be more stable. Loggerhead shrikes are considered Species of Special Concern only at nesting sites.

The species nests in low numbers throughout the Shoreline Study Area. Loggerhead shrikes are found in a number of locations around the Study Area where nest sites (e.g., trees and shrubs) occur adjacent to open fields, ruderal habitats (e.g., active and closed landfills), and marshes. Shrikes forage in ruderal habitats, on salt pond levees, and in marshes in the Study Area.

California Horned Lark (*Eremophila alpestris actia*). Federal Listing Status: None; State Listing Status: Species of Special Concern. Horned larks are songbirds that occur over much of North America in bare ground habitats with short grass, scattered bushes, or no vegetation. In winter, they often form large flocks that sometimes contain several subspecies. The California horned lark is a widespread breeder along the coast and in the Central Valley of California. They breed from March through July, with peak activity in May. Horned larks build grass-lined nests directly on the ground, in dry, open habitats with sparse vegetation.

Horned larks occur primarily as migrants and winter visitors in the Shoreline Study Area, when they may be found in small numbers foraging along salt pond levees, in salt pannes within dried-out salt ponds, and in short grassland and ruderal habitats (e.g., active and closed landfills) around the South Bay. A few pairs likely breed in these locations as well, as evidenced by scattered breeding-season records in and around the Alviso Pond Complex (Steve Rottenborn, pers. obs.; Santa Clara County Bird Data Unpublished).

Saltmarsh Common Yellowthroat (*Geothlypis trichas sinuosa*). Federal Listing Status: None; State Listing Status: Species of Special Concern. The saltmarsh common yellowthroat is a small songbird that inhabits emergent vegetation, primarily in fresh and brackish marshes, and associated upland areas in the San Francisco Bay Area. This subspecies (one of approximately 12 subspecies of common yellowthroat recognized in North America) breeds from mid-March through early August, and pairs frequently raise two clutches/year. Because this subspecies cannot be reliably distinguished in the field from other races that occur in the South Bay as migrants, determination of the presence of saltmarsh

common yellowthroats can be achieved only by observation of presence during the summer months when other subspecies are not expected to be present. Although little is known regarding the movements of this taxon, the wintering areas have been described as coastal salt marshes from the San Francisco Bay region to San Diego County (Terrill 2000).

Despite their common name, saltmarsh common yellowthroats breed primarily in fresh and brackish marshes, and in freshwater riparian habitats. In the South Bay, this species is a fairly common breeder in such habitats virtually wherever they occur, although very small patches of marsh often lack this species. Particularly large populations occur in brackish and freshwater marshes in the Alviso Complex (e.g., along the middle and upper reaches of the major sloughs and in the Warm Springs/Alviso marshes). The saltmarsh common yellowthroat likely breeds to some extent in salt marshes providing taller herbaceous vegetation (Ray 1919), as evidenced by the species' presence during the breeding season in such marshes (Santa Clara County Bird Data Unpublished; Santa Clara County Breeding Bird Atlas Committee Unpublished). Saltmarsh common yellowthroats also breed in the riparian corridor of Coyote Creek within the Study Area.

California Yellow Warbler (*Dendroica petechia brewsteri*); Federal Status: None; State Status: Species of Special Concern. The yellow warbler is a small songbird that breeds in well-developed riparian vegetation, and feed on insects. The yellow warbler is a migratory species that is common during migration, but migratory birds in California are mostly of one of the northern subspecies. Yellow warblers that remain to breed in northern and central California are of the race *D. p. brewsteri*. Due to a loss of riparian habitat in California over the last century, this subspecies is listed as a California Species of Special Concern. Most California yellow warblers migrate to Mexico and South America in the fall and return to California to breed from May through August. Yellow warblers are rare breeders in the Study Area, likely nesting only in the riparian corridor along lower Coyote Creek.

Alameda Song Sparrow (*Melospiza melodia pusillula*). Federal Listing Status: None; State Listing Status: Species of Special Concern. The Alameda song sparrow is one of three subspecies of song sparrow breeding only in salt marsh habitats in the San Francisco Bay area. Locally it is most abundant in the taller vegetation found along tidal sloughs, including salt marsh cordgrass and marsh gumplant. Populations of the Alameda song sparrow have declined due to the loss of salt marshes around the Bay, although within suitable habitat it is still fairly common. The location of the interface between populations of the Alameda song sparrow and those of the race breeding in freshwater riparian habitats (*M. m. gouldii*) along most creeks is not known due to difficulties in distinguishing individuals of these two races in the field.

In salt marshes, *pusillula* are most abundant in tall marsh vegetation, particularly in the marsh gumplant/California cord grass association immediately adjacent to tidal sloughs. *Pusillula* are also found in peppergrass in the upper, drier portions of salt marshes and occasionally in brackish marshes dominated by bulrushes (Marshall and Dedrick 1994). Except during very high tides, they make more limited use of the broad expanses of short pickleweed favored by savannah sparrows. Along several streams in the South Bay, song sparrows seem to be distributed continuously from the upper reaches down to tidal salt marsh. This distribution indicates that *gouldii* and *pusillula* come into contact along

these streams, probably at the interface of brackish and freshwater habitats, as Grinnell (1901) found at San Francisquito Creek.

Song sparrows nest as early as March, but peak nesting activity probably occurs in May and June. Salt marsh-breeding song sparrows in the Bay area (including *pusillula*) are known to breed about two weeks earlier than *gouldii* (Johnston 1954; Johnston 1956). This early breeding by *pusillula* is apparently an adaptation to breeding in a tidal environment, as high tides in late spring and early summer may destroy large numbers of nests.

Optimum habitat for this subspecies is tidal salt marsh, although it occurs in tidal brackish marsh, seasonal wetlands, salt pond complexes and other adjacent habitats. Alameda song sparrows occur commonly in suitable habitat throughout the South Bay, including the Shoreline Study Area, being particularly abundant in more extensive marshes but also occurring fairly commonly in narrower marshes along tidal sloughs as long as taller herbaceous vegetation for nesting is present.

Tricolored Blackbird (*Agelaius tricolor*). Federal listing status: None; State Listing Status: Species of Special Concern (nesting colony). Tricolored blackbirds are found almost exclusively in the Central Valley and central and southern coastal areas of California. This species was originally listed as a Species of Special Concern (at its nesting colonies) in California due to concerns over the loss of wetland habitats in the state. However, in 1992, surveys by the California Department of Fish and Game determined that the population of this species was much larger than previously believed (Beedy and Hamilton 1997), lessening concern for the species.

The tricolored blackbird is highly colonial in its nesting habits and forms dense breeding colonies, which in some Central Valley areas may consist of up to tens of thousands of pairs. This species typically nests in tall, dense, stands of cattails or tules, but also nests in blackberry, wild rose bushes and tall herbs. Nesting colonies are usually located near standing or flowing fresh water. Tricolored blackbirds form large, often multi-species, flocks during the non-breeding period and range more widely than during the reproductive season.

Appropriate breeding habitat for this species in the Shoreline Study Area is limited, and most breeding sites in the South Bay area are well inland from areas of tidal influence. This species nested in 1992 in ruderal habitat in the San Jose-Santa Clara Water Pollution Control Plant (Santa Clara County Breeding Bird Atlas Committee Unpublished), but no other breeding records are known from the immediate Study Area. Freshwater marshes providing fairly extensive stands of tules and cattails are present along upper Artesian, Alviso, and Guadalupe Sloughs, in the Warm Springs marshes, and along the Moffett Channel. However, the tricolored blackbird typically nests only in nontidal freshwater marshes, and it is therefore unlikely to use such tidal marshes for nesting.

Salt Marsh Wandering Shrew (*Sorex vagrans halicoetes*). Federal Listing Status: None; State Listing Status: Species of Special Concern. Formerly more widely distributed in the Bay area, this small insectivorous mammal is now confined to salt marshes of the South Bay (Findley 1955). Salt marsh wandering shrews occur most often in medium-high wet tidal marsh (six to eight feet above sea

level), with abundant driftwood and other debris for cover (Shellhammer 2000b). They have also been recorded occasionally in diked marsh. This species is typically found in fairly tall pickleweed, in which these shrews build nests. They breed and give birth during spring, although very little is known regarding the natural history of the species.

This subspecies was formerly recorded from marshes of San Pablo and San Francisco Bays in Alameda, Contra Costa, San Francisco, San Mateo, and Santa Clara Counties, but captures in recent decades have been very infrequent anywhere in these areas. Shrews are occasionally captured during salt marsh harvest mouse trapping studies (see Table 6 above), but the difficulty in identifying them to species has precluded a better understanding of the current distribution of this species in the South Bay. As of 1986, there were only four locations, including Bair Island, the Alameda Creek mouth, Dumbarton Point, and Mowry Slough, where this species had been positively identified between 1980 and 1985, although the species was considered likely present in a number of other marshes in the South Bay (Western Ecological Services Company (WESCO) 1986).

This species is likely present, albeit probably in low numbers, in extensive tidal salt marshes within the Shoreline Study Area. Much of the previous discussion of the habitat requirements of the salt marsh harvest mouse, such as extensive salt marsh with high-tide refugia, and of the effects of habitat fragmentation and barriers to dispersal, applies to the salt marsh wandering shrew as well.

Pacific Harbor Seal (*Phoca vitulina richardsi*). Federal Listing Status: None; State Listing Status: None. Pacific harbor seals are currently the only marine mammals that are permanent residents of San Francisco Bay. Although they are not listed by the state as a Species of Special Concern, harbor seals are protected under the federal Marine Mammal Protection Act, and are sensitive to human disturbance. NOAA Fisheries (the agency that oversees the protection of marine mammals) recommends a 100-yard disturbance-free buffer around harbor seals. Disturbance can lead to separation of pups from nursing mothers, can add physiological stress to adults, and can lead to long-term abandonment of historical haul-out sites (Lidicker and Ainley 2000).

Pacific harbor seals occur along the Pacific coast of North America from Alaska south to Baja California. In San Francisco Bay, they haul out at a number of sites to rest and pup (give birth). Most pupping occurs during spring, with a peak in April (Fancher and Alcorn 1982). Females nurse pups for about 28 days, during which time they are susceptible to being separated as a result of human disturbance. Haul-out sites are typically mudflats far from areas used regularly by humans, and near deeper water, where seals forage. Harbor seals forage in nearshore marine habitats on variety of fishes and invertebrates. Kopec and Harvey (1995) studied diet at several haul-out sites in 1991-1992, and found that in the South Bay, major diet items included yellowfin goby (*Acanthogobius flavimanus*), staghorn sculpin (*Leptocottus armatus*), and white croaker (*Genyonemus lineatus*).

More than ten sites around the Bay may be used by seals at any given time (Lidicker and Ainley 2000), and any undisturbed intertidal habitat accessible to the open Bay could potentially be used by harbor seals. Primary haul-out sites in San Francisco Bay are Mowry Slough (243 seals in 1999), Castro Rocks near the Richmond-San Rafael Bridge (107 seals in 1999), and Yerba Buena Island (72 seals in 1999;

(Lidicker and Ainley 2000). Mowry Slough, the most important site in the South Bay, produced 78 pups in 1999, 90 in 2000, 102 in 2001 and 144 in both 2002 and 2003 (Green et al. 2004); surveys in April 2004 found 283 seals, including 59 pups, at Mowry Slough and 34 seals, including nine pups, near the mouth of Coyote Creek at Calaveras Point (Bell Unpublished). At both these sites, mudflats and adjacent pickleweed marsh at various locations may be used at any particular time. Use of haul-out sites varies over time, and other South Bay sites, including Guadalupe Slough near the northeastern end of Pond A3N, the mouth of the Alameda Flood Control Channel, Newark Slough, Bair Island, and Greco Island are currently used or have been important haul-outs historically (Bell Unpublished; Fancher and Alcorn 1982; Kopec and Harvey 1995) (Figure 5).

4.4.3 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires federal fishery management plans (FMPs) to describe the habitat essential to the fish being managed and describe threats to that habitat from both fishing and non-fishing activities. In addition, in order to protect this Essential Fish Habitat (EFH), federal agencies are required to consult with NOAA Fisheries on activities that may adversely affect EFH.

The Shoreline Study Area includes EFH from three FMPs, the Coastal Pelagic, West Coast Groundfish, and Pacific Coast Salmon FMPs. Fish species covered under these plans that occur in the South Bay are listed in Table 10.

Table 10 - Fisheries Management Plan (FMP) species in the South Bay

Common Name	Scientific Name	Occurrence
Coastal Pelagic FMP		
Northern anchovy	*Engraulis mordax*	Abundant from South to Central Bay; adults and juveniles present in South and South-Central Bay, adults, juveniles, larvae, and eggs present in Central Bay
Pacific sardine	*Sardinops sagax*	Present in South and South-central Bay and rare in Central Bay; adults and juveniles present
Jack mackerel	*Trachurus symmetricus*	Present in Central Bay; eggs and larvae
Pacific Groundfish FMP (Estuarine Composite EFH)		
Leopard shark	*Trikakis semifasciata*	Present from South Bay to Central Bay; adults and juveniles present
Soupfin shark	*Galeorhinus galeus*	Present in South-central and Central Bay and rare in South Bay; adults and juveniles present in Central Bay and rare in South Bay, less known about life stages in South-central Bay
Spiny dogfish	*Squalus acanthias*	Present from South Bay to Central Bay; adults and juveniles in South and Central Bay, less known about life stages in South-central Bay
Big skate	*Raja binoculata*	Present from South Bay to Central Bay; adults and juveniles present in Central Bay, less known about other life stages present in South and South-central Bay

Common Name	Scientific Name	Occurrence
California skate	*Raja inornata*	Present in South Bay (probably rare)
Lingcod	*Ophiodon elongatus*	Present from South to Central Bay but rare in South-central Bay; adults and juveniles present in Central Bay, less known about life stages present in South Bay
Kelp greenling	*Hexagrammos decagrammus*	Present in Central Bay; juveniles and adults
Pacific whiting (hake)	*Merluccius productus*	Present in Central Bay; eggs and larvae
Brown rockfish	*Sebastes auriculatus*	Present from South to Central Bay; juveniles present in South and South-Central Bay, adults and juveniles present in Central Bay
Curlfin sole	*Pleuronichthys decurrens*	Present in Central Bay; juveniles
English sole	*Parophrys vetulus*	Abundant from South to Central Bay; adults and juveniles present
Pacific sanddab	*Cintharichthys sordidus*	Present from South to Central Bay; adults, juvenile, larvae, and eggs present in Central Bay, less known about life stages in South Bay
Sand sole	*Psettichthys melanostictus*	Present in South and Central Bay but rare in South-central Bay; adults, juveniles, and larvae present
Starry flounder	*Platichthys stellatus*	Present from South to South-central Bay and abundant in Central Bay; adults and juveniles present in South Bay and adults juveniles, larvae, and eggs present in Central Bay
Cabezon	*Scorpaenichthys marmoratus*	Rare to few from South to Central Bay; juveniles present in South and South-Central Bay, adults and juveniles present in Central Bay
Bocaccio	*Sebastes paucispinis*	Rare in Central Bay, less known about presence and life stages elsewhere in Bay
Calico rockfish	*Sebastes dalli*	Rare in South Bay, life stages unknown
Rex sole	*Glyptocephalus zachirus*	Rare in South Bay, life stages unknown
Pacific Coast Salmon FMP (Estuarine Composite EFH)		
Chinook salmon Central Valley fall- and late fall-run ESU	*Oncorhynchus tshawytscha*	Spawns in several South Bay streams, including Coyote Creek and the Guadalupe River

The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the Pacific Coast Salmon FMP, the EFH includes freshwater and marine habitats, including habitats for estuarine and ocean rearing and juvenile and adult migration. The important features of EFH include "1) adequate water quality; 2) adequate temperature; 3) adequate prey species and forage base (food); and 4) adequate depth, cover, marine vegetation, and algae in estuarine and near-shore habitats." For the Coastal Pelagic Species FMP, the EFH includes "all marine and estuarine waters from the shoreline along the coasts of California, Oregon and Washington offshore to the limits of the Exclusive Economic Zone (EEZ) and above the thermocline where sea surface temperatures range between ten and 26 degrees C." For the West Coast Groundfish FMP, seven "composite" EFH categories are defined. The estuarine composite includes:

"...those waters substrates and associated biological communities within bays and estuaries of the coasts of Washington, Oregon, and California, seaward from the high tide line (MHHW) or extent of upriver saltwater intrusion. These areas are delineated from the USFWS National Wetland Inventory (NWI) and supplemented from NOAA's Coastal Assessment Framework for the water portion of the Estuarine Drainage Areas for two small estuaries (Klamath River and Rogue River), the Columbia River, and San Francisco Bay. NWI defines estuaries as areas with water greater than 0.5 ppt ocean-derived salt."

Thus, all marine areas within the Study Area below MHHW with salinity of 0.5 ppt or greater are considered EFH.

5. LITERATURE CITED

Accurso LM. 1992. Distribution and abundance of wintering waterfowl on San Francisco Bay 1988-1990 [Master's thesis]. Arcata, CA: Humboldt State University. 252 p.

Ackerman JT, Takekawa JY, Strong C, Athearn N, Rex A. 2006. California Gull Distribution, Abundance, and Predatino on Waterbird Eggs and Chicks in South San Francisco Bay. Final Report, U.S. Geological Survey, Western Ecological Research Center, Davis and Vallejo, CA. 61 pp.

Ahl JSB. 1991. Factors affecting contributions of the tadpole shrimp, *Lepidurus packardi*, to its oversummering egg reserves. Hydrobiologica 212:137-143.

Ainley DG. 2000a. Brown Pelican. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 322-323.

Ainley DG. 2000b. Double-crested Cormorant. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 323-324.

Albertson JD. 1995. Ecology of the California Clapper Rail in South San Francisco Bay. San Francisco, CA: Unpubl. Masters Thesis: San Francisco State University. 199 p.

Alderete CS, McGowan MF. 2003. Western pond turtle (*Clemmys mormorata*) presence/absence survey of NASA Ames Research Center, Moffet Field, California, 2002. Unpubl. Report, NASA Ames Research Center.

Alpine AE, Cloern JE. 1992. Trophic interactions and direct physical effects control phytoplankton biomass and production in an estuary. Limnol Oceanogr(37): 946-955.

American Bird Conservancy. 2004. Cats Indoors! Washington, D.C. http://www.abcbirds.org/cats/states/california_intro.htm.

Anderson DW, Gress F. 1983. Status of a northern population of California Brown Pelicans. Condor(85):79-88.

Anderson W. 1970. A preliminary study of the relationship of saltponds and wildlife - south San Francisco Bay. California Fish and Game 56(4):240-252.

Anonymous. Unpublished. A Study of the Diet of Breeding Forster's terns in the South Bay in 1972. On file at H. T. Harvey & Associates, San Jose, CA.

Austin CC, Shaffer HB. 1992. Short-, medium-, and long term repeatability of locomotor performance in the tiger salamander Ambystoma californiense. Functional Ecology 6:145-153.

Bailey SF, Eliason DA, Hoffman BL. 1965. Flight and dispersal of the mosquito *Culex tarsalis* Coquillett in the Sacramento Valley of California. Hilgardia 37(3):73-113.

Barclay J, Bean C, Plumpton D, Walton B. Burrowing owls in California: issues and challenges. Second International Burrowing Owl Symposium (poster abstract); 1998.

Barnby MA, Collins JN, Resh VH. 1985. Aquatic macroinvertebrate communities of natural and ditched potholes in a San Francisco Bay salt marsh. Estuarine, Coastal and Shelf Science 20(3):331-347.

Baxter RK, DeLeon K, Hieb S, Orsi J. 1999. Report on the 1980-1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California. California Department of Fish and Game. Interagency Ecological Program for the Sacramento - San Joaquin Estuary. Report nr Interagency Ecological Program Technical Report 63.

Baye PR. 2000. Plants and environments of diked baylands; in Baylands Ecosystem Species and Community Profiles. Oakland, California: San Francisco Bay Regional Water Quality Control Board.

Baye PR, Faber PM, Grewell B. 2000. Tidal marsh plants of the San Francisco Estuary. In: Olofson PR, editor. Baylands ecosystem species and community profiles. Oakland, CA: San Francisco Bay Regional Water Quality Control Board. p 9-33.

BDOC. Unpublished. Draft briefing paper on introduced fish, wildlife, and plants in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Bay-Delta Oversight Council, California Resources Agency, Sacramento, California. 33 p.

Beedy EC, Hamilton WJ. 1997. Tricolored Blackbird Status Update and Management Guidelines. (Jones & Stokes Associates, Inc. 97-099). Sacramento, CA: Prepared for U.S. Fish and Wildlife Service, Portland, OR and California Department of Fish and Game, Sacramento, California.

Bell NW. Unpublished. Data collected by Norton Bell, Don Edwards San Francisco Bay National Wildlife Refuge volunteer, on harbor seal numbers near the mouth of Alviso Slough in 2004.

Bertness MD. 1991. Zonation of Spartina patens and Spartina alterniflora in a New England salt marsh. Ecology 72:138-148.

Bias MA. 1994. Ecology of the salt marsh harvest mouse in San Pablo Bay [Unpubl. Ph.D.]. Berkeley: University of California. 243 p.

Bohart RM, Washino RK. 1978. Mosquitoes of California: 3rd Edition. Univ. Calif. Div. Agr. Sci., Berkeley, Publ. 4084. 153 pp.

Bollman FH, Thelin PK, Forester RT. 1970. Bimonthly bird counts at selected observation points around San Francisco Bay, February, 1964 to January, 1966. Calif. Fish and Game 56:224-239. 11 p.

Boursier, P. 1997. (H. T. Harvey & Associates). Personal observation udring rare plant surveys of the Springtown Wetlands Preserve.

Boyer, K. E. and J. B. Zedler. 1999. Nitrogen addition could shift plant community composition in a restored California salt marsh. Restoration Ecology 7:74-85.

Bradley PM, Morris JT. 1990. Physical characteristics of salt marsh sediments: ecological implications. Mar. Ecol. Progr. 61:245-252.

Briggs KT, Tyler WB, Lewis DB, Carlson DR. 1987. Bird communities at sea off California: 1975 to 1983. Studies in Avian Biology 11.

Britton RH, Johnson AR. 1987. An ecological account of a Mediterranean salina: the Salin de Geraud, Camargue (S. France). Biological Conservation 42:185-230.

Buchan, LAJ, Randall, PJ. 2003. Assessment of Stream Ecosystem Functions for the Coyote Creek Watershed Coyote Creek Watershed Integrated Pilot Assessment Final Report. Prepared for the Santa Clara Valley Urban Runoff Pollution Prevention Program.

Buchan, LAJ, Randall, PJ, Dovorsky, J. 2002. Stream Classification for the Coyote Creek Watershed. Prepared for the Santa Clara Valley Urban Runoff Pollution Prevention Program.

CalFlora. 2004. CalFlora: Information on California plants for education, research and conservation. [web application]. Berkeley, California: The CalFlora Database. Available: http://www.calflora.org/.

California Department of Fish and Game. 2004. RareFind: California Department of Fish and Game Natural Diversity Database (CNDDB). Version 3.0.5. Sacramento: California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch.

California Department of Fish and Game. 2007. RareFind: California Department of Fish and Game Natural Diversity Database (CNDDB). Version 3.0.5. Sacramento: California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch.

California Native Plant Society (CNPS). 2001. California Native Plant Society Inventory 6th Ed. List of Taxa (last updated July, 2000). http://www.cnps.org/rareplants/ inventory/6thEdition.htm.

California State Coastal Conservancy, U.S. Fish and Wildlife Service. 2003. San Francisco Estuary Invasive Spartina Project: Spartina Control Program. VOLUME 1:Final Programmatic Environmental Impact Statement/Environmental Impact Report. 454 p.

Campbell KF, Erickson RA, Bailey SF. 1987. Middle Pacific Coast Region. American Birds 41:482-486.

Carlton JT. 1975. Introduced intertidal invertebrates. R.I. Smith and J. Carlton, Light's Manual: Intertidal invertebrates of the Central California Coast. Berkeley, CA: University of California Press. p 17-25.

Carlton JT. 1979a. History, Biogeography, and Ecology of the Introduced Marine and Estuarine Invertebrates of the Pacific Coast of North America [Ph.D.]. Davis, CA: University of California, Davis. pp. 904 p.

Carlton JT. 1979b. Introduced invertebrates of San Francisco Bay. In: Cosmos TJ, editor. San Francisco Bay: The Urbanized Estuary: Pacific Div./Amer. Associ. Adv. Sci., San Francisco. p 427-444.

Carlton JT, Thompson JK, Schemel LE, Nichols FH. 1990. Remarkable invasion of San Francisco Bay California USA by the Asian clam *Potamocorbula amurensis* I. Introduction and dispersal. Marine Ecology Progress Series 66(1-2):81-95.

Carpelan LH. 1957. Hydrobiology of the Alviso salt ponds. Ecology 38(3):375-390.

Carpenter SJ, LaCasse WJ. 1955. Mosquitoes of North America. Berkeley: Univ. Calif. Press. p 360.

Carter, JL, Fend SV. 2000. The distribution and abundance of lotic macroinvertebrates during Spring 1997 in seven streams of the Santa Clara Valley area, California: U.S. Geological Survey Open-File Report 00-68.

Casazza ML, Miller MR. 2000. Northern Pintail. In: Olofson PR, editor. Baylands ecosystem species and community profiles. Oakland, CA: San Francisco Bay Regional Water Quality Control Board.

CH2M Hill. 1989. Salt Marsh Conversion in Coyote Creek, 1970 - 1987. 19 pp. and Appendices p.

Chase TJ, Chandik T. 1966. Middle Pacific Coast Region. Audubon Field Notes 20:597.

Clarke JL. 1943. Studies of the flight range of mosquitoes. J. Econ. Ent. 36:121-122.

Cogswell HL. 2000. The use of salt ponds by some selected birds other than shorebirds and waterfowl. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 390-402.

Cohen AN. 1998. Ships' ballast water and the introduction of exotic organisms into the San Francisco Estuary: current status of the problem and options for management. Richmond, California: San Francisco Estuary Institute.

Cohen AN, Carlton JT. 1995. Non-indigenous aquatic species in a United States estuary: A case study of the biological invasions of the San Francisco Bay and Delta. US Fish and Wildlife Service and National College Sea Grant Program. http://www.anstaskforce.gov/sfinvade.htm. Report nr PB96-166525. 246 p.

Cohen AN, Carlton JT. 2003. Nonindigenous aquatic species in a United States Estuary: A case study of the biological invasions of the San Francisco Bay and Delta. An ANS Task Force Report for the U.S. Fish and Wildlife Service and the National Sea Grant College Program Conneticut Sea Grant (NOAA Grant Number NA36RG0467). Report nr NOAA Grant Number NA36RG0467.

Collins C, Garrett K. 1996. The Black Skimmer in California: an overview. Western Birds 27:127-135.

Collins JN. 2004. Maintaining and improving functioning of the South Bay ecosystem and restoring tidal salt marsh and associated habitats over the next 50 years at pond and pond-complex levels. Unpublished science synthesis for the Science Team of the South Bay Salt Pond Restoration Project.

Collins JN, Grossinger RM. 2004. Synthesis of scientific knowledge concerning estuarine landscapes and related habitats of the South Bay Ecosystem. Oakland, CA: San Francisco Estuary Institute. 91 p.

Colwell MA, Danufsky T, Fox-Fernandex NW, Roth JE, Conklin R. 2003. Variation in shorebird use of diurnal, high-tide roosts: how consistently are roosts used? Waterbirds 26:484-493.

Colwell MA, J.R. Jehl J. 1994. Wilson's Phalarope (Phalaropus tricolor). In: Poole A, Gill F, editors. The Birds of North America, No. 83: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Compagno LJ. 1984. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated cataloque of shark species known to date. Part 2. Carcharhiniformes. FAO Fish. Synop. 433-434 p.

Cox MC. 1969. The biology of the euryhaline water boatman Trichocorixa reticulata (*Guerin-Meneville*) [Unpubl. Masters thesis]: San Diego State University.

Cressey S. 1997. Benthos and fisheries assessment Palo Alto Wastewater Treatment Plant discharge channel. Prepared for Larry Walker Associates.

Darsie RF, Ward RA. 1981. Identification and geographical distribution of the mosquitoes of North America, north of Mexico. Mosq. Syst. Suppl. 1:1-313.

Davidson NC, Evans PR. 1986. The role and potential of man-made and man-modified wetlands in the enhancement of the survival of overwintering shorebirds. Colonial Waterbirds 9(2):176-188.

DeLaune RD, Buresh RJ, W. H. Patrick Jr. WH. 1979. Relationship of soil properties to standing crop biomass of Spartina alterniflora in a Louisiana marsh. Estuarine and Coastal Marine Science 8:477-487.

Department of the Interior. 2003. 50 CFR Part 17 Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Final Rule.

DeSante DF, Ruhlen E, Amin S, Burton KM. 1993. Results of the 1991 census of burrowing owls in central California: an alarmingly small and declining population. J. Raptor Res 27:59 (abstract).

DeSante DF, Ruhlen ED, Adamany SL, Burton KM, Amin. S. 1997. A census of burrowing owls in central California in 1991. Rap. Res. Report 9:38-48.

Durso SL. 1996. The Biology and Control of Mosquitoes in California. In: Durso SL, editor: Mosquito and Vector Control Association of California, Elk Grove. 150 pp.

Elliott ML, Saenz BL, Abraham CA, Roth JE, Sydeman WJ, Zoidis A. 2004. Oakland Harbor deepening project (-50'): Least tern, fish, and plume monitoring. Final Report Year 2003. San Francisco, California: Unpubl. Report, Tetra Tech, Inc.

Environmental Science Associates I. 1991. Ecological assessment of the tidal wetland 1990 Bay Road site. Prepared for Jenkins, Sanders & Associates. 17 p.

Ervin, G. N. and R. G. Wetzel. 2002. Influence of a dominant macrophyte, Juncus effusus, on wetland plant species richness, diversity, and community composition. Oecologia. 130: 626-636.

Evans PR. 1976. Energy balance and optimal foraging strategies in shorebirds: some implications for their distributions and movements in the non-breeding season. Ardea 64:117-39.

Fancher LE, Alcorn DJ. 1982. Harbour seal census in South San Francisco Bay (1972-1977 and 1979-1980). Calif Fish and Game 68(2):118-121.

Findley JS. 1955. Speciation of the wandering shrew. Occasional Papers of the Museum of Natural History 9:1-68.

Fisler GF. 1965. Adaptations and speciation in harvest mice of the marshes of San Francisco Bay [Ph.D.]. Berkeley: University of California. 108 p.

Foerster KS, Takekawa JE. 1991. San Francisco Bay National Wildlife Refuge predator management plan and final environmental assessment. Newark, CA: U.S. Fish and Wildlife Service.

Foerster KS, Takekawa JE, Albertson JD. 1990. Breeding density, nesting habitat, and predators of the California Clapper Rail. Fremont, CA: Unpubl. Rep. No. SFBNWR-116400-90-1, San Francisco Bay Wildlife Refuge. 21+ p.

Ford RG, Himes Boor GK, Henkel L. 2002. South San Francisco Bay Waterfowl Surveys methodology. Oakland, California: Unpubl. report prepared for URS Corp.

Fowler BH. 1977. Biology and life history of the salt marsh snail, Assiminea californica (Tryon, 1865) (Mesogastropoda: Rissoacea) [Unpubl. Masters thesis]: San Jose State University.

Foxgrover AC, Higgins SA, Ingraca MK, Jaffe BE, Smith RE. 2004. Deposition, erosion, and bathymetric change in South San Francisco Bay: 1858-1983.: U.S. Geologic Survey.

Gallagher SP. 1996. Seasonal occurrence and habitat characteristics of some vernal pool Branchiopods in northern California, U.S.A. Journal of Crustacean Biology 16:323-329.

Garcia-Rossi D, Hedgecock D. 2002. Provenance analysis of Chinook salmon (Oncorhynchus tshawytscha) in the Santa Clara Valley watershed. Unpublished report prepared by Bodega Marine Laboratory, University of California, Davis, Bodega Bay, California. 25 p.

Geissel W, Shellhammer H, Harvey HT. 1988. The ecology of the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in a diked salt marsh. Journal of Mammalogy 69(4):696-703.

Gerstenberg RH. 1979. Habitat utilization by wintering and migrating shorebirds on Humboldt Bay, California. Studies in Avian Biology. 2:33-40.

Gill RE, Jr. 1973. The breeding birds of the South San Francisco Bay [Unpubl. Masters thesis]: San Jose State University.

Gill RJ. 1977. Breeding avifauna of the South San Francisco Bay estuary. Western Birds 8(1):1-12.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. First Reprint. San Francisco, CA/Oakland, CA: U.S. Environmental Protection Agency/San Francisco Bay Regional Water Quality Control Board. 209 p.

Goals Project. 2000. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Olofson PR, editor. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board.

Goss-Custard JD. 1970. The responses of redshank Tringa totanus (L.) to spatial variations in the density of their prey. J. Anim. Ecol. 39:91-113.

Goss-Custard JD. 1977. Optimal foraging and the size selection of worms by redshank, Tringa totanus, in the field. Anim. Behav. 25:10-29.

Goss-Custard JD. 1979. Effect of habitat loss on the numbers of overwintering shorebirds. In: Pitelka FA, editor. Studies in Avian Biology. Lawrence, Kansas: Allen Press Inc. p 167-177.

Goss-Custard JD, Jenyon RA, Jones RE, Newberry PE, Williams R. 1977. The ecology of the Wash II. Seasonal variation in the feeding conditions of wading birds (Charadrii). J. Appl. Ecol. 14:701-719.

Grace JB, Wetzel RH. 1981. Habitat partitioning and competitive displacement in cattails (Typha): experimental field studies. American Naturalist 118:373-463.

Green DE, Grigg EK, Allen SG, Markowitz H. 2004. Monitoring the potential impact of the seismic retrofit construction activities at the Richmond-San Rafael Bridge on harbor seals (*Phoca vitulina*): May 1998 - March 2004. Incidental Harassment Authorization Interim Report submitted to NOAA/NMFS. 90 p.

Grinnell J. 1901. The Santa Cruz Song Sparrow, with notes on the salt marsh Song Sparrow. Condor 3:92-93.

Grinnell J, Miller AH. 1944. The distribution of the birds of California.: Pacific Coast Avifauna 27. Cooper Ornithological Club.

Grinnell J, Wythe MW. 1927. Directory to the bird-life of the San Francisco Bay Region. Berkeley, CA: Cooper Ornithological Club.

Grosholz ED, Ruiz GM, Dean CA, Shirley KA, Maron JL, Connors PG. 2000. The impacts of a non-indigenous marine predator in a California bay. Ecology 81:1206-1224.

Grossinger RM. 1995. Historical evidence of freshwater effects on the plan form of tidal marshlands in the Golden Gate Estuary [Unpubl. Masters thesis]: University of California at Santa Cruz.

Grossinger RM, Askevold RA, Striplen CJ, Brewster E, Pearce S, Larned KN, McKee LJ, Collins JN. 2006. Coyote Creek Watershed Historical Ecology Study: Historical Condition, Landscape Change, and Resotration Potential in the Eastern Santa Clara Valley, California. Prepared for the Santa Clara Valley Water District. A report of SFEI's Historical Ecology, Watersheds, and Wetlands Science Programs, SFEI Publication 426, San Francisco Estuary Institute, Oakland, CA.

H. T. Harvey & Associates. 1984a. Biological Assessment of the Ideal Cement Site, Project 243-01. 18 p.

H. T. Harvey & Associates. 1984b. South Bay Dischargers Authority Comparative Study, Project 156-02.

H. T. Harvey & Associates. 1985a. King and Lyons Property Salt Marsh Harvest Mouse Trapping Survey. Project 261-02. 12 p.

H. T. Harvey & Associates. 1985b. Mayhew's Landing salt marsh harvest mouse trapping survey. Prepared for Oliver DeSilva Company. Report nr 152-03. 11 p.

H. T. Harvey & Associates. 1985c. Salt Marsh Harvest Mouse and Small Mammal Trapping at Concord Naval Weapons Station. Project 263-01. 31 p.

H. T. Harvey & Associates. 1987. Citation Homes Roberts Landing Salt Marsh Harvest Mouse Trapping, August, September, 1987. Project 184-03. 33 p.

H. T. Harvey & Associates. 1988. Mayhew's Landing saltmarsh harvest mouse trapping, winter 1988-89. Prepared for Oliver DeSilva Company. Report nr 152-07. 23 p.

H. T. Harvey & Associates. 1989. Mayhew's Landing salt marsh harvest mouse trapping, winter 1988-89. Prepared for Oliver DeSilva Company. Report nr 152-08. 28 p.

H. T. Harvey & Associates. 1990. San Jose Permit Assistance Program Salt Marsh Harvest Mouse Trapping Surveys Spring and Summer. Project 477-11. 55 p.

H. T. Harvey & Associates. 1991. San Jose permit assistance program salt marsh harvest mouse trapping surveys. Prepared for CH2M Hill. Report nr 477-11. 57 p.

H. T. Harvey & Associates. 1996. Ora Loma Marsh Restoration Site Salt Marsh Harvest Mouse Monitoring. Project 1126-01. 16 p.

H. T. Harvey & Associates. 1997a. Coyote Creek Flood Control Project, Reach 1A Mitigation Site, 1997 Monitoring Report. Project 182-30.

H. T. Harvey & Associates. 1999b. Santa Clara Water District, Western Pond Turtle, Distribution and Status -- 1999. San Jose, CA: Santa Clara Valley Water District. 29 p.

H. T. Harvey & Associates. 2001. Coyote Creek Flood Control Project Reach 1A Management Area 2001 Monitoring Report. Project No. 182-34.

H. T. Harvey & Associates. 2002. South San Francisco Bay Marsh Ecology: Tidal And Edaphic Characteristics Affecting Marsh Vegetation-Year 2. San Jose, California: Prepared for City of San Jose. 32 p.

H. T. Harvey & Associates. 2005. Shoreline Park, Mountain View Salt Marsh Harvest Mouse Survey. Project No. 2485-01.

H. T. Harvey & Associates. 2006. Marsh Plant Associations of South San Francisco Bay: 2006 Comparative Study. Project No. 477-28. San Jose, California: Prepared for City of San Jose.

H. T. Harvey & Associates. 2007. Marsh Studies in South San Francisco Bay 2005 - 2008: California Clapper Rail and Salt Marsh Harvest Mouse Survey Report 2006. Project No. 477-28.

H. T. Harvey & Associates. Unpublished. Study of shorebird abundance and habitat use on Eden Landing Ponds E10 and E11 following drawdown, conducted in July and August 2004. San Jose, CA.

H. T. Harvey & Associates, PWA, Associates M, Staff of San Francisco Bay Conservation and Development Commision. 1982. Guidelines for Enhancement and Restoration of Diked Historic Baylands. Technical Report prepared for the San Francisco Bay Conservation and Development Commission, April 1982. 100 plus appendices p.

Halat KM. 1996. The distribution and abundance of the Chinese mitten crab in southern San Francisco Bay: University of California, Berkeley. 80 p.

Hamilton RB. 1975. Comparative behavior of the American Avocet and the Black-necked Stilt (Recurvirostridae): The American Ornithologists' Union, Ornithological Monograph No. 17.

Hanna GD. 1966. Introduced mollusks of Western North America. Occ. Paper California Academy of Science 48:108.

Hansen SR. 2003. Assessment of impact to aquatic life associated with circulation of saline pond water during the initial stewardship period. Report to USFWS, S.R. Hansen & Associates.

Hanson JT, Kopec D. 1994. (revised 2004 by C.M. Strong). Shorebird location and activity during high tides in South San Francisco Bay, 1992-1993. Draft report for the San Francisco Estuary Project. 102 p.

Harding EK, Albertson J, Doak DF, Takekawa J. 1998. Predator management in San Francisco Bay wetlands: past trends and future strategies. Sacramento, CA: final report. Prepared for USFWS Division of Ecological Services.

Harrington B, Perry E. 1995. Important shorebird staging sites meeting Western Hemisphere Shorebird Reserve Network criteria in the United States. Washington, D.C.: Department of Interior, Fish and Wildlife Service.

Harvey and Stanley Associates. 1985. Warm Springs International Industrial Park salt marsh harvest mouse trapping survey. Project No. 101-03. Prepared for King and Lyons.

Harvey and Stanley Associates. 1986. Warm Springs II salt marsh harvest mouse trapping report. Project No. 261-03. Prepared for LSA, Inc.

Harvey HT, Haltiner J, Williams P. 1982. Guidelines for Enhancement and Restoration of Diked Historic Baylands. Prepared for San Francisco Bay Conservation and Development Commission.

Harvey HT, Mason HL, Gill R, Wooster TW. 1977. The marshes of San Francisco Bay: their attributes and values. San Francisco, California: Prepared for San Francisco Bay Conservation and Development Commission.

Harvey TE. 1988. Breeding biology of the California Clapper Rail in south San Francisco Bay. Trans. Western Section The Wildlife Society 24:98-104.

Harvey TE, Hothem RL, Keck RA, Miller KJ, Page GW, Rauzon MJ. 1992. Status and trends report on wildlife of the San Francisco Estuary. U.S. Fish and Wildlife Service.

Harvey TE, Kelly PR, Lowe RW, Fearn D. The value of saltponds for waterbirds in San Francisco Bay and considerations for future management; 1988 June 26-29, 1988; Oakland, CA. Association of State Wetland Managers.

Hatfield SE. 1985. Seasonal and interannual variation in distribution and population abundance of the shrimp *Crangon franciscorum* in San Francisco Bay. Hydrobiologia 129:199-210.

Hedgecock D. 2002. Documenting biodiversity of coastal salmon (*Oncorhynchos* spp.) in northern California. Bodega Marine Lab, Univeristy of California- Davis.

Helm B. 1998. The biogeography of eight large branchiopods endemic to California. IN C.W. Witham, E. Bauder, D. Belk, W. Ferren, and R. Ornduff (Eds.), Ecology, conservation, and management of vernal pool ecosystems – proceedings of a 1996 conference. California Native Plant Society. Sacramento, CA. Pp. 124-139.

Heppleston PB. 1971. The feeding ecology of Oystercatchers (*Haematopus ostralegus*) in winter in northern Scotland. J. Anim. Ecol. 40:651-672.

Herbst DB. 2001. Gradients of salinity stress, environmental stability and water chemistry as a template for defining habitat types and physiological strategies in inland salt waters. Hydrobiologia 466:209-219.

Hickman JC, editor. 1993. The Jepson Manual: Higher Plants of California. Berkeley, CA: University of California Press.

Hieb KA. 2000a. Arrow goby. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 136-138.

Hieb KA. 2000b. Bay goby. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 139-141.

Hieb KA. 2000c. Longjaw mudsucker. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 142-144.

Hooper DU and Vitousek PM. 1997. The effects of plant composition and diversity on ecosystem processes. Science 277:1302-1305.

Hopkins DR. 1987. Temporal variations in the benthic communities at four intertidal sites in San Francisco Bay, California, 1983-85. U.S. Geological Survey Open-File Report 87-387. 228 p.

Hornberger MI, Luoma SN, Cain DJ, Parchaso F, Brown CL, Bouse RM, Wellise C, Thompson JK. 2000. Linkage of bioaccumulation and biological effects to changes in pollutant loads in South San Francisco Bay. Environmental Science and Technology 23(12):2401-2409.

Hurt R. 2004. (USFWS) email message to S. Rottenborn and L. Henkel, dated 6 August 2004.

Isola CR, Colwell MA, Taft OW, Safran RJ. 2000. Interspecific differences in habitat use of shorebirds and waterfowl foraging in managed wetlands of California's San Joaquin Valley. Waterbirds 23:196-203.

Jang EB. 1977. Hydromineral regulation in the saline water corixid *Trichocorixa reticulata* [Unpubl. Masters thesis]: Hayward State University.

Jaques DL. 1994. Range expansion and roosting ecology of non-breeding California Brown Pelicans [Unpubl. Masters thesis]: U.C. Davis.

Jehl JR, Jr. 1988. Biology of the Eared Grebe and Wilson's Phalarope in the nonbreeding season: a study of adaptations to saline lakes Studies in Avian Biology No. 12: Cooper Ornithological Society.

Jennings MR, Hayes M. 1994. Amphibian and reptile species of special concern in California. California. Sacramento, California: Department of Fish and Game.

Johnson V, Shellhammer H. 1988. The ecology of the salt marsh harvest mouse (*Reithrodontomys raviventris*) in a diked marsh and adjacent grasslands in Palo Alto, California. Sacramento, California: Report to U. S. Fish and Wildlife Service, Endangered Species Sections. 29 p.

Johnston RF. 1954. Variation in breeding season and clutch size in Song Sparrows of the Pacific Coast. Condor 56:268-273.

Johnston RF. 1956. Population structure in salt marsh Song Sparrows. Part I. Environment and annual cycle. Condor 58:24-58.

Jones BJ. 1906. Catalogue of the Ephydridae, with bibliography and description of new species. Univ. Calif. Publ. Ent. 1:153-198.

Jones PA. 1986. Aspects of the reproductive biology of the California Gull (Larus californicus) in Alviso, California [Unpubl. Masters thesis]: San Francisco State University.

Jones & Stokes. 2006. Water year 2005 mitigation monitoring report for the Guadalupe River project, Downtown San Jose, California. May. (J&S 05819.05) Sacramento, CA. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA, in coordination with the Santa Clara Valley Water District, San Jose, CA.

Josselyn M, Hatch A, Strong C, Nichols F. 2004. Impact of invasive species and other nuisance species. Unpublished science synthesis for the Science Team of the South Bay Salt Pond Restoration Project.

Josselyn M, San Francisco State Univ. 1983. The ecology of San Francisco Bay tidal marshes: a community profile. United States: National Coastal Ecosystems Team, U.S. Fish and Wildlife Service. Biological Report. Report nr ISSN: 0895-1926. 102 p.

Kelly PR, Cogswell HL. 1979. Movements and habitat use by wintering populations of willets and marbled godwits. Studies in Avian Biology 2:69-82.

Kennish, M.J. 2001. Coastal salt marsh systems in the U.S.: A review of anthropogenic impacts. Journal of Coastal Research 17(3): 731-748.

Kinnetic Laboratories. 1987. South Bay Dischargers Authority Water Quality Monitoring Program: final monitoring report, December 1981 - November 1986. San Jose, CA: South Bay Dischargers Authority.

Kline KF. 2000. tarry flounder. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 148-150.

Koch H. 1989. Desiccation resistance of the supralittoral amphipod Traskorchestia traskiana (Stimpson, 1857). Crustaceana 56:162-175.

Koch MS, Mendelssohn IA. 1989. Sulfide as a soil phytotoxin: Differential responses in two salt marsh species. Journal of Ecology(77):565-578.

Koch MS, Mendelssohn IA, McKee KL. 1990. Mechanisms for the hydrogen sulfide-induced growth limitation in wetland macrophytes. Limnology & Oceanography(35):359-408.

Kopec AD, Harvey JT. 1995. Toxic pollutants, health indices and population dynamics of harbor seals in San Francisco Bay, 1989-1992. Moss Landing Marine Laboratories Technical Pub. 96-4:138.

Larsson BC. 2000. Franciscan brine shrimp. In: Olofson PR, editor. Goals Project. 2000. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 151-152.

Layne VL, Richmond RJ, Metropulos P. 1996. First nesting of Black Skimmers on San Francisco Bay. Western Birds 27(3):159-162.

Leidy RA, Becker GS, Harvey BN. 2003. Historical distribution and current status of steelhead (*Oncorhynchus mykiss*), coho salmon (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*) in streams of the San Francisco Estuary, California. San Francisco, California: Unpubl. report, USEPA.

Leidy, RA, Becker GS, Harvey BN. 2005. Historical distribution and current status of steelhead/rainbow trout (*Oncorynchus mykiss*) in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.

Lidicker WZ, Jr. 1989. Impacts of non-domesticated vertebrates on California grasslands. Pages 135-150 in Grassland structure and function: California annual grassland (L.F. Huenneke and H. Mooney, eds.). Dordrecht, The Netherlands: Kluwer Acad. Pub.

Lidicker WZJ. 2000. California vole, *Microtus californicus*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 229-231.

Lidicker WZJ, Ainley DG. 2000. Harbor seal, *Phoca vitulina richardsi*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 243-246.

Life Science. 2003. South Bay Salt Ponds Initial Stewardship Plan. Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game.

Life Science. 2004. South Bay Salt Ponds Initial Stewardship Project: Environmental Impact Report/Environmental Impact Statement. Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game.

Long LL, Ralph CJ. 2001. Dynamics of habitat use by shorebirds in estuarine and agricultural habitats in northwestern California. Wilson Bull. 113:41-52.

Lonzarich DG, Smith JJ. 1997. Water chemistry and community structure of saline and hypersaline salt evaporation ponds in San Francisco Bay, California. Calif Fish and Game 83(3):89-104.

Lonzarich DJ. 1989. Temporal and spatial variations in salt pond environments and implications for fish and invertebrates [Master of Arts]. San Jose, CA: San Jose State University.

LSA Associates. 1999. Biological Report and Wetland Characterization, Cisco Site 6. Alviso, Santa Clara County, California: City of San Jose.

MacDonald JS, Birtwell IK, Kruzynski GM. 1987. Food and habitat utilization by juvenile salmonids in the Campbell River Estuary. Canadian Journal of Fisheries and Aquatic Sciences 44:1233-1246.

Maffei WA. 2000a. Brine flies. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 179-182.

Maffei WA. 2000b. A note on invertebrate populations of the San Francisco estuary. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 184-192.

Maffei WA. 2000c. Reticulate water boatman. In: Olofson P, editor. Goals Project. 2000. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of

Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 154-156.

Maffei WA. 2000d. Summer Salt Marsh Mosquito, *Aedes dorsalis*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Communities Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 167-168.

Maffei WA. 2000e. Washino's Mosquito, *Aedes washinoi*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Communities Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 172-173.

Maffei WA. 2000f. Western Encephalitis Mosquito, *Culex tarsalis*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Communities Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 173-177.

Maffei WA. 2000g. Winter Marsh Mosquito, *Culiseta inornata*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Communities Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 177-179.

Maffei WA. 2000h. Winter Salt Marsh Mosquito, *Aedes squamiger*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Communities Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Goals Project. San Francisco Bay Regional Water Quality Control Board. p 169-172.

Maragni DB. 2000. Chinook Salmon. In: P.Olofson, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 91-100.

Marshall JT, Dedrick KG. 1994. Endemic song sparrows and yellowthroats of San Francisco Bay. Studies in Avian Biology 15:316-327.

McGinnis SM. 1984. Freshwater fishes of California: University California Press, Berkeley, pp 316.

McGowan MF. 1986. Northern anchovy, Engraulis mordax, spawning in San Francisco Bay, California 1978-1979, relative to hydrography and zooplankton prey of adults and larvae. Fish. Bull., U.S. 84(4):879-894.

McGowan MF. 2000a. Leopard shark. In: P.Olofson, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 81-82.

McGowan MF. 2000b. Northern anchovy. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 85-86.

McNicholl MK, Lowther PE, Hall JA. 2001. Forster's tern (Sterna forsteri). In: Poole A, Gill F, editors. The Birds of North America: No. 595. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Meiorin EC, Josselyn MN, Crawford R, Calloway J, Miller K, Pratt R, Richardson T, Leidy R. 1991. Status and trends report on wetlands and related habitats in the San Francisco estuary. Oakland, California: San Francisco Estuary Project.

Mendelssohn IA, McKee KL. 1988. *Spartina alterniflora* die-back in Louisiana: Time-course investigation of soil waterlogging effects. Journal of Ecology(76):509-521.

Miles AK. 2000a. Ruddy Duck (*Oxyura jamaicensis*). In: Olofson PR, editor. Goals Project. Baylands

Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 277-280.

Miles AK. 2000b. Surf Scoter. In: P.Olofson, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, California: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 273-277.

Morris C. 2004. Communication on public use of US FWS lands. In: Plunkett D, editor. San Francisco.

Morris JT. 1980. The nitrogen uptake kinetics of *Spartina alterniflora* in culture. Ecology(76):509-521.

Moyle PB. 1976. Fish introductions in California: history and impact on native fishes. Biological Conservation 9:101-118.

Muench S. 1985. Salt marsh harvest mouse trapping survey Triangle Marsh, New Chicago Marsh Alviso, California. Unpubl. report. 17 p.

Munz PA, Keck DD. 1959. A California Flora and Supplement. Berkeley, California: University of California Press.

Nichols DR, Wright NA. 1971. Preliminary Map of Historic Margins of Marshland, San Francisco Bay, California. U.S. Geological Survey.

Nichols FH. 1979. Natural and Anthropogenic Influences on Benthic Community Structure in San Francisco Bay. U.S. Geological Survey, Pacific Division, AAAS. 409-426 p.

Nichols FH, Cloern JE, Luoma SN, Peterson DH. 1986. The modification of an estuary. Science 231(4738):567-573.

Nichols FH, Pamatmat MM. 1988. The Ecology of the Soft-Bottom Benthos of San Francisco Bay California USA a Community Profile. U S Fish Wildl Serv Biol Rep 85(719):1-74.

Nichols FH, Thompson JK. 1985a. Persistence of an introduced mudflat community in South San Francisco Bay, California. Marine Ecology Progress Series 24:83-97.

Nichols FH, Thompson JK. 1985b. Time scales of change in the San Francisco Bay benthos. Hydrobiologia 129:121-138.

Niesen TM, Lyke EB. 1981. Pioneer infaunal communities in the Hayward Salt Marsh restoration (San Francisco Bay). Estuaries 4(3):243.

Nyman JA, DeLaune RD, Patrick Jr. WH. 1990. Wetland soil formation in the rapidly subsiding Mississippi River deltaic plain: Mineral and organic matter relationships. Estuarine, Coastal and Shelf Science 31:57-69.

Obrebski S, Irwin GH, Mazzota J. 2000. Mutualistic interaction between *Traskorchestia traskiana* and *Salicornia virginica* in a San Francisco Bay marsh. Unpublished abstract, Calfed Science Conference,Sacramento, California.

Page GW. 2001. Preliminary findings from shorebird use of South San Francisco Bay study. Unpublished information prepared for 7/26/01 Salton Sea meeting.

Page GW, Stenzel LE, Kjelmyr JE. 1999. Overview of shorebird abundance and distribution in wetlands of the Pacific Coast of the contiguous United States. Condor 101:461-471.

Page GW, Winkler DW, Swarth CW. 1983. Spacing out at Mono Lake: breeding success, nest density, and predation in the snowy plover. AUK 100:13-24.

Page HM. 1997. Importance of vascular plant and algal production to macro-invertebrate consumers in a southern California salt marsh. Estuarine, Coastal, and Shelf Science 45:823-834.

Painter RE. 1966. Zoobenthos of San Pablo and Suisun bays. Pages 40-56 in Kelley, D.W. (ed.), Ecological studies of the Sacramento-San Joaquin Estuary. Sacramento, CA: Fisheries Bulletin 133, California Department of Fish and Game.

Pearson OP. 1985. Predation. Biology of New World Microtus. In: Tamarin RH, editor. American Society of Mammalogists Special Pub. No. 8. 893 pp. p 536-566.

Pennings SC, Callaway RM. 1992. Salt marsh plant zonation: the relative importance of competition and physical factors. Ecology 73(2):681-690.

Persoone G, Sorgeloos P. 1980. General aspects of the ecology and biogeography of Artemia. The brine shrimp Artemia, 3. In: Persoone G, P. Sorgeloos, E. Roels and E. Jaspers (eds.),, editor. Ecology, culturing, use in aquaculture. Wetteren: Universal Press. p 3-23.

Pienkowski MW. 1981. Differences in habitat requirements and distribution patterns of plovers and sandpipers as investigated by studies of feeding behaviour. Verh. Ornithol. Ges. Bayern 23:105-124.

Porcella L. and J. Nishijima. 2006. Alamitos fish ladder year 2-monitoring report 2004-2005. Santa Clara Valley Water District Project No. 62742011.

Porcella L. 2007. Smooth Cordgrass Control Program Annual Monitoring Report Year 4-2006. Santa Clara Valley Water District Project No. 00761082.

Powell, JA, Hogue, C.L. 1979. *California Insects.* University of California Press, Berkeley, California. 388 pp.

PRBO Conservation Science. 2004. Conservation objectives for the San Francisco Bay estuary as outlined in planning documents of North America's major bird conservation initiatives. In collaboration with the Restoration Strategy and Technical Committee of the San Francisco Bay Joint Venture. 58 p.

PWA, H.T. Harvey & Associates. 2006. Status of Invasive Spartina Distribution and Control in the South Bay Salt Pond Restoration Project Area. San Francisco, CA.: Prepared for: California State Coastal Conservancy, U.S. Fish and Wildlife Service, California Department of Fish and Game.

PWA, H. T. Harvey & Associates, Brown and Caldwell, EDAW. 2004. Data Summary Report, South Bay Salt Pond Restoration Project. San Jose, CA.: Prepared for: California State Coastal Conservancy, U.S. Fish and Wildlife Service, California Department of Fish and Game.

Race MS. 1981. Field ecology and natural history of Cerithidea californica (Gastropoda: Prosobranchia) in San Francisco Bay. Veliger 24:18-27.

Ray MS. 1919. More summer birds of San Francisco County. Condor 18:222-27.

Recher HF. 1966. Some aspects of the ecology of migrant shorebirds. Ecology 47(393-407).

Rees DM, Nielsen LT. 1947. On the biology and control of Aedes dorsalis (Meigen) in Utah. Proc. N.J. Mosq. Exterm. Assoc. 34:160-165 p.

Rigney M, Rigney T. 1981. A breeding bird survey of the south San Francisco Bay salt pond levee system, 1981. Alviso, CA: South Bay Institute for Avian Studies.

Rintoul C, Warnock N, Page GW, Hanson JT. 2003. Breeding status and habitat use of Black-necked Stilts and American Avocets in South San Francisco Bay. Western Birds 34(1):2-14.

Robinson JA, L. W. Oring, J. P. Skorupa, Boettcher R. 1997. American Avocet (Recurvirostra americana). In: Gill APaF, editor. The Birds of North America: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Robinson JA, Reed JM, Skorupa JP, Oring LW. 1999. Black-necked Stilt (Himantopus mexicanus). In: Gill APaF, editor. The Birds of North America. Washington, DC.: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Robinson C, Strong CS, Tucci L, Alberston J. 2006. Western Snowy Plover numbers, nesting success, and avian predator surveys in the San Francisco Bay, 2006. Unpublished Report, SFBBO, Alviso, CA.

Roessler, C., D. Salsbery, L. Porcella, and S. Duckler. 2001. Standish Dam annual monitoring report and three year summary 1998-2000. Santa Clara Valley Water District Lower Coyote Creek Flood Control Project Reaches 1 through 3. Project No.402111.

Rubega MA, Inouye C. 1994. Switching in phalaropes: feeding limitations, the functional response and water policy at Mono Lake, CA. Biological Conservation 70:205-210.

Rubega MA, Robinson JA. 1997. Water salinization and shorebirds: emerging issues. In: J. M. Reed NW, and L. W. Oring, editor. Conservation and management of shorebirds in the western Great Basin of North America. International Wader Studies 9. p 45-54.

Safran RJ, Isola CR, Colwell MA, Williams OE. 1997. Benthic invertebrates at foraging locations of nine waterbird species in managed wetlands of the northern San Joaquin Valley, California. Wetlands

17(3):407-415.

Saiki MK. 2000a. California halibut. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 144-148.

Saiki MK. 2000b. Jacksmelt. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 113-115.

Saiki MK. 2000c. Topsmelt. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 115-118.

San Francisco Bay Joint Venture. 2004. West Nile virus strategy and communications plan. Unpublished report. 13 p.

San Francisco Estuary Institute. 1999. Conceptual Models of Freshwater Influences on Tidal Marsh Form and Function with an Historical Perspective. San Jose, CA: City of San Jose. 60 p.

Santa Clara County Bird Data. Unpublished. Data compiled by William G. Bousman for the Santa Clara Valley Audubon Society.

Santa Clara County Breeding Bird Atlas Committee. Unpublished. Data Compiled for the Santa Clara County Breeding Bird Atlas, used with permission.

Shellhammer HS. 1977. Of mice and marshes. San Jose Studies, San Jose State University 3:23-35.

Shellhammer HS. 1982. *Reithrodontomys raviventris*. Mammalian Species 169(1-3).

Shellhammer HS. 1989. Salt marsh harvest mice, urban development, and rising sea levels. Conservation Biology 3(1):59-65.

Shellhammer HS. 2000a. Salt Marsh Harvest Mouse, *Reithrodontomys raviventris*. In: Olofson PR, editor. Goals Project 2000. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 219-228.

Shellhammer HS. 2000b. Salt marsh wandering shrew, *Sorex vagrans halicoetes*. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 231-233.

Shellhammer HS, Duke R. 2004. Salt Marsh Harvest Mouse Habitat of the South San Francisco Bay: an analysis of habitat fragmentation and escape cover. San Francisco Estuarine Institute:26 + maps.

Shellhammer HS, Duke R, Harvey HT, Jennings V, Johnson V, Newcomer M. 1988. Salt marsh harvest mice in the diked salt marshes of southern San Francisco Bay. Wasmann Journal of Biology 46(1/2):89-103.

Shellhammer HS, Jackson R, Davilla W, Gilroy AM, Harvey HT, Simons L. 1982. Habitat preferences of salt marsh harvest mice (*Reithrodontomys raviventris)*. Wasmann Journal of Biology 40(1/2):102-114.

Shields M. 2002. Brown Pelican (Pelecanus occidentalis). In: Gill APaF, editor. The Birds of North America. Washington DC: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Shuford WD, Ryan TP. 2000. Nesting populations of California and ring-billed gulls in California: recent surveys and historical status. Western Birds 31(3):133-164.

Sibley CG. 1952. The birds of the south San Francisco Bay region. Unpublished manuscript.

Siegel SW. 2002. Slough channel network and marsh plain morphodynamics in a rapidly accreting tidal marsh restoration on diked, subsided bayland in San Francisco Estuary, California. Berkeley, CA: Doctoral dissertation, Department of Geography, University of California at Berkeley.

Simenstad CA, Freshm K.L., Salo EO. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. In: Kennedy VS, editor. Estuarine Comparisons. New York: Academic Press. p 343-364.

Skagen S, Oman HD. 1996. Dietary flexibility of shorebirds in the Western hemisphere. Canadian Field Naturalist 110:419-432.

Skinner JE. 1962. An historical review of the fish and wildlife resources of the San Francisco Bay area. The Resources Agency of California Department of Fish and Game Water Projects Branch report No. 1.

Sommer TR. 2000. Striped bass. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 129-132.

Stenzel LE, Kjelmyr JE, Page GW, Shuford WD. 1989. Results of the first comprehensive shorebird census of northern and central California coastal wetlands 8-12 September 1988. Stinson Beach, CA: PRBO.

Stenzel LE, Page GW. 1988. Results of the first comprehensive shorebird census of San Francisco and San Pablo bays. Wader Study Group Bulletin 54:43-48.

Stenzel LE, Page GW. 1989. Results of the 16-18 April 1988 shorebird census of San Francisco and San Pablo Bays. Stinson Beach, CA: PRBO. 18 p.

Storer RW. 1951. The seasonal occurrence of shorebirds on Bay Farm Island, Alameda County, California. Condor 53(4):186-193.

Stralberg D, Warnock N, Nur N, Spautz H, Page G. 2003. Predicting the effects of habitat change on South San Francisco Bay bird communities: An analysis of bird-habitat relationships and evaluation of potential restoration scenarios. Habitat Conservation Model: Phase One. Stinson Beach, CA: PRBO. 112 p.

Strickman D. 2005. Memo summarizing a meeting with the U.S. Army Corps of Engineers concerning mosquito habitats and the South Bay Shoreline Study. San Jose, CA: Santa Clara County Vector Control.

Strong C. 2004a. San Francisco Bay Bird Observatory, October 2004 comments on 50% draft of existing conditions report, and 6 August 2004 meeting with Steve Rottenborn.

Strong CM. 2003. Coyote Creek flood control project Reach 1A waterbird pond monitoring program 1992-2003 final report. Prepared for the Santa Clara Valley Water District.

Strong CM. 2004b. A summary of nesting waterbirds in the San Francisco Bay, from 1982 to 2004. Unpubl. report, San Francisco Bay Bird Observatory, Alviso, California. Alviso: San Francisco Bay Bird Observatory.

Strong CM. 2006. Colonial waterbird nesting summary for the South San Francisco Bay, 2006. Unpublished Report, SFBBO, Alviso, CA.

Swarth CW, Akagi C, Metropulos P. 1982. The distribution patterns and ecology of waterbirds using the Coyote Hills salt ponds. 75 p.

Takekawa J. 1993. The California clapper rail: turning the tide? Tideline (East Bay Regional Park District) 13(2):1-3, 11.

Takekawa JY, Alexander JM, Becker DR, Page GW. 2000. Waterfowl and shorebirds of the San Francisco Estuary. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 309-316.

Takekawa, JY, Athearn, ND, Hattenbach, BJ, and Schultz, AK. 2006. Bird monitoring for the South Bay Salt Ponds Restoration Project. Data Summary Report, U.S. Geological Survey, Vallejo, CA. 74 pp.

Takekawa JY, Lu C, Pratt R. 2001. Avian communities in baylands and artificial salt evaporation ponds of the San Francisco Bay estuary. Hydrobiologia 466:317-328.

Takekawa JY, Marn C. 2000. Canvasback. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 268-273.

Takekawa JY, Marn CM, Accurso LM. 1988. Abundance, distribution, and habitat use of wintering waterfowl in the San Francisco Bay ecosystem 1987-88. U.S. Fish and Wildlife Service. 42 p.

Takekawa JY, Miles AK, Schoellhamer DH, Athearn ND, Saiki MK, Duffy WD, Kleinschmidt S, Shellenbarger GG, Jannusch CA. 2004. Trophic structure and avian communities across a salinity gradient in evaporation ponds of the San Francisco Bay estuary. Unpubl. manuscript.

Takekawa, JY, Miles, KA, Schoellhammer, DH, Jaffe, B, Athearn, ND, Spring, SE, Shellenbarger, GG, Saiki, MK, Mejia, F. 2005. South Bay Salt Ponds Restoration Project, Short-term Data Needs, 2003-2005 Draft Final Report.

Talley TS, Crooks JA, Levin LA. 2001. Habitat utilization and alteration by the invasive burrowing isopod, *Sphaeroma quoyanum*, in California salt marshes. Marine Biology 138(3):561-573.

Tasto RN. 2000a. Pacific herring. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 82-85.

Tasto RN. 2000b. Pacific staghorn sculpin. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. 123-126 p.

Taylor DW. 1981. Freshwater mollusks of California: adistributional checklist. California Fish and Game 67(3):140-163.

Teal JM. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 43:614-624.

Telford AD. 1958. The pasture Aedes of Central and Northern California. Seasonal History. Ann. Ent. Soc. Amer. 51:360-365.

Terrill SB. 2000. Salt Marsh Common Yellowthroat. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. p 366-369.

Thelander CG, M. C. 1994. Life on the edge: a guide to California's endangered natural resources. Santa Cruz, CA.: BioSystems Books. 550 p.

Thompson JK. 1999. The effect of infaunal bivalve grazing on phytoplankton bloom development in South San Francisco Bay. PhD Thesis, Stanford University.

Thompson JK, Shouse MK. 2004. A summary of our knowledge of South San Francisco Bay infaunal invertebrate community. U.S. Geological Survey, unpublished report.

Trenham PC, Koenig WD, Shaffer HB. 2001. Spatially Autocorrelated Demography and Interpond Dispersal in the Salamander *Ambystoma californiense*. Ecology (82):3519-3530.

Trenham PC, Shaffer HB. 2005. Amphibian Upland Habitat Use and its Consequences for Population Viability. Ecological Applications (15): 1158-1168.

Trulio LA. 2000. Western Burrowing Owl. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 362-365.

U.S. Fish and Wildlife Service. 1983. The California Brown Pelican Recovery Plan. Portland: U.S. Fish and Wildlife Service. Portland, Oregon.

U.S. Fish and Wildlife Service. 1984. Salt marsh harvest mouse and California Clapper Rail Recovery Plan. Portland: U. S. Fish and Wildlife Service. 141 p.

U.S. Fish and Wildlife Service and California Department of Fish and Game. 2003. South Bay Salt Ponds Initial Stewardship Plan.

U.S. Fish and Wildlife Service 2004. Endangered and threatened wildlife and plants; determination of threatened status for the California tiger salamander; and special rule exemption for existing routine ranching activities. Federal Register. 69: 47212–47248.

U.S. Fish and Wildlife Service 2005. Endangered and threatened wildlife and plants: designation of critical habitat for the California tiger salamander, central population: Final rule. Federal Register 70: 49379-49458.

U.S. Fish and Wildlife Service 2006a. Endangered and threatened wildlife and plants: designation of critical habitat for four vernal pool crustaceans and eleven vernal pool plants; Final rule. Federal Register 71:7118-7316.

U.S. Fish and Wildlife Service 2006b. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To Delist the California Brown Pelican and Initiation of a 5-Year Review for the Brown Pelican. Federal Register 71: 29908-29910.

Van de Kam J, Ens B, Piersma T, Zwarts L. 2004. Shorebirds an illustrated behavioral ecology: KNNV Publishers, The Netherlands.

Vassallo MT. 1969. The ecology of Macoma inconspicua (Broderip & Sowerby, 1929) in central San Francisco Bay. Part 1. The vertical distribution of the Macoma community. Veliger 11:223-234.

Velasquez C. 1993. The ecology and management of waterbirds at commercial saltpans in South Africa. Unpubl. Ph.D. dissertation. Capetown: University of Capetown, South Africa.

Veldhuizen TC, Stanish S. 1999. Overview of the life history, distribution, abundance and impacts of the Chinese mitten crab, Eriocheir sinensis. Sacramento: California Department of Water Resources, Environmental Services Office, Sacramento, California.

Vitousek, PM 1990. Biological invasions and ecosystem processes: Towards an integration of population biology and ecosystem studies. Oikos 57(1): 7-13.

Wang JCS. 1986. Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: a guide to the early life histories. Tech. Rep. No. 9. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service.

Warnock N. 2004a. 9 November 2004 meeting with Steve Rottenborn and Scott Terrill. PRBO Conservation Science.

Warnock N. 2004b. Managing salt ponds to protect migratory bird diversity and abundance. Unpublished science synthesis for the Science Team of the South Bay Salt Pond Restoration Project.

Warnock N, Bishop MA. 1998. Spring stopover ecology of migrant western sandpipers. Condor 100(3):456-467.

Warnock N, Page GW, Ruhlen TD, Nur N, Takekawa JY, Hanson JT. 2002. Management and conservation of San Francisco Bay salt ponds: effects of pond salinity, area, tide, and season on Pacific Flyway waterbirds. Waterbirds 25:79-92.

Warnock N, Page GW, Stenzel LE. 1995. Non-migratory movements of Dunlins on their California wintering grounds. Wilson Bulletin 107:131-139.

Warnock SE, Takekawa JY. 1995. Habitat preferences of wintering shorebirds in a temporally changing environment: Western Sandpipers in the San Francisco Bay estuary. Auk 112(4):920-930.

Warnock SE, Takekawa JY. 1996. Wintering site fidelity and movement patterns of Western Sandpipers *Calidris mauri* in the San Francisco Bay Estuary. Ibis 138:160-167.

Warwick RM, Price R. 1975. Macrofauna production in an estuarine mud flat. Journal of the Marine Biological Association of the United Kingdom 55(1):1-18.

Washino RK, Jensen T. 1990. Biology, ecology, and systematics of Aedes dorsalis, Ae. melanimon, and Ae. campestris in western North America. Univ. Calif. Ann. Rep. Mosq. Cont. Res(40-41).

Webb EC, Mendelssohn IA. 1996. Factors affecting vegetation dieback of an oligohaline marsh in coastal

Louisiana: Field manipulation of salinity and submergence. American Journal of Botany 83:1429-1434.

Webb EC, Mendelssohn IA, Wilsey BJ. 1995. Causes for vegetation dieback in a Louisiana salt marsh: A bioassay approach. Aquatic Botany 51:281-289.

Wernette FG. 2000. Longfin smelt. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. Oakland, CA: San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. p 109-113.

Western Ecological Services Company (WESCO). 1986. A review of the population status of the salt marsh wandering shrew, *Sorex vagrans halicoetes*.

Wetlands Research Associates. 1994. Biological evaluation for dredge lock use and levee maintenance. Prepared by Wetland Research Associates for the USACOE.

Wetlands Research Associates. 1999. Rare Plant Survey of the Pacific Commons Preserve. Prepared for the Catellus Development Corporation. Fremont, California.

White JR, Hoffman PS, Hammond D, Baumgartner S. 1988. Selenium verification study 1986-1987. Report to the California State Water Resources Control Board. California Department of Fish and Game. 60 p.

Williams WD, Boulton AJ, R.G. T. 1990. Salinity as a determinate of salt lake fauna: a question of scale. Hydrobiologia 197:257-266.

Winkler DW. 1996. California Gull (Larus californicus). In: Poole A, Gill F, editors. The Birds of North America: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Wondolleck JT, Zolan W, Stevens GL. 1976. A population study of the harvest mice (/*Reithrodontomys raviventris*/ DIXON) in the Palo Alto Baylands salt marsh. Wasmann Journal of Biology 34(1):52-64.

Wondolleck JT, Zolan W., G.L. S. 1972. A population study of the harvest mice in the Palo Alto salt marsh. Unpubl. report. 13 p.

Wurtsbaugh WA. 1992. Food-web modification by an invertebrate predator in the Great Salt Lake (USA). Oecologia 89:168-175.

Yee DG, Fix D, Bailey SF. 1994. Middle Pacific Coast Region. National Audubon Society Field Notes 48:984-987.

Zedler JB. 1982. The Ecology of Southern California Coastal Salt Marshes: a Community Profile FWS/OBS 81/54. U.S. Fish and Wildlife Service.

Zedler JB, C.S. Nordby, Kus BE. 1992. The Ecology of Tijuana Estuary, California: A National Estuarine Research Reserve. Washington, D.C.: NOAA Office of Coastal Resource Management, Sanctuaries and Reserves Division.

Zedler JB, Callaway JC, Desmond JS, Vivian-Smith G, Williams GD, Sullivan G, Brewster AE, Bradshaw BK. 1999. California salt-marsh vegetation: an improved model of spatial pattern. Ecosystems 2:19-35.

PERSONAL COMMUNICATIONS

Bush R. 2004. pers. comm. to S. Rottenborn, telephone conversation on 21 December 2004.

Dyer B. 2005. pers. comm. on 50% draft of SBSP existing biological conditions report. San Jose, CA: Santa Clara Valley Water District.

Krause J. 2005. (CDFG) pers. comm. to S. Rottenborn at a meeting of the South Bay Salt Ponds Restoration Project Team, 10 January 2005.

Krause J. 2004. (CDFG), pers. comm., written comments on 50% draft existing conditions report, 29 October 2004.

Laine T. 2005. (Alviso resident) pers. comm. to S. Rottenborn, 11 January 2005 meeting.

Launer A. 2006. pers. comm. to Steve Rottenborn, 24 February 2006.

Morris C. 2005. (USFWS) pers. comm. to S. Rottenborn at a meeting of the South Bay Salt Ponds Restoration Project Team, 10 January 2005.
Salsbery D. Unknown. (SCVWD) pers. comm. to David Johnston.
Smith J. Unknown. (San Jose State University) pers. comm. to David Johnston.
Takekawa J. 2004. USGS pers. comm. to S. Rottenborn 11 August 2004 meeting.
Wilcox C. G. 2005. (CDFG) pers. comm. to S. Rottenborn at a meeting of the South Bay Salt Ponds Restoration Project Team, 10 January 2005.

6. LIST OF PREPARERS

Ron Duke, H. T. Harvey & Associates
Steve Rottenborn, H. T. Harvey & Associates
John Bourgeois, H. T. Harvey & Associates
Patrick Boursier, H. T. Harvey & Associates
Laird Henkel, H. T. Harvey & Associates
Laura Bauman, H. T. Harvey & Associates
Amanda Breen, H. T. Harvey & Associates
Mark Lagarde, H. T. Harvey & Associates
Samatha Moturi, H. T. Harvey & Associates
Sharon Kramer, H.T. Harvey & Associates

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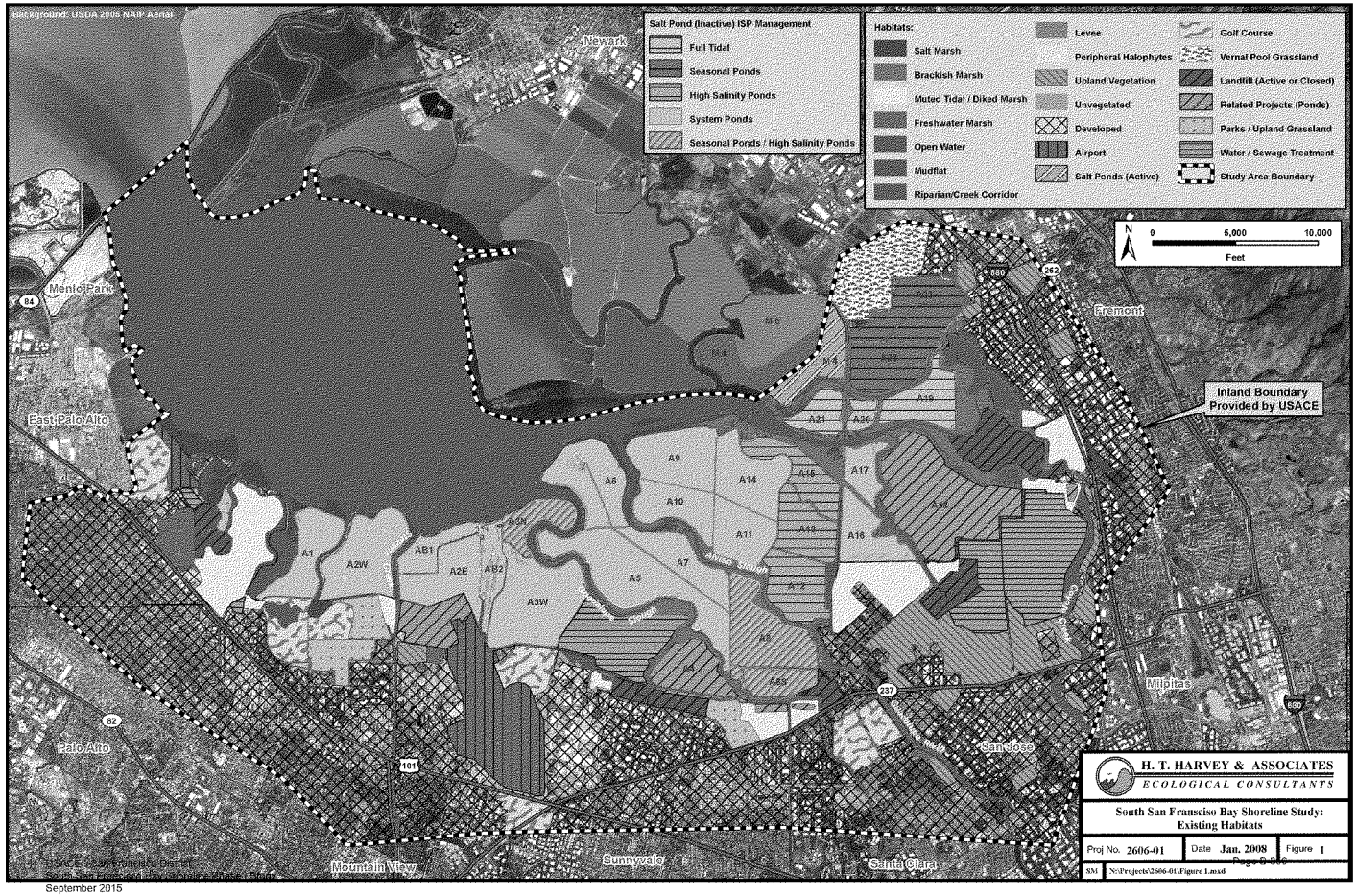
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Salt Pond (Inactive) ISP Management
Full Tidal
Seasonal Ponds
High Salinity Ponds
System Ponds
Seasonal Ponds / High Salinity Ponds
Habitats:
Salt Marsh
Brackish Marsh
Muted Tidal / Diked Marsh
Freshwater Marsh
Open Water
Mudflat
Riparian/Creek Corridor
Levee
Peripheral Halophytes
Upland Vegetation
Unvegetated
Developed
Airport
Salt Ponds (Active)
Golf Course
Vernal Pool Grassland
Landfill (Active or Closed)
Related Projects (Ponds)
Parks / Upland Grassland
Water / Sewage Treatment
Study Area Boundary
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Menlo Park
East Palo Alto
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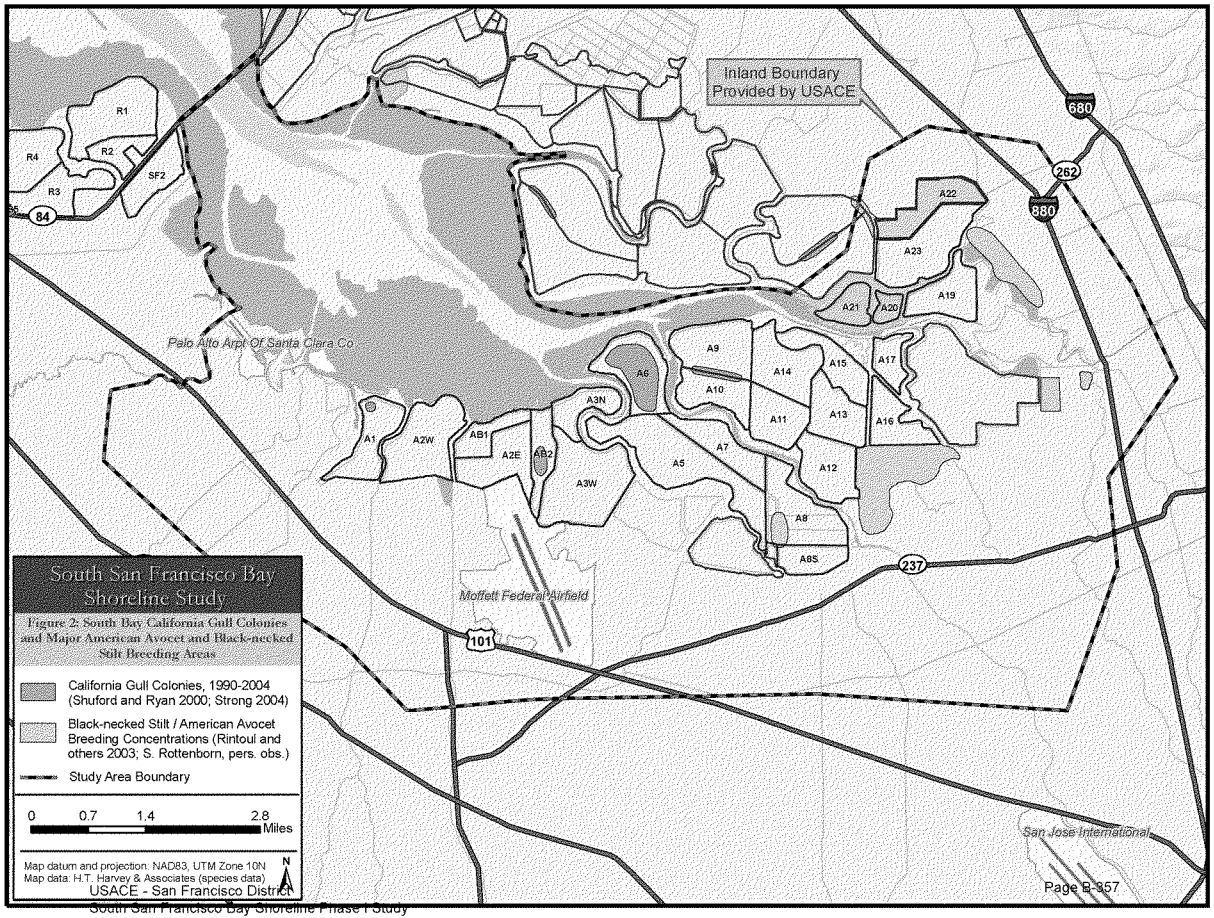
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Shoreline Study
Figure 2: South Bay California Gull Colonies and Major American Avocet and Black-necked Stilt Breeding Areas
California Gull Colonies, 1990-2004 (Shuford and Ryan 2000; Strong 2004)
Black-necked Stilt / American Avocet Breeding Concentrations (Rintoul and others 2003; S. Rottenborn, pers. obs.)
Study Area Boundary
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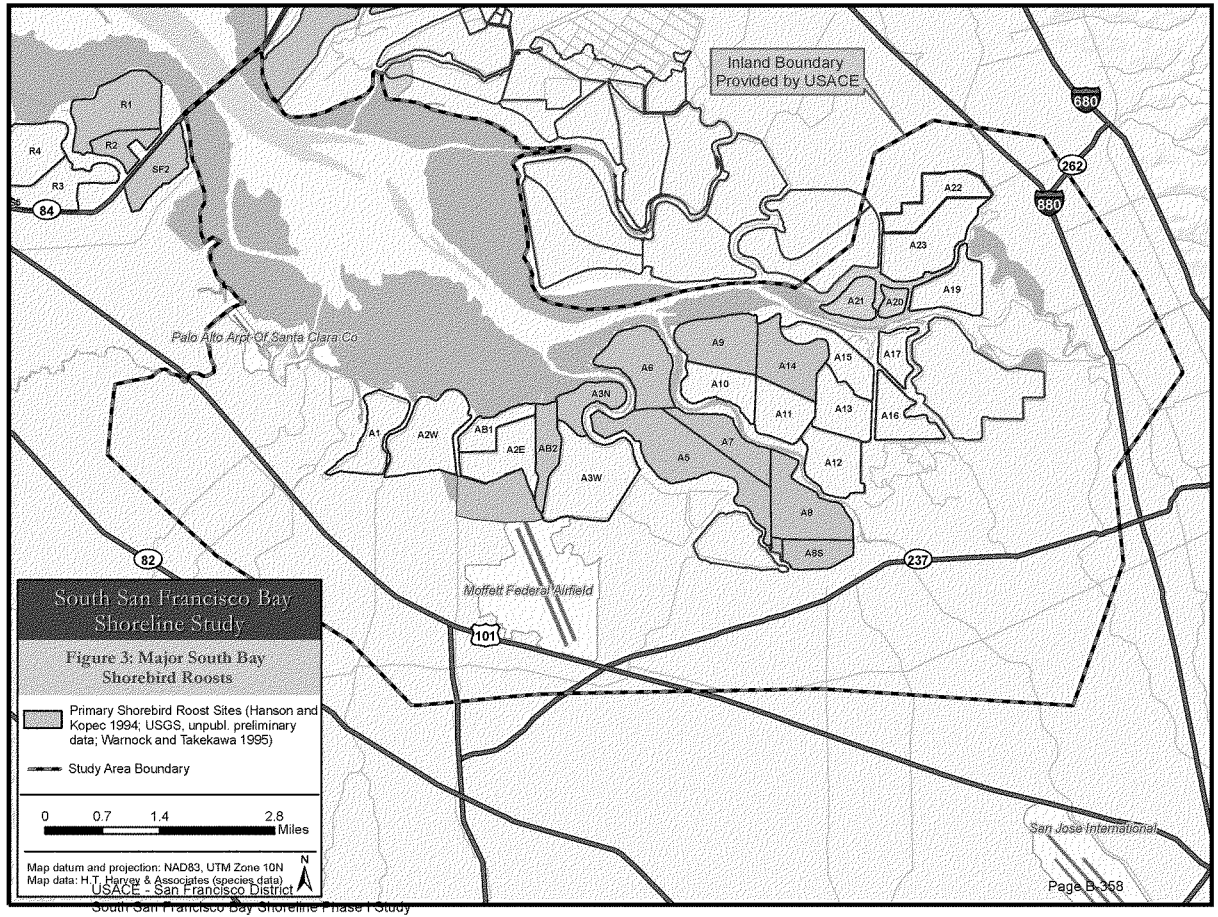
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Shoreline Study
Figure 3: Major South Bay
Shorebird Roosts
Primary Shorebird Roost Sites (Hanson and Kopec 1994; USGS, unpubl. preliminary data; Warnock and Takekawa 1995)
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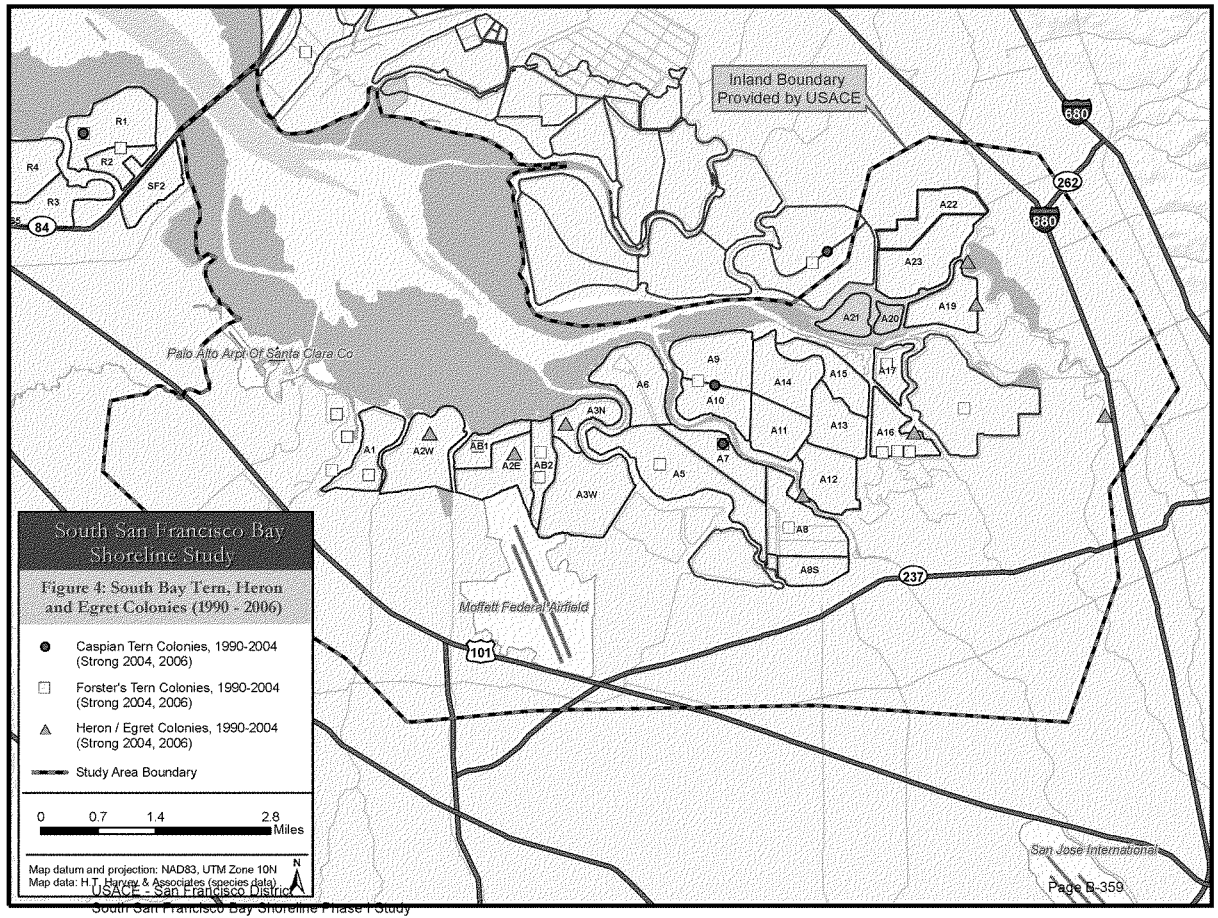
South San Francisco Bay Shoreline Study
Figure 4: South Bay Tern, Heron and Egret Colonies (1990 - 2006)
Caspian Tern Colonies, 1990-2004 (Strong 2004, 2006)
Forster's Tern Colonies, 1990-2004 (Strong 2004, 2006)
Heron / Egret Colonies, 1990-2004 (Strong 2004, 2006)
Study Area Boundary
0 0.7 1.4 2.8 Miles
Map datum and projection: NAD83, UTM Zone 10N
Map data: H.T. Harvey & Associates (species data)
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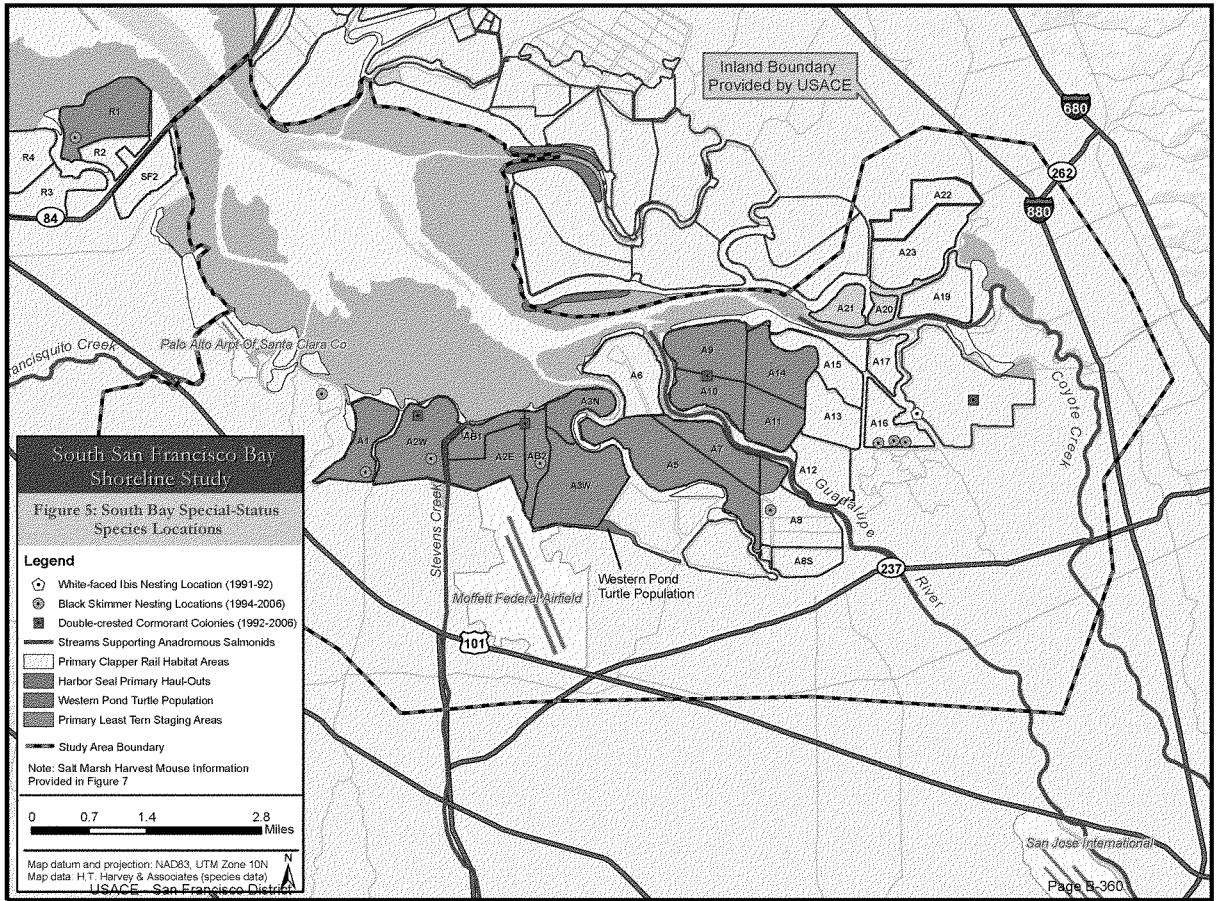
South San Francisco Bay Shoreline Study
Figure 5: South Bay Special-Status Species Locations
Legend
White-faced Ibis Nesting Location (1991-92)
Black Skimmer Nesting Locations (1994-2006)
Double-crested Cormorant Colonies (1992-2006)
Streams Supporting Anadromous Salmonids
Primary Clapper Rail Habitat Areas
Harbor Seal Primary Haul-Outs
Western Pond Turtle Population
Primary Least Tern Staging Areas
Study Area Boundary
Note: Salt Marsh Harvest Mouse Information Provided in Figure 7
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Map datum and projection: NAD83, UTM Zone 10N
Map data: H.T. Harvey & Associates (species data)
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Inland Boundary Provided by USACE
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Moffett Federal Airfield
Western Pond Turtle Population
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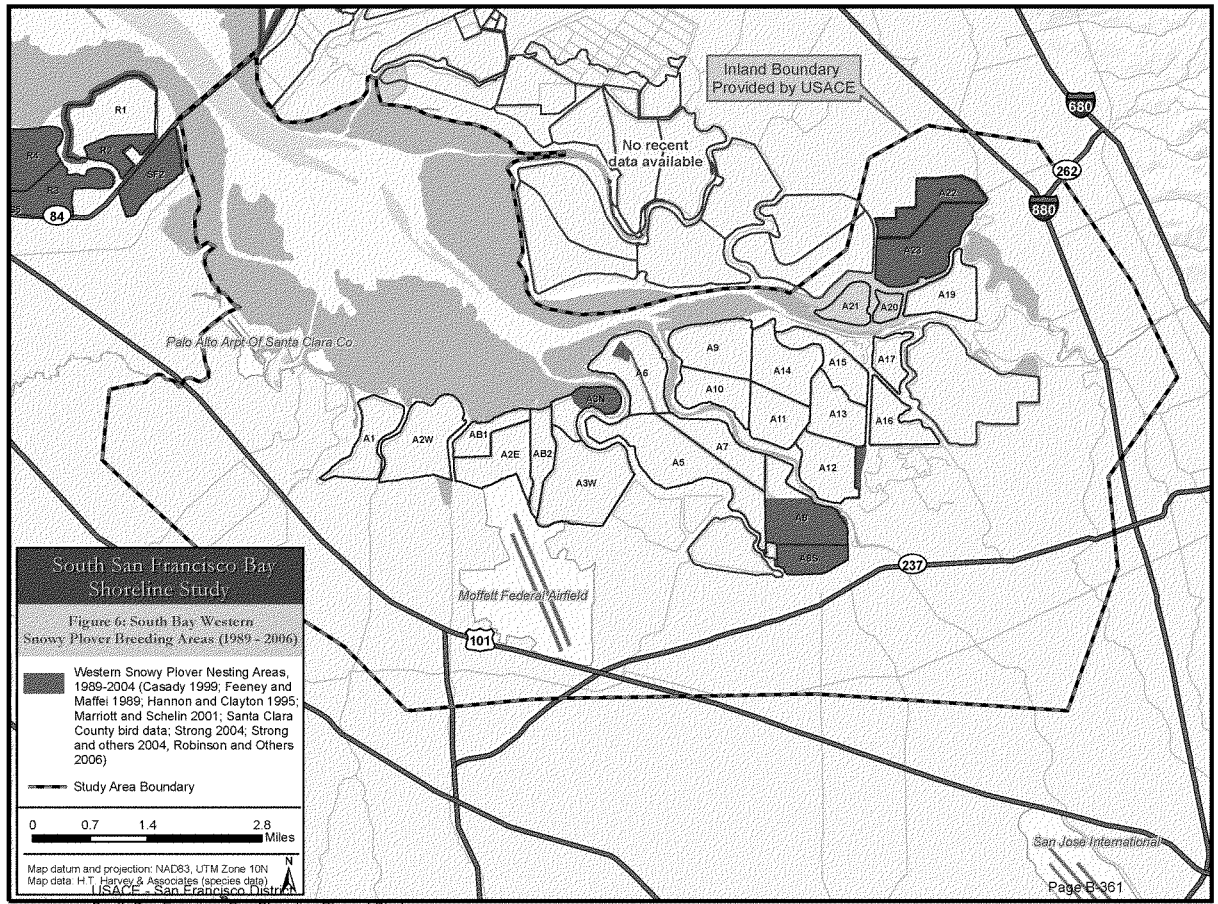
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South San Francisco Bay
Shoreline Study
Figure 6: South Bay Western
Snowy Plover Breeding Areas (1989 - 2006)
Western Snowy Plover Nesting Areas, 1989-2004 (Casady 1999; Feeney and Maffei 1989; Hannon and Clayton 1995; Marriott and Schelin 2001; Santa Clara County bird data; Strong 2004; Strong and others 2004, Robinson and Others 2006)
Study Area Boundary
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Map data: H.T. Harvey & Associates (species data)
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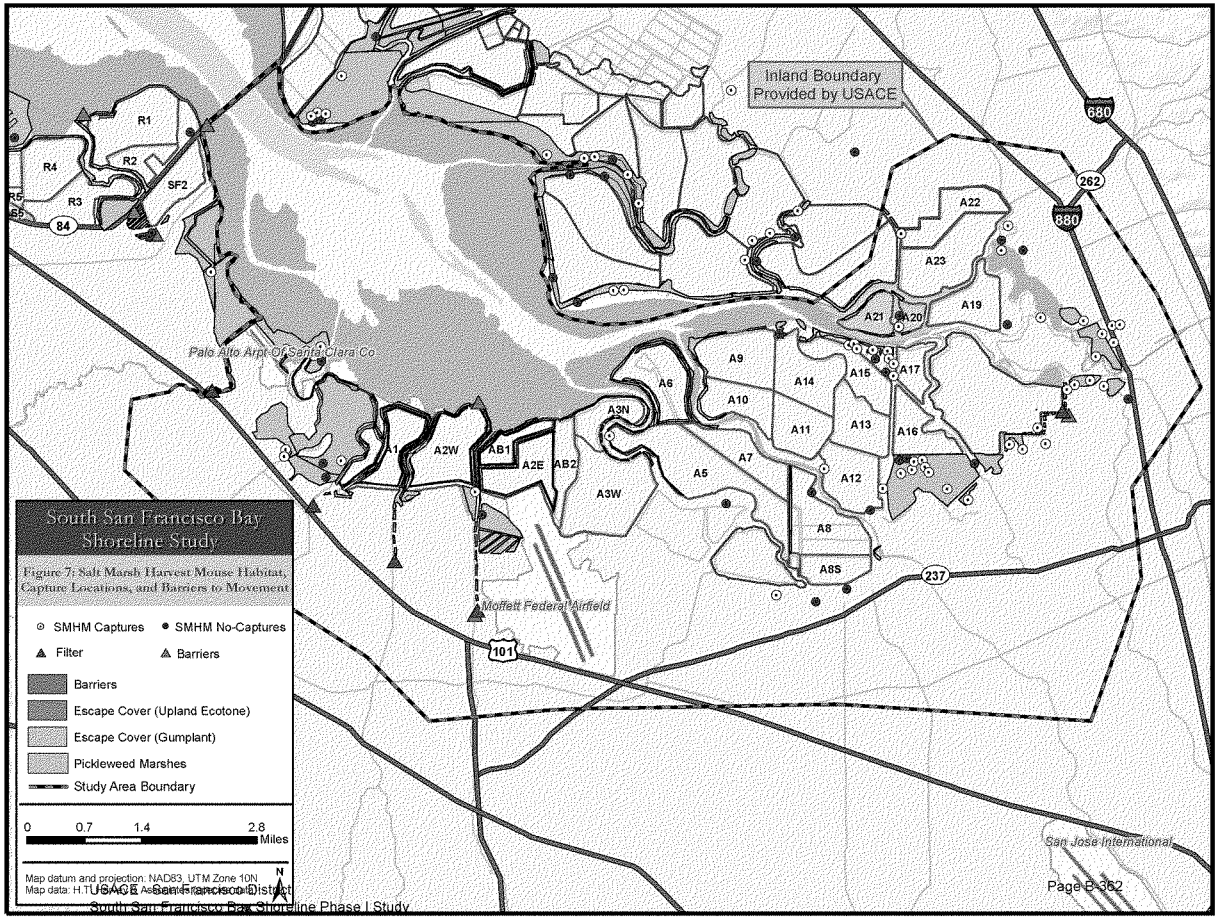
South San Francisco Bay Shoreline Study
Figure 7: Salt Marsh Harvest Mouse Habitat, Capture Locations, and Barriers to Movement
SMHM Captures
SMHM No-Captures
Filter
Barriers
Barriers
Escape Cover (Upland Ecotone)
Escape Cover (Gumplant)
Pickleweed Marshes
Study Area Boundary
0 0.7 1.4 2.8 Miles
Map datum and projection: NAD83, UTM Zone 10N
Map data: H.T. Harvey & Associates, San Francisco, CA
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Inland Boundary Provided by USACE
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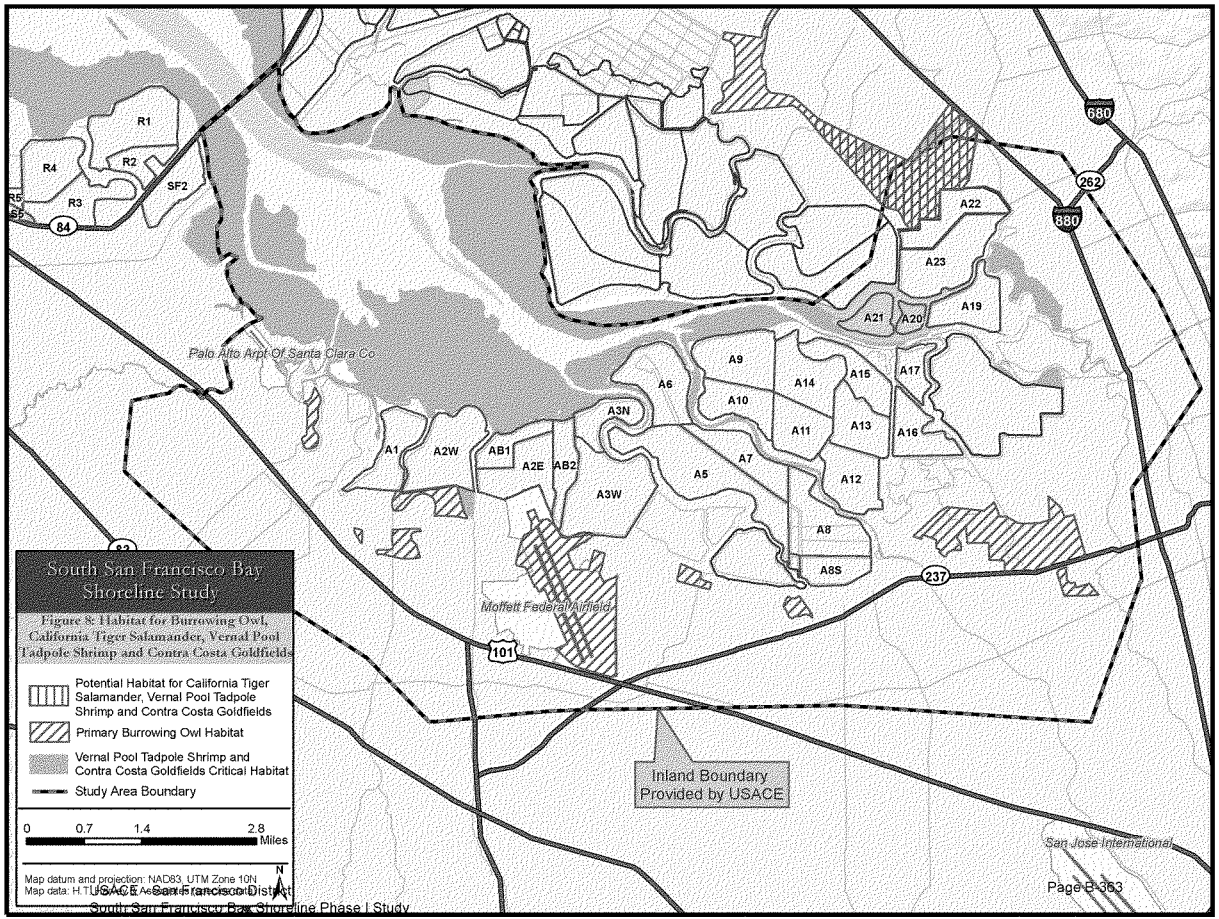

USACE, San Francisco District
South San Francisco Bay Shoreline Phase I Study
September 2015

Appendix A.

Special-Status Species Regulations Overview

Overview. Federal and state endangered species legislation gives special status to several plant and animal species known to occur in the vicinity of the Study Area. In addition, state resource agencies and professional organizations, whose lists are recognized by agencies when reviewing environmental documents, have identified as sensitive some species occurring in the vicinity of the Study Area. Such species are referred to collectively as "species of special status" and include plants and animals that are listed, proposed for listing, and candidates for listing as threatened or endangered under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA); animals listed as "fully protected" under the California Fish and Game Code; animals designated as "Species of Special Concern" by the CDFG; and plants listed as rare or endangered by the California Native Plant Society (CNPS) in the *Inventory of Rare and Endangered Plants of California* (2001).

ESA provisions protect federally listed threatened and endangered species and their habitats from unlawful take. Under the ESA, to "take" is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any of the specifically enumerated conduct." The U.S. Fish & Wildlife Service's (USFWS) regulations define harm as "an act which actually kills or injures wildlife." Such an act "may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering" (50 CFR § 17.3). Activities that may result in "take" of individuals are regulated by the USFWS. The USFWS produced an updated list of candidate species May 11, 2005 (50 CFR Part 17). Candidate species are not afforded any legal protection under ESA; however, candidate species typically receive special attention from federal and state agencies during the environmental review process.

Provisions of CESA protect state-listed threatened and endangered species. CDFG regulates activities that may result in "take" of individuals (*i.e.*, "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill"). Habitat degradation or modification is not expressly included in the definition of "take" under the California Fish and Game Code. Additionally, the California Fish and Game Code contains lists of vertebrate species designated as "fully protected" (California Fish & Game Code §§ 3511 [birds], 4700 [mammals], 5050 [reptiles and amphibians], 5515 [fish]). Such species may not be taken or possessed.

In addition to federal and state-listed species, the CDFG also has produced a list of Species of Special Concern to serve as a watch list. Species on this list are of limited distribution or the extent of their habitats has been reduced substantially, such that threat to their populations may be imminent. Species of Special Concern may receive special attention during environmental review, but they do not have statutory protection. USFWS also uses the label "Species of Special Concern" as an informal term that refers to those species that might be in need of concentrated conservation actions. Species of Special Concern receive no legal protection as a result of their designation as Species of Special Concern, and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species. However, most, if not all, of these species are currently protected by state and federal laws.

Vascular plants listed as rare or endangered by the CNPS, but which might not have designated status under state endangered species legislation, are defined as follows:

- List 1A Plants considered by the CNPS to be extinct in California.
- List 1B Plants rare, threatened, or endangered in California and elsewhere.
- List 2 Plants rare, threatened, or endangered in California, but more numerous elsewhere.
- List 3 Plants about which more information is needed – a review list.

Appendix B7

USFWS Coordination Act Report under the Fish and Wildlife Coordination Act

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08-FBDT00-
2015-CPA-0001

JUL 21 2015

Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, California 94103-1398

Dear Sir:

Please find enclosed our final Fish and Wildlife Coordination Act report for the U.S. Army Corps of Engineers' South San Francisco Bay Shoreline Phase I Study. This report has been revised based on comments on our June 25, 2015, draft report.

If you have questions on this final report, please contact Steven Schoenberg of my staff at (916) 414-6564, or at Steven_Schoenberg@fws.gov.

Sincerely,

K. Webb

Kim Webb
Acting Field Supervisor

Enclosure

cc:
Joseph Terry, Sacramento Fish and Wildlife Office, Sacramento, California
Anne Morkill, Refuge Manager, San Francisco Bay NWR, Fremont, California
William DeJager, San Francisco Corps of Engineers, San Francisco, California
Brenda Buxton, California Coastal Conservancy, Oakland, California
Tami Schane, California Department of Fish and Wildlife, Yountville, California
Rechelle Blank, Santa Clara Valley Water District, San Jose, California

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE SOUTH SAN FRANCISCO BAY SHORELINE PHASE I STUDY

PREPARED BY:

Steven Schoenberg, Senior Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Habitat Conservation Division
Bay Delta Fish and Wildlife Office
Sacramento, California

PREPARED FOR:

U.S. Army Corps of Engineers
San Francisco District
San Francisco, California

July 2015

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SUMMARY

The South San Francisco Bay Shoreline Phase I Study addresses the risk of tidal flooding and ecological restoration of former industrial salt ponds in an area of south San Francisco Bay between Alviso Slough and Coyote Creek. This project includes building an engineered levee 15.2 feet high along the Alviso North levee alignment to the west and the Water Pollution Control Plant South levee alignment to the east, a 30:1 ecotone on the bay side of those levees adjacent to Ponds A12/13 and A18, and a tidal flood gate at Artesian Slough, and conducting tidal restoration actions in Ponds A9-A18. The proposed levees are needed to allow the adjacent tidal restoration actions to proceed and to protect the community of Alviso and the San Jose Water Pollution Control Plant from flood damage and sea level rise. The tidal habitat restored would benefit a diversity of aquatic and terrestrial species, including the listed salt marsh harvest mouse and California clapper rail, and other native species. The tidal restoration would be phased beginning with Ponds A12 and A18. Monitoring and adaptive management would be used following the initial restoration phase to best ensure that alternative habitat needs are balanced without major effects on species groups, and to guide the fate and design of future phases. The U.S. Fish and Wildlife Service supports the selection of the locally-preferred alternative (alternative 3) and recommends implementation of the project as proposed.

INTRODUCTION

This document constitutes the U.S. Fish and Wildlife Service's (Service) detailed report on the U.S. Army Corps of Engineers' (Corps) South San Francisco Bay Shoreline Phase I Study (project). The project is a combined flood control and habitat restoration effort encompassing ~7,450 acres (ac) at the south end of the bay between Alviso Slough and Coyote Creek, just north of urban development in San Jose, including the San Jose/Santa Clara Water Pollution Control Plant (WPCP), a facility that serves 1.4 million residents in the region. About 2,900 ac are former salt ponds currently owned by the Service and City of San Jose. The area has experienced significant subsidence due to groundwater overdrafting which exacerbates the flood risk in urban areas and affects habitat values and restoration potential. Because of this subsidence, the flood control elements involving levee construction must precede opening up the ponds to tidal action for the purpose of restoration.

It is estimated that 85% of the historic tidal marshes in San Francisco Bay have been lost due to development, much associated with the salt industry. Industrial salt ponds provide significant habitat values to some wildlife species, but not the same types nor all of the values of fully tidal marsh and mudflat. These retired salt ponds require perpetual management of non-engineered levees to retain these functions and provide only a modest level of flood protection to adjacent urban lands. Tidal habitats provide for much greater values to a diversity of vegetation and forage for birds, fishes, and invertebrates, including listed species, with reduced management costs. Restoring large contiguous blocks of tidal habitat in San Francisco Bay has become a primary goal of major initiatives to improve conditions for fish and wildlife resources (Goals Project 1999; USFWS and CDFW 2007). In 2003, about 15,100 ac of former salt ponds around the bay were acquired by the Service and California Department of Fish and Wildlife, and tidal restoration (among other actions such as enhancement of managed ponds) has been initiated in select ponds in 2008-2014 under Phase I of the South Bay Salt Pond Restoration Project (SBSPRP), including in the vicinity of the proposed project. Over the long term, the SBSPRP has a bay-wide goal to shift the habitat distribution from predominantly managed ponds to at least 50% tidal marsh by 2030 and to 90% tidal marsh over the longer term if wildlife needs can be balanced. While adjacent to and sharing the same goals and approach as the SBSPRP, the proposed project is a separate but related and complementary project to the SBSPRP effort.

There are a number of significant uncertainties which should be considered for tidal restorations in the South Bay generally that apply to the proposed project. The non-tidal ponds are heavily used by some wildlife species adapted to the water depth and salinity, conditions which will change with tidal restoration. When exposed to tidal action, these ponds will transition first to tidal mudflat and open water and then to mostly vegetated tidal marsh over the long term. Responses of wildlife populations to the conversion of non-tidal to tidal habitat cannot be easily predicted because they can depend on a variety of factors such as breeding grounds elsewhere (for migratory species), and the capacity of the remaining ponds to support populations. Tidal channels and adjacent fringe marsh will be expected to erode relatively soon after initial breaching due to the large increase in tidal prism, and perhaps rebuild over the long term as sediment accretes and the tidal prism is reduced. Salient processes in marsh evolution like sediment accretion and channel scour can only be coarsely estimated from models, and model predictions may differ from actual processes observed in the field. Other uncertain factors

include the ability to manage non-native vegetation in restored tidal marsh, and the effect of mercury present in sediments in the Alviso area which may be mobilized by restoration actions. Because of these unknowns, only the initial phase in tidal pond restoration is affirmed for certain (Ponds A12 and A18). Thereafter, monitoring and adaptive management will be applied to inform resource managers and guide decisions on the fate of the remaining ponds in the project area.

The non-Federal sponsors, the California Coastal Conservancy and the Santa Clara Valley Water District, have identified a preferred alternative which the Corps intends to recommend for Congressional authorization. The purpose of this report is to provide the Service's analysis of the project alternatives, our recommendation regarding implementation of the preferred alternative, our evaluation of the effects of the preferred alternative on resource values, and our recommendations, if any, for project refinement or related aspects. In letters of December 26, 2012, and October 21, 2014, we expressed support for a new levee alignment along the Alviso railroad spur to the west, and to the south of Pond A18 near the WPCP to the east (also called the WPCP South alignment). In our letter dated March 31, 2015, we withdrew this recommendation, and instead recommended the Alviso Slough North and WPCP South alignment, the same levee alignment described in the preferred alternative. A draft version of this report was provided for comment to the Corps and key stakeholders on June 25, 2015.

Information considered in this final report includes: (1) the Shoreline Phase I Study Draft Interim Feasibility Report and Environmental Impact Statement Report, prepared December 2014 (Corps 2014); (2) observations and information gathered during a site visit on May 7, 2015; (3) a memorandum on modeling of accretion and habitat conditions for preliminary alternatives for the project (ESA PWA 2012); (4) documents on the SBSPRP available on the internet (http://www.southbayrestoration.org/); (5) documents on the results of contracted habitat assessments (NHI 2012, 2014); (6) comments on the draft version of this report; and (7) other information in our files including, but not limited to, formal and informal communications.

PHYSICAL SETTING

The project study area is located at the south end of San Francisco Bay between Alviso Slough and Coyote Creek (Figure 1). It includes New Chicago Marsh (NCM), a diked saltwater wetland, the San Jose/Santa Clara Water Pollution Control Plant (WPCP), Zanker landfill, and various former industrial solar salt ponds (Ponds A9-A15, A18). The WPCP includes active and retired sewage ponds. Most of the salt ponds and NCM are owned and managed by the Service for wildlife, with the exception of Pond A18 which is owned by the City of San Jose. There are various types of ponds (muted tidal/diked, batch, circulation) and other habitats discussed in more detail below (see Resource Categories and Mitigation Goals). Artesian Slough carries freshwater in the form of treated effluent from the WPCP to Coyote Creek, and is parallel to another unnamed tidal ditch which receives local runoff. Overall, the project area is about 7,450 ac of which 1,704 ac are some form of upland, 1,317 ac are a type of wetland, and 4,429 ac are a type of open water. There are another ~5,000 ac of other ponds in the Alviso pond complex that are adjacent to but not within the project area. These are in various states of restoration, enhancement, or are planned for such in the future under the SBSPRP. Much of the project area has experienced subsidence owing to groundwater withdrawal; we estimate the current ground

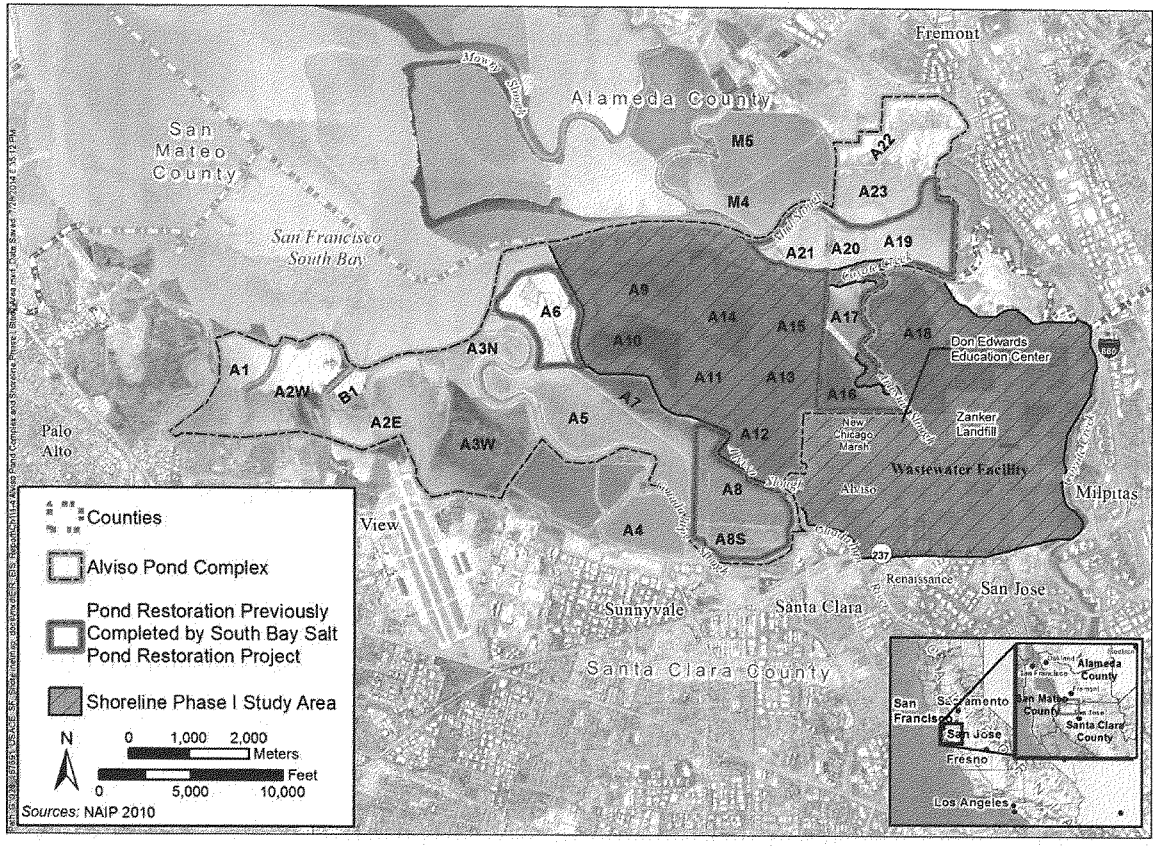

Figure 1. Area map for the SBSPRP Phase 1 actions and the South San Francisco Bay Shoreline Phase I Study project (Corps 2014).

elevations for ponds in the study area to vary from about 2.4 to 5.3 feet below mean tide level depending on the pond.

BIOLOGICAL RESOURCES

Studies of biological resources in the project area have been recently summarized (Harvey 2007) and various other studies have been carried out or commissioned by the Service (e.g., Amato and Vallopi 2015), the SBSPRP (http://www.southbayrestoration.org/), the San Francisco Estuary Project (e.g., Goals Project 1999), and other interests (e.g., Siegel and Bachand 2002; SFBO et al. 2008). Despite major historical losses of tidal wetlands, the project area still has significant habitat today that supports an array of fish and wildlife species, including rare, endemic, and/or listed species. San Francisco Bay as a whole, of which the study area is part, is of regional importance to migratory waterfowl and commercial fish species.

Fish: San Francisco Bay supports about 100 fish species and has been studied specifically to some extent for both tidal waters and pond habitats in the vicinity of the project area (Hobbs 2012). Hobbs (2012) observed a winter assemblage of species that tolerate a range of salinity such as longfin smelt, American shad, and Pacific herring. The summer assemblage included highly salinity and temperature tolerant species like Pacific staghorn sculpin and three-spine stickleback, both of which are also found in low-salinity ponds. The most abundant fish overall were Pacific staghorn sculpin, English sole, and northern anchovy. Harvey (2007) noted the most abundant fish in trawls of nearby open bay waters were northern anchovy, shiner surfperch, longfin smelt, white croaker, Pacific staghorn sculpin, bay goby, plainfin midshipman, English sole, and others. The dominant fish at beach seine stations were topsmelt, arrow and yellowfin goby, and jacksmelt. Results of slough channel sampling varied with the study, but were similar, with anchovy, staghorn sculpin, topsmelt, American and threadfin shad, longjaw mudsucker, longfin smelt, and others (Harvey 2007). Many of these same fish and others such as bat ray and leopard shark are also found in tidal sloughs and mudflats when inundated. The primary fish species in the lower salinity ponds are topsmelt, threespine stickleback, longjaw mudsucker, rainwater killifish, and yellowfin goby. Freshwater and freshwater tolerant species are present in Artesian Slough, such as Sacramento sucker, American shad, threespine stickleback, and common carp. No fish are present in ponds with a salinity greater than 100 parts per thousand.

Birds: The South Bay is recognized as contributing significant habitat support for a diverse and abundant bird community of resident and migratory birds, including several special status species. Shorebirds are the most abundant with an estimated 1 million resident and migrant shorebirds bay wide (SFBO et al. 2008). Most species are mudflat specialists, foraging at low tide in the project area generally in the vicinity of Coyote Creek and Alviso Slough. These include western and least sandpipers, dunlin, red knot, dowitchers, willet, long-billed curlew, and marbled godwit. These species could also use shallow waters of managed ponds at high tide. Other species tend to be pond specialists, such as phalaropes, black-necked stilt, American avocet, the threatened western snowy plover, pelicans, gulls (large populations in the project area), and terns. For these pond specialists, the ponds provide higher-quality nesting and/or foraging habitat than tidal habitats. Ponds and their levees are sometimes used by birds as refugia from wind and storm events.

Diving ducks are the most abundant wintering waterfowl, and include scaups, ruddy duck, canvasback, bufflehead, surf scoter, common goldeneye, and red-breasted merganser. The most abundant dabbling duck is the northern shoveler, followed by American wigeon, northern pintail, mallard, and gadwall. Use of South Bay ponds by dabbling ducks has increased from 2004-2011 (Pitkin and Wood 2011).

There are a number of species of large waders and other fish-eating birds present in the area including grebes, herons, cormorants, and egrets. The relatively uncommon white-faced ibis is known from Artesian Slough in the project area. Some other important birds in the project area include eared grebe, American coot, the State-listed as threatened California black rail, and the federally-listed as endangered California clapper rail (also called Ridgway's rail). There are various insectivorous passerine birds in the project area although the only nesting species are the marsh wren, Alameda song sparrow, and savannah sparrow.

Mammals: In the project area, there are mostly common species of mammals typical of the urban-wildland interface such as raccoon, opossums, rats, mice, and skunk. Other small mammals include the federally-listed endangered salt marsh harvest mouse and salt marsh wandering shrew (a California species of special concern), as well as more common species of bat, squirrel, rabbit, and fox. The Pacific harbor seal is the only marine mammal present in the area. Several non-native mammals are present such as Norway rat, red fox, and feral cat, all of which are subject to refuge control and removal under an ongoing predator management plan.

Vegetation: Vegetation in the project area has been recently mapped including tidal and non-tidal (muted tidal/diked) salt marsh, brackish marsh, and freshwater marsh. There are 322 ac of tidal salt marsh in the project study area, mostly along the bayward portions of Coyote Creek and Alviso Slough, with some additional tidal salt marsh just outside the project area in recently-restored Pond A17. Brackish marsh (432 ac) is found slightly farther upstream along the creek and slough, as well as in Triangle Marsh (just west of Pond A17) and along some of Artesian Slough. Freshwater marsh (93 ac) is restricted to the upper portions of Artesian Slough. Upland vegetation, mostly non-native grassland, is present in minor amounts on the various levees bordering the ponds, with much more present outside the project footprint in and around Zanker Landfill. The majority of the project area bayward of the proposed levees is unvegetated and consists of pond interior areas of open water or mudflat, a small area of pond islands, and barren portions of the levee subject to wavewash. Based on our May 7, 2015 site visit, shallower portions of Pond A18 do exhibit sparse vegetation, even though it is mapped as open water.

Several nonnative plant species are present in the project area but have not been quantified. The most significant of these which deserve management attention are smooth cordgrass (*Spartina alterniflora*) in tidal areas and perennial pepperweed (*Lepidium latifolium*) in many wetlands as well as in upland areas.

Listed Species: The following is basic information on special status species; for detailed information on these species, project effects, project-proposed avoidance and minimization measures, and terms and conditions, see the Service's Biological Opinions to the Corps and Service Refuge dated April 27, 2015 (USFWS 2015a-b).

Several special status fish species in the study area include chinook salmon, steelhead trout, green sturgeon, and longfin smelt. All are anadromous, spawning seasonally in freshwater. Salmon and steelhead spawn in Coyote Creek, the Guadalupe River, and other area streams, and are seasonally present in the project area during migration and rearing periods. Green sturgeon would be expected to forage in estuaries and bays including the South Bay and sloughs in the project area, but there are very little data on this species in the project area. Longfin smelt is much more abundant, and has been seasonally documented as part of the winter fish assemblage in the tidal sloughs in the project area.

Federally-listed bird species in the project area include the endangered California clapper rail and threatened western snowy plover. According to our Biological Opinions for this project, the rail has been occasionally detected along Alviso, Coyote, and Guadalupe Sloughs in the project area and most often near the mouth of Alviso Slough and around Triangle Marsh near Coyote Slough. According to Corps (2014), the plover breeds in and near the study area including ponds A13, A16-17, and A23, with additional birds present in the project area during winter. Nests have also been detected in the last 5 years in NCM and Pond A9 (personal communication, Strong 2015) The native habitat of the plover is tidal beach sand, although it is known to use salt ponds and levees. California clapper rails are generally associated with saltwater marshes dominated by pickleweed and Pacific cordgrass where they nest. They also forage along the edges of tidal channels.

The endangered salt marsh harvest mouse is the only federally-listed mammal species in the project area. It is typically associated with dense cover areas of tidal marsh, usually pickleweed but sometimes alkali bullrush in brackish marshes. In the South Bay, it has been captured in NCM, fringe marshes along various tidal creeks, Triangle Marsh, and the margin lands between Pond A18 and the WPCP (Figure 7 *in* Harvey 2007). NCM appears to have one of the largest blocks of pickleweed habitat outside of Triangle Marsh, as well as multiple captures of salt marsh harvest mice.

COVER-TYPES, RESOURCE CATEGORIES, AND MITIGATION GOALS

The Service's Mitigation Policy (Policy) (FR 46:15 January 23, 1981) provides general guidance in making recommendations to conserve fish and wildlife resources. Under the Policy, resources are assigned to one of four Resource Categories, with a mitigation goal consistent with the values provided to fish and wildlife and the rarity of that habitat (cover-type). A mitigation goal is assigned ranging from "no loss of existing habitat value" (Resource Category 1) for the most valuable kinds of habitat to "minimize loss of habitat value" (Resource Category 4) for the less valuable and most common kinds of habitat. Application of the Policy involves designating cover-types which may be affected and assigning evaluation species based on the sensitivity of those species to the project action, their role in the ecosystem, or association with Service-wide resource management issues such as anadromous fish and migratory birds. We then state the Resource Category, the rationale for that selection, and the corresponding mitigation goal.

For this project area, we have designated seven basic cover-types within the project area and adjacent areas affected by the project. If a cover-type is considered unaffected both directly and indirectly by the project, it is not discussed here. Due to differences in water depth and/or

salinity, there may be several more specific habitats within these cover-types, which are noted below.

Subtidal slough/channels: These are represented by the unvegetated, consistently open waters of Alviso Slough, Artesian Slough and Coyote Creek. These are used as habitat by numerous resident and migratory fishes during all tide levels and by an array of birds which forage at the interface between the fringe marsh and the channel, including the endangered California clapper rail. Such channels carry sediment and organic matter between marshes, upland watersheds, and bay waters that are important for sustaining the productivity of the bay and marsh as well as maintaining the marsh elevation in the face of rising sea level. Pond breaching would create a larger tidal prism which may cause channel enlargement at the expense of fringe marsh, and would eventually create more channels within the restored ponds. Appropriate evaluation species would be the longfin smelt and Pacific staghorn sculpin. Slough/channel habitat has been reduced in extent and quality during the historic loss of tidal wetlands and extensive shoreline development to the edge of many channels in the Bay area. Due to the vital importance of the slough/channel network, it is designated Resource Category 2, with a mitigation goal of no net loss of in-kind habitat value.

Open bay waters: Open waters are represented by unvegetated, permanently inundated areas of south San Francisco Bay below mean lower low water. These waters would not be directly affected by project actions, but would indirectly benefit from the transport of organic matter and food organisms from tidal marsh restored by the project. This cover-type is important for saltwater fish species and diving ducks like canvasback and scaups. An appropriate evaluation species would be one of the numerically abundant resident fish, such as topsmelt. Bay waters have been indirectly affected by tidal marsh loss and urban pollutants and contaminants, but direct losses from fill have been limited and it remains regionally abundant. For this reason, we designate it Resource Category 3, with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value.

Non-tidal pond waters: Non-tidal ponds constitute most of the project area which would be directly affected by the project. The ponds vary in depth, circulation, and chemistry. There are about 2,000 ac of somewhat lower salinity "circulation ponds" maintained by circulating bay water through a series of ponds linked by water control structures. These ponds support some species of saltwater resident fish in addition to benthic and pelagic invertebrate forage organisms. They are used by dabbling and diving ducks, and other bird groups, depending on depth for forage and shelter. About 800 ac of the project area are called "batch" ponds because there is less circulation and a higher maintained salinity. These ponds do not have fish but have abundant brine shrimp and brine flies that provide forage for other birds like eared grebes, phalaropes, and shorebirds. At least some of these ponds, and potentially all of them, would be converted to tidal marsh with the project. As evaluation species, we would select a resident shorebird such as the American avocet for the batch ponds, and a duck such as the northern shoveler for the circulation ponds. Non-tidal pond waters are moderately abundant, providing significant habitat to these evaluation species, and replacing some of the functions of higher marsh salt pannes in the historical landscape. Due to this abundance and medium-to-high value to the evaluation species, we designate it Resource Category 3, with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value.

Microtidal/diked pond waters: This type of pond is represented by NCM (340 ac) in the project area. It receives water through a control structure through the levee bordering Pond A16, and water levels vary minimally. This cover-type has some of the same features as fully tidal marsh in terms of vegetation and chemistry, but with lower plant and fish diversity. The lack of tidal connection means that bird foraging on this cover-type may occur throughout the tidal cycle, but also that it does not contribute organic material to bay open waters, nor provide value for migratory fish. In the study area, this cover-type provides important habitat support for the listed salt marsh harvest mouse, western snowy plover, and California clapper rail, as well as for Forster's tern, black-necked stilt, American avocet and other small shorebirds. With the proposed project, a small portion of this pond would be directly affected by levee construction, and levee overtopping and associated flood effects would no longer occur. A shorebird like the black-necked stilt would be an appropriate evaluation species. Due to the modest diversity and ecological function, but high use by some bird species, and medium-to-high value to the evaluation species, we designate it Resource Category 3, with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value.

Tidal emergent marsh: In the project area, tidal emergent marsh presently occurs mainly as a fringe marsh of varying width along Alviso Slough, Artesian Slough and Coyote Creek. Tidal restoration elements of the project would affect the quantity of this cover-type because the increased tidal prism would cause erosion of this fringe marsh. Over a longer period of up to several decades or more, the breached pond interiors would accrete sediment to the point at which vegetation would colonize the surface. Species composition varies with salinity and elevation, contributing to a high diversity of plants and wildlife which use this cover-type. Dominant vegetation species in the project area are cordgrass, pickleweed, and saltgrass, along with other salt tolerant species. This cover-type provides significant, high value habitat to an array of mammals like the salt marsh harvest mouse, birds such as the marsh wren and clapper rail, and many fishes. Additionally, tidal emergent marsh produces organic matter that supports invertebrate and small fish forage organisms, that in turn are used by fish-eating birds and larger predatory fish. It is also a nursery ground for juvenile estuarine fish and invertebrates. An appropriate evaluation species would be a tidal marsh specialist like the marsh wren or black rail. The value of tidal marsh increases disproportionately with unit size, making it important to plan restoration projects with large contiguous units. Regionally, most of the tidal marsh has been lost due to conversion to industrial salt production and other coastal development. Due to this regional scarcity and very high values to the evaluation species, we designate tidal emergent marsh as Resource Category 2, with a goal of no net loss of in-kind habitat value.

Mudflat: Mudflats are substantially unvegetated tidal areas between mean low and mean lower low water that are regularly exposed during low tide. Mudflats are present along the margins of lower Coyote Creek and Alviso Slough, and more exists just outside the project area in ponds which were recently breached (Ponds A7, A19-21). With the project, much more mudflat would form as an interim habitat in breached ponds exposed to tidal action as sediment accretes. Over the longer term (after 30-50 years), sediments would accrete to the point that vegetation would colonize the surface and these interim mudflats would decline. Mudflat areas typically have a productive benthic community which provides forage for the shorebirds which specialize on them, as well as for gulls, terns, larger wading birds like herons and egrets, and ducks (see *Birds*, above). At higher tide stages, fish enter the mudflats and forage. Shorebird species which

specialize on recently exposed mud such as the western and least sandpiper would be appropriate evaluation species. While some mudflat has been lost due to fill and urban development, it has not been affected to the same extent as tidal emergent marsh. Due to the moderate amount of mudflat, and its high importance to the evaluation species, we designate mudflat as Resource Category 2, with a goal of no net loss of in-kind habitat value.

Upland: Upland in the project area occurs mostly as non-native annual grassland habitat on levee slopes, some of which would be temporarily disturbed by new levee construction. It supports common small mammals and passerine birds, many of which are non-native. A native species like the California vole would be an appropriate evaluation species. A modest area of upland adjacent to tidal emergent marsh has some value as a refugium for mammals like the salt marsh harvest mouse during tidal flood events. Considering its moderate abundance and value, we designate upland as Resource Category 4, with a mitigation goal to minimize loss of habitat value.

ALTERNATIVES

The Corps developed project alternatives using different combinations of flood risk management options for the Alviso segment levee alignment, levee height, and construction of transitional habitat on the outboard side of the levee adjacent to Ponds A12 and A18. The levee alignment also affects the extent of restoration. For all of the action alternatives, *common elements* would be: in-pond preparations in advance of tidal restoration, tidal restoration of Ponds A9-15 and A18, tide gates at Artesian Slough and a railroad crossing, a south alignment of the WPCP levee (no alignment options), replacing the siphon between Pond A16 and NCM, providing an alternative mechanism for brackish water transfer to a nontidal marsh area just south of Pond A18 and east of Artesian Slough, creating a small berm breach to restore freshwater flow between Artesian Slough and a parallel unnamed ditch and adjacent marsh to the west, staging areas, and recreational trails. Levees would be constructed of engineered earth fill and have 3:1 (horizontal:vertical) slopes. The components of the advance preparation for tidal restoration include: draining ponds and removing vegetation; internal fill features such as ditch blocks; internal dike lowering and internal breaches; and stabilizing pond dikes inboard of ponds to be breached. After this preparation, external channel work such as pilot channels would be completed, followed by the breaching and/or lowering of the outboard levees. Additionally, the sequence of restoration involves early tidal restoration of Ponds A12 and A18, with possible tidal restoration of the rest of the ponds to follow if warranted after 4-10 years of monitoring (Figure 2). The Corps would initially conduct actions on Ponds A12 and A18. For the purpose of this report, we assume that the monitoring, funding, and other considerations will lead to a decision by the Corps to proceed with future tidal restoration of the remaining Ponds A9-11 and A13-15.

Levee alignment options: The alternatives discussed below involve three options for the Alviso segment of the project (i.e., west of Artesian Slough) (Figure 3). The Alviso North alignment follows the western and northern outer levees of NCM along the margins of Ponds A12, A13, and A16. This alignment would exclude NCM from tidal restoration in the future, protect it from flooding, and preserve its current state as a diked marsh. The Alviso South alignment follows

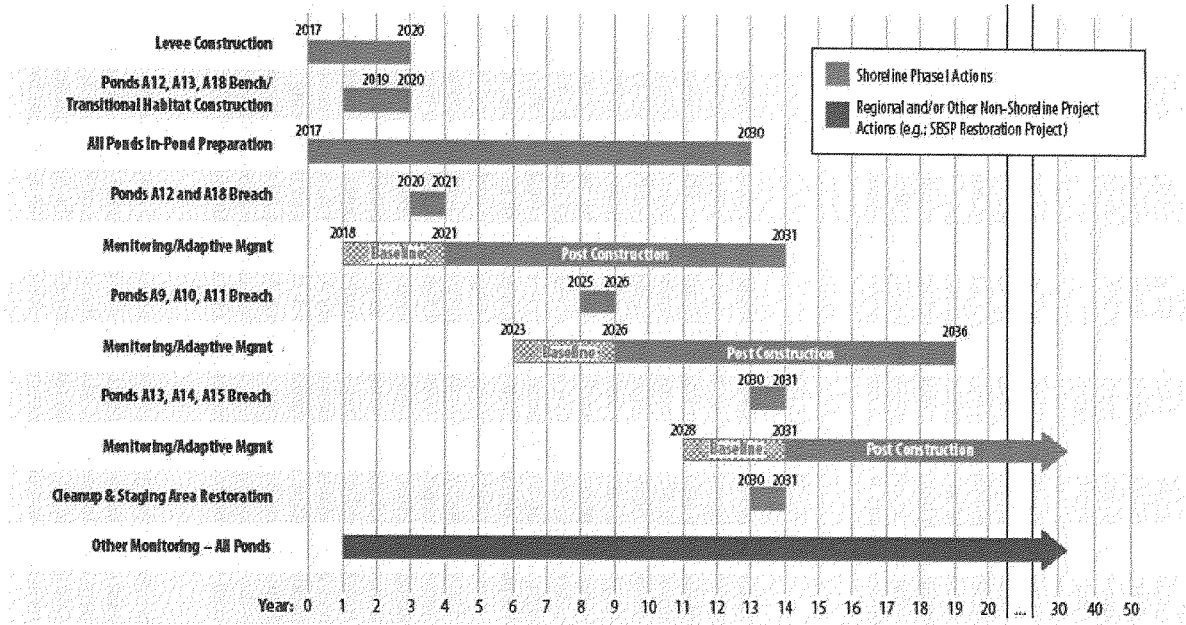

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Figure 2. Construction Schedule for the South Bay Shoreline Phase 1 Study (personal communication, HDR 2015).

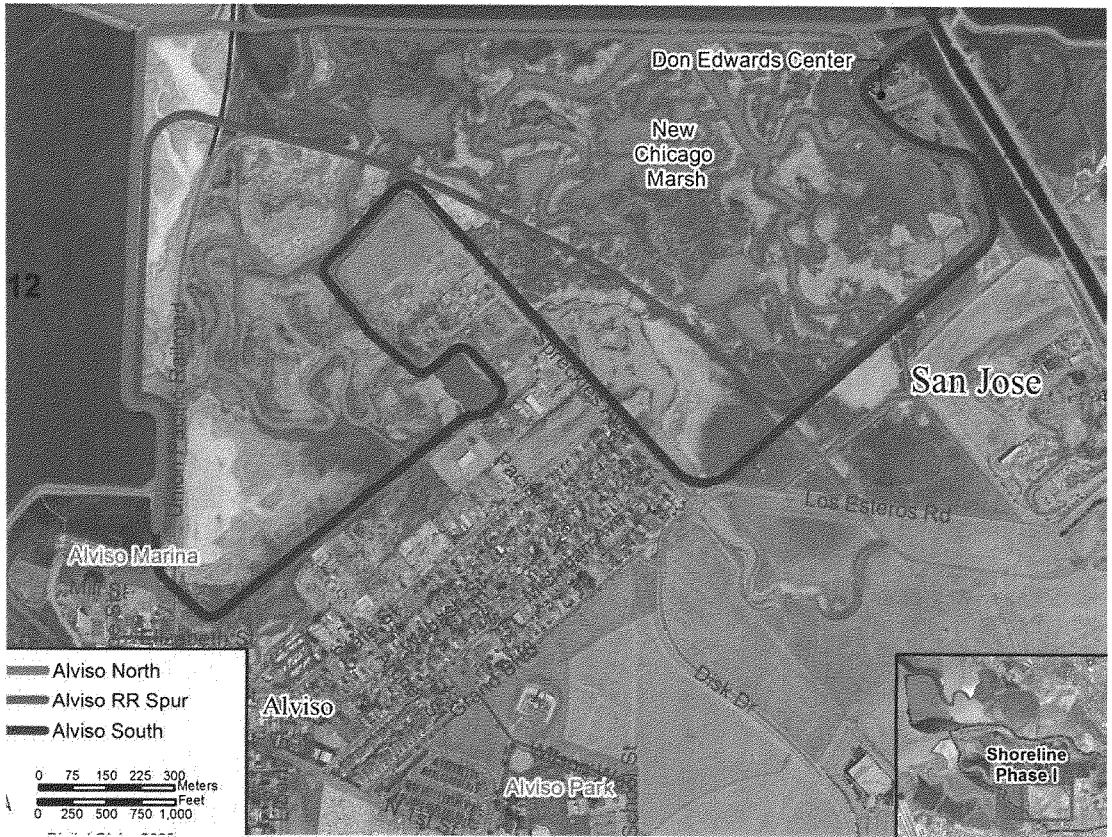

Figure 3. Alviso segment levee alignment options (Corps 2014).

the outer, generally south border between NCM and the town of Alviso, and would affect about 20 ac of diked marsh and 15 ac of developed land. This alignment would not protect any of NCM from flooding and it could be restored to tidal marsh. The Alviso Railroad Spur alignment follows some of the border of Pond A12, and then goes along an existing railroad spur levee through NCM. With this alignment, the roughly one third of the NCM area south of the new levee would be protected from flooding and would remain diked marsh. The area north of the new levee could be restored to tidal marsh.

Levee height options: The alternatives discussed below involve two options for levee height in addition to the no-project alternative. Recent history shows significant past flooding in Alviso about three times in the last 40 or so years due to overtopping of the slough levees. With the completion of flood control projects on Guadalupe River and lower Coyote Creek, the remaining risk is tidal flooding from the bay overtopping non-engineered levees. Under the no-project alternative, the risk of overtopping of the current, non-engineered levee is estimated at 1 in 3 years for the year 2017, which will rise to 1 in 2 years by the year 2067 due to sea level rise. For the 13.5-foot-high option, the chance of overtopping by the 1-percent event is reduced to 0.1-11.8% per year by year 2067, depending on the sea level rise scenario. The 15.2-foot-high option is two feet above the 1% event for year 2067, would meet FEMA accreditation, and would not be overtopped by the 1% event. The 15.2-foot levee height option is locally preferred and is the Corps proposed project height.

Transitional habitat options: There are two transitional habitat options, a 50-foot-wide flat bench with a steep slope into the pond bottom, and a broad, 30:1 sideslope "ecotone", about 350-feet wide (Figure 4). This transitional habitat would be built on the bayward side of the levee work bordering ponds intended for tidal restoration (Ponds A12, A13, and A18). No bench or ecotone would be constructed adjacent to Pond A16 because it would remain a managed pond. The bench or ecotone would be constructed of non-engineered fill. The 50-foot bench would be grassland, but the edge of the steep slope could have narrow bands of marsh. For the ecotone, the first 15 feet where it meets the levee would be maintained to low grass at most in accordance with Corps policy (Engineering Technical Letter 1110-2-571). The rest of the ecotone would be unmanaged (no mowing) and allowed to establish on its own to include herbaceous species like cordgrass, pickleweed, and other marsh plants, with occasional woody plants up to 5-feet-tall. Due to the scarcity of transitional habitat currently, either option would provide benefit in the forms of high tide refugium and early marsh habitat. However, there would be much more such benefit for the ecotone than for the bench option.

Alternative 1 (No-Project): Under the no-project alternative, no actions would be taken for flood risk management or ecosystem restoration. The Service would conduct the same types of maintenance of the existing levees as it does today, however, it is acknowledged that these are non-engineered levees and at insufficient height and quality to withstand tidal floods. As such, these levees would be expected to fail under moderately large events. This would be followed by attempts to repair the levees and restore pre-flood conditions.

Alternative 2: This alternative would combine the common elements with the Alviso North levee alignment (the current north border of NCM), a 13.5 foot levee height throughout, and a

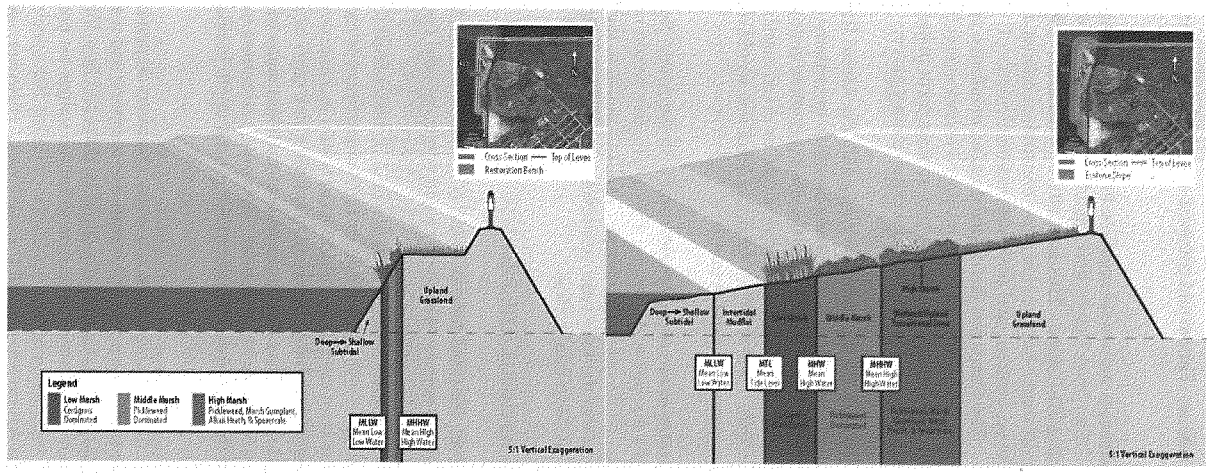

Figure 4. Transitional habitat options: Left - 50-foot-wide "bench"; Right - ~350-foot-wide "ecotone" (from Corps 2014).

flat 50-foot-wide bench as transitional habitat. This would preserve all of NCM in its present state as a diked tidal marsh.

Alternative 3: This is the preferred alternative and would combine the common elements with the Alviso North levee alignment, a 15.2 foot levee height throughout, and a broad, ~350-foot-wide transitional habitat constructed with a 30:1 slope. This alternative would also preserve all of NCM in its present state as a diked tidal marsh but provide more transitional habitat and more flood protection. The locations of the levee, ecotone, and pond restoration elements of Alternative 3 are illustrated in Figure 5. The Corps has developed detailed avoidance and minimization measures for this alternative. The Corps has also proposed enhancement of breeding substrate on one island in Pond A16 and enhanced predator management in key locations as compensatory conservation measures for impacts to western snowy plover.

Alternative 4: This alternative would combine the common elements with the Alviso Railroad alignment, a 15.2 foot levee height throughout, and a 50-foot-wide bench as transitional habitat. This alternative would protect about a third of NCM from tidal flooding and allow continued management as diked marsh. The remainder of NCM could be managed as diked marsh in the short term or actively restored to tidal marsh. Over the long term, sea level rise would overtop the non-engineered levees, exposing this portion to tidal action.

Alternative 5: This alternative would combine the common elements with the Alviso South alignment, a 15.2-foot levee height, and a 50-foot-wide bench. This alternative would not protect any of NCM from tidal flooding. NCM could be managed as diked marsh in the short term or actively restored to tidal marsh. Over the long term, sea level rise would overtop the non-engineered levees, exposing all of NCM to tidal action.

FUTURE WITHOUT THE PROJECT

Without the project (no-action alternative), the pond habitat would continue in the immediate term as managed open water, with relatively narrow tidal sloughs and fringes of tidal emergent marsh. The batch and circulation ponds would continue to provide values to ducks and pond specialists like the American avocet. The non-engineered levees would be maintained to the extent possible, but would almost certainly be overtopped and/or fail several times or more over a 50 year period of analysis. The risk of an overtopping/failure event would increase over this period with sea level rise. The levees would probably be repaired within a few years or less for a few decades. Eventually, with sea level rise, it may not be possible to maintain many of the levees. Most or all of the project area would then become tidal. However, restoration to tidal emergent marsh may not be possible at this later date because of the greater depth in relation to sediment accretion.

When uncontrolled levee failure events happen, circulation and water chemistry in ponds would be unmanaged and there could be some tidal exchange until repairs are complete and water circulation control is restored. Depending on whether repairs could be done and how long they take, uncontrolled breaching could result in an interim reduction in habitat values for pond specialist bird species together with an increase in habitat values for estuarine fish species due to the reconnection between the ponds and Alviso Slough and Coyote Creek. However, any such

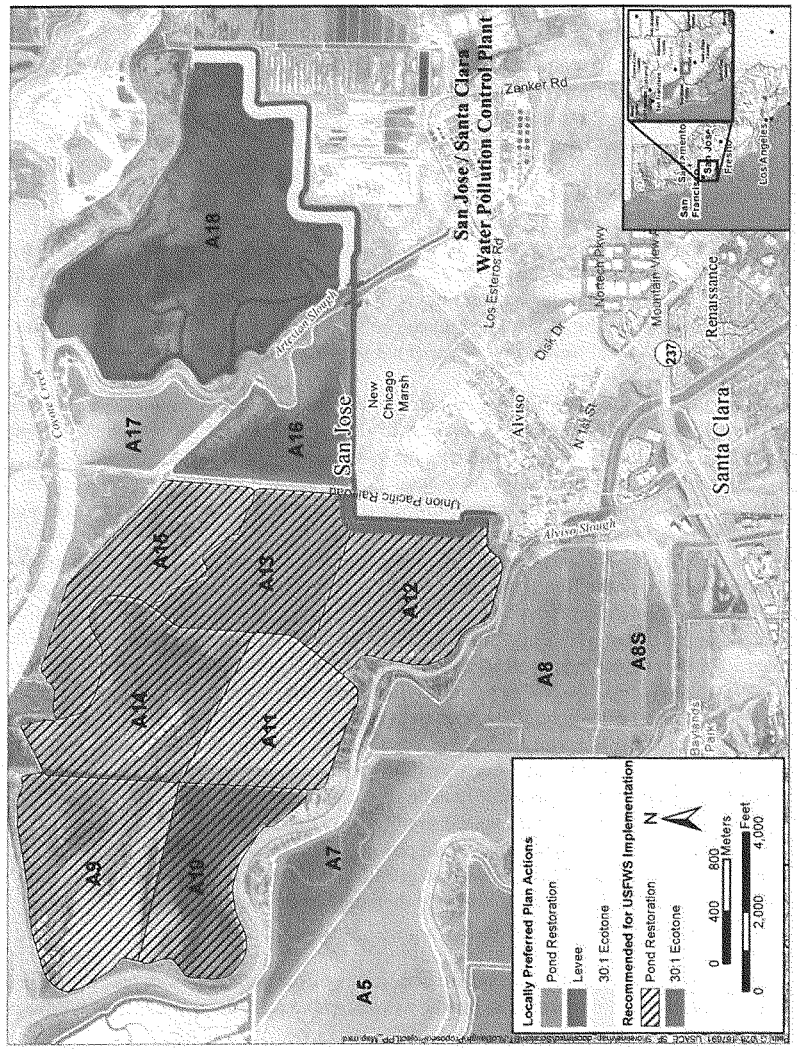

Figure 5. Preferred alternative (alternative 3) features (from Corps 2014).

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tidal benefits under the no-action alternative with this kind of uncontrolled breaching would be lower than tidal benefits under the action alternative. The effect of uncontrolled breaching on birds which use ponds cannot be easily estimated because these birds may move to other areas and use habitat created by other regional restoration actions. Mammals, including the salt marsh harvest mouse, may be more adversely affected by levee failure under the no-action alternative because of the limited refugium at the urban-wildland interface, and their limited mobility.

FUTURE WITH THE PROJECT

With the project (alternative 3), pond habitat would be progressively converted from non-tidal managed ponds to tidal influence, beginning with Ponds A12 and A18. The expected result is that these would become emergent tidal marsh over time. However, complete restoration to tidal marsh will take many years and the final outcome is not certain. At the outset, there would be around 3 years of construction needed to build the major levee components and place the fill for the ecotone in both Alviso and WPCP segments (Figure 2). There would be considerable machinery movement and noise associated with this construction which is likely to reduce wildlife use in the immediate vicinity of the work, and could cause displacement of birds away from the levee or to other habitat in the vicinity. The total footprint for this levee work is about 63 ac, including about 9 ac of various wetland types, 38 ac of ponds or open water, and 16 ac of upland or development including the existing levee (Table 4.7-3 *in* Corps 2014). The wetland impact includes about 1.8 ac of muted/diked marsh habitat in NCM.

There would be some direct loss of tidal and diked marsh habitat associated with the new levees, the Artesian Slough flood gate, and excavation of the pilot channels and dike breaches of Pond A18. When a pond is breached, there would be a large increase in tidal prism, depending on specific depth, number and location of breaches, and slough capacity. One major effect of this tidal prism is that it will cause some erosion of outboard habitat at the breach location, and along the edges and bottoms of sloughs between the breach and the bay. The highest erosion rates would likely be near the breach location, at least initially. Initial accretion rates within a pond would be relatively high for the first few years after breaching because of this source of eroded material, and decrease thereafter. The habitat in the pond interiors for most of the next 30-40 years after breaching would be mudflat, with increasing time of mudflat exposure as the marsh plain accretes. This would provide increasing values to wildlife which use mudflat during this period. Whether this remains mudflat or becomes tidal emergent marsh, and how much becomes tidal marsh, would depend largely on the suspended sediment concentration (SSC) over the long term. At 100 milligrams per liter (mg/L) SSC it is predicted to remain mudflat after 50 years, but at 200 mg/L SSC, it is predicted to fully transition to emergent marsh after 40 years (ESA PWA 2012). As sediment accumulates, the initially enlarged tidal prism would decline, which may lead to narrowing of tidal channels and expansion of the outboard fringe marsh. If tidal emergent marsh is formed as is hoped, this would provide substantial ecosystem values in the form of support of tidal marsh wildlife, as well as production of organic matter. This organic matter would not only enhance the productivity of the bay, but would contribute to accretion rates and may offset the effect of sea level rise.

Thus, there is some uncertainty about the future conditions of the pond interiors related to the rate of sediment accretion within breached ponds, as well as the regional responses of wildlife to

the changes in habitat distribution. To guard against adverse effects associated with these uncertainties, monitoring and adaptive management is proposed so that the decision on whether to breach more ponds in later phases, or what additional measures might be needed to promote tidal marsh, can be informed from data collected from initially-restored Ponds A12 and A18.

Because the ecotone area is at a higher elevation initially, we expect marsh vegetation to begin forming within one season of breaching (Figure 4). Planting or seeding could be done to accelerate colonization and favor desired plant species diversity. Once established, the vegetated ecotone would provide up to 60 ac of early tidal marsh habitat. Later, as tidal emergent marsh begins to form within the pond interior, the ecotone would also function as refugium for wildlife during high tides. The maximum post-construction tidal emergent marsh for the preferred alternative 3 is estimated at 2,783 ac (Table 4.6-8 *in* Corps 2014).

The other likely major effect of the increased tidal prism would be the effect of salinity on the plant community. Much of the fringe marsh along the major channels is vegetated by brackish species, and some of it has freshwater species. With the increased tidal prism, average salinity should increase, leading to an expansion of salt tolerant species such as pickleweed and saltgrass. This could have a positive effect on tidal marsh species like the salt marsh harvest mouse and California clapper rail.

Compared to without-project conditions, maintenance activities with the project would be more frequent and regular, but restricted to mowing on the slope of the engineered levees or portions thereof. Erosion of these new levees from windwaves or flood tides, and the need for repair of such damage, would be greatly reduced when the project is complete. Maintenance of the remaining levees around the ponds (also called "dikes"), outside of these engineered levees, would nevertheless remain until the later phases of the project. If later phases involved additional restoration of ponds to tidal action, levee maintenance around these ponds and associated effects of such maintenance on wildlife would be greatly reduced.

The with-project conversion of managed ponds into tidal salt marsh would have some effect on the value for managed pond specialist birds which use these ponds for foraging and roosting. One possible response would be that these specialist species would be displaced to nearby areas which would remain as ponds (e.g., NCM, Pond A16, and other managed ponds in the region). Pond A16 and other vicinity ponds under phase I of the SBSPRP have been separately enhanced under the SBSPRP to increase value to these specialists (Amato and Valoppi 2015). Or, the specialist species populations may decline to some extent. Over time, these specialists may begin to use salt pannes that could form within the restored tidal wetlands. It is expected that monitoring after the initial sequence of restoration will be sufficient to detect any regional, population-level effects on the species. Any initial adverse effects would likely be minimized by delaying further tidal restoration, and/or conducting other actions such as preserving or enhancing additional pond habitat if needed.

The project could also adversely affect diving ducks which currently use the non-tidal ponds for foraging, but the magnitude of these effects are uncertain. These species may not be habitat limited. There will be some remaining pond habitat in the region with the project, and tidal sloughs created by the proposed restoration may have some benefit that offsets the loss.

Migratory waterfowl populations may also be affected by factors in their breeding grounds away from the project area. Monitoring of diving ducks under the SBSPRP is ongoing and can be used to inform decisions on later phases of the project or further study needs if effects are observed.

The effect of the project on listed species (California clapper rail, western snowy plover, and salt marsh harvest mouse) is likely to be beneficial soon after levee construction is complete, with greater benefits over the long term. Flooding of NCM will be prevented, eliminating the effects of flooding and response to flooding (i.e., pumpout, levee repair) on habitat use or the displacement and mortality of individuals. Up to 60 ac of early marsh habitat expected to establish on the ecotone would benefit these species. Over time, restored tidal marsh would provide additional habitat that would allow expansion of populations of these species.

DISCUSSION

Alternative Evaluation: The locally-preferred alternative 3 has several benefits over the other alternatives from a fish and wildlife resource standpoint. Alternative 3 is the only alternative with the 30:1 sloped ecotone as transitional habitat. This type of transitional habitat would provide some substrate for early tidal marsh colonization, and would also serve as refugia from high tide events. The slope and width of the ecotone would result in more transitional habitat than would the flat bench in alternatives 2, 4, and 5. This habitat would also offset the direct loss of marsh on the margin of NCM and Artesian Slough that would have occurred due to construction of the levees and floodgates. Finally, the shallow slope of the ecotone is expected to more efficiently dissipate wave energy than would a flat bench or no transitional habitat. The Alviso North alignment in alternative 3 would preserve and protect the current water management of NCM, which is consistent with long term plans under the SBSPRP (USFWS and CDFW 2007). This current management provides for improved water quality in NCM and promotes salt marsh vegetation used by the salt marsh harvest mouse. NCM also functions as breeding and foraging habitat for the listed western snowy plover, and is adjacent to Pond A16 which is also used by this species for nesting. Other important species present on NCM include Forster's tern, American avocet, and black-necked stilt. Alternative 3 would largely preserve the habitat support for these wildlife species.

The construction impact on muted/diked tidal marsh for alternative 3 is 1.8 ac, compared to 20+ ac of such impact for alternatives 4 and 5. Because the levee section between NCM and Pond A16 under alternative 3 would be wider and taller than the existing dike, there could be some effect on the behavior of western snowy plovers and their use of NCM. For the purpose of this discussion, we assume this behavioral effect to be offset by the benefits of the proposed compensatory conservation measures. By comparison, constructing the levee alignments under alternatives 4 and 5 would not protect much of NCM from flood risk. Under these alternatives, with either active restoration or dike failure/overtopping with eventual sea level rise, the several hundred acres of unprotected muted/diked tidal marsh would become tidal. If active tidal restoration of NCM were attempted, the marsh plain would need to accrete 3 to 5 feet or more of sediment to begin to be recolonized by tidal marsh vegetation. Active tidal restoration of NCM would likely require early breaching, which could delay or affect the restoration of other ponds. Allowing the levees to fail at some later point due to sea level rise may result in permanent open tidal water rather than tidal marsh, due to the higher initial sea level at time of breaching.

The location of NCM poses challenges to tidal restoration. A railroad line is on its west border with Pond A12, which would be the access to tidal waters on Alviso Slough. A breach would be possible on that side, but it would likely be fixed rather than of flexible dimension. Pond A16, which is to be preserved as a managed pond, forms the north border with NCM, so it would be inconsistent with management to connect it to bay waters on that side. The east border is with Artesian Slough, which has a major freshwater influence that could affect (and be affected by) a pond breach. The town of Alviso is south of NCM and has been elevated above NCM by fill. Past subsidence is more pronounced in the south direction (Hecht and Seel 1990), which may explain the deeper surface at the south end of Pond A12 and possibly NCM as well. The result of this topography is that water would pond in the area of NCM, which also receives interior drainage from the town of Alviso. Considering the surroundings, current values to listed species at NCM, and the suite of alternatives evaluated, the Service concurs with the selection of alternative 3 as the preferred alternative, which preserves long-term management of NCM in its current state as a microtidal/diked marsh.

Habitat Evaluation: To assess the habitat values which would be produced by the project, we considered the change in habitat types and value shown in a Combined Habitat Assessment Protocol (CHAP) analysis (NHI 2014) as well as functions not represented by the CHAP method. The habitat type changes used in the CHAP analysis were based on modeled elevation data by ESA PWA (2012). Habitat value calculated by the CHAP method is based on the number of potential species associated with the habitat types. Habitat types with the project are projected to shift from the current dominance of managed pond to largely unvegetated mudflat in the intermediate term (5 to 20 years after initial breaching), and then tidal emergent marsh over the longer term (30 to 50 years after initial breaching). The CHAP method did not show major changes in habitat value over time with the project compared to other alternatives or the baseline condition[1]. This result is believed to be related to the inability of the CHAP method to consider the different conservation values of various habitats and their species associations, and the inherent emphasis of CHAP on species diversity.

Some loss in habitat value may occur with the project due to conversion of managed ponds to mudflat and then tidal marsh, and during associated project construction. Notwithstanding the shortcomings of the CHAP method just mentioned, total habitat units calculated by this method showed only modest differences between baseline and alternative scenarios (Table 3 *in* NHI 2014). While a reduction in habitat value deviates from our Policy goal of no net loss of habitat value for Resource Category 3, it is a small difference (<5%). In reality, we believe habitat values with the project will actually increase significantly due to factors not considered in the CHAP method (i.e., bay-wide benefits of tidal marsh such as from exported organic matter input; benefits to migratory fishes and listed species; large contiguous unit size). Additionally, the remaining managed ponds in the project vicinity along with ongoing and proposed pond enhancements under the SBSPRP are expected to provide adequate habitat, and likely improved habitat values to pond specialists in the region as a whole.

[1] An error in the baseline condition in the CHAP analysis was found involving the assumption that baseline conditions would involve uncontrolled and unrepaired breaching, resulting in similar values for the no project and with project alternatives. We did not correct this error, but do not believe it would change this report's conclusion.

The habitat benefit of the project can also be expressed in terms of its end point contribution to the long term habitat goals to increase tidal emergent marsh. The maximum post-construction total of tidal emergent marsh is estimated from modeling to be 2,783 ac, although the actual amount could be less than this due to formation of tidal channels and a lower SSC than the higher modeled condition (200 mg/L SSC). This habitat would provide a major contribution towards reversal of historical losses of emergent marsh, would benefit an array of wildlife species and native fishes, and would contribute towards the recovery of listed species. The tidal marsh would also contribute to the productivity of the bay through the production of organic matter and forage organisms used by wildlife. Compared to the current managed pond dominance, restoring the majority of the shoreline study area to tidal marsh as proposed would eventually result in less maintenance on refuge lands, allowing the Service to focus its management effort on other needs.

Adaptive Management: The proposed project involves significant uncertainties in how habitat will evolve after breaching, and how different wildlife groups will respond to habitat changes. Key uncertainties in tidal restoration involve: the rate of sediment accretion; the amount of scour of tidal sloughs, outboard marsh and fringe marsh; the associated formation of tidal emergent marsh and use by target species such as the harvest mouse and clapper rail; the productivity of estuarine fish; the extent and controllability of invasive species in restored tidal marsh; the region-wide responses of pond-associated birds to reduction in managed ponds; and any changes in mercury accumulation in the food web. The proposed project shares many of the same goals and objectives as the SBSPRP, and would be subject to the same guiding principles.

The SBSPRP employs two strategies to address the varying wildlife resource needs in the region while achieving restoration goals. These strategies are also applied in the design and implementation of the proposed project. The first strategy is to maintain and enhance a reduced area of managed ponds that can be used by wildlife associated with the ponds which will be converted to marsh. This has already been initiated in the region as part of phase I of the SBSPRP in advance of the proposed project, by enhancing some 477 ac of managed ponds. This will be done in the project area vicinity by retaining Pond A16 and NCM in their current state and by adding gravel to one island in Pond A16 as a compensatory conservation measure to benefit western snowy plover. The second strategy is to use the results of monitoring during the early years of tidal restoration to inform the decision-making process regarding future phases of the project, as well as additional management actions which could be employed to reach restoration targets.

For this project, the Corps has included a set of monitoring actions of key processes as part of the proposed project that can be used to measure early success and guide adaptive management. The physical monitoring includes water levels, sedimentation rates, and SSC. For example, it is hoped that sediment accretion will be sufficient to result in conversion to tidal marsh over the 50-year project life. Modeled rates can vary depending on actual SSC and tidal flows, and observed rates may differ substantially from the model predictions. If sedimentation is too slow to indicate progression towards tidal marsh (or sea level rise is faster than predicted), then the consequences could be examined, and responsive action taken. Potential actions might include importing fill or adding wave breaks to increase accretion, adjusting the project phasing schedule, or reconsideration of the target habitat distribution.

Biological monitoring for this project includes collection of data on coverage of tidal marsh, estuarine fish, invasive vegetation, and early vegetation in the transitional habitat (ecotone). It is less likely that this specific monitoring would have bearing on tidal restoration of later phases because the evolution into tidal marsh can vary and is slower for more deeply subsided sites such as Pond A12.

In addition to the monitoring for the proposed project, the SBSPRP has identified high priority applied study questions, many which would be addressed in association with the recently completed phase I of the SBSPRP (Appendix D *in* USFWS and CDFW 2007). Among these are bird use with changing habitat, effects on non-avian species, mercury effects, and so on. Bay-wide monitoring of wildlife could also be useful in determining whether populations are declining as a result of the project or are redistributing to other locations in the region. Lessons learned from results monitoring restoration efforts throughout the bay are expected to be useful in guiding adaptive management actions within the shoreline project area.

Although marsh evolution and wildlife responses of individual tidal systems cannot be predicted with precision, results of other area work are promising. Early monitoring of other tidal restoration sites under phase I of the SBSPRP indicates significant benefits to fish and wildlife such as an abundance of mysid shrimp and longfin smelt in recently restored Ponds A19-21 (Amato and Valoppi 2015). There are also some effects noted in this early work as well, such as increases in mercury in some ponds and eggs of birds that forage in them. Such effects are being carefully monitored to determine whether they persist or dissipate over time and the best course for management action if needed. Similarly, the use of phasing, monitoring and an adaptive management program for the proposed project are expected to maximize benefits while minimizing the potential for any shortcoming or unforeseen circumstance to become significantly adverse.

CONCLUSION

Based on our evaluation of the effects, uncertainties, and potential benefits of the proposed levee improvement and tidal restoration measures described above for the South San Francisco Bay Shoreline Phase I Study, and considering the restoration performance thus far in phase I of the SBSPRP, we recommend that the preferred alternative 3 be implemented as proposed. No modifications or additional measures have been identified.

RECOMMENDATIONS

We recommend that the Corps:

1. Evaluate measures to maximize the performance of the ecotone. Such measures may include establishing criteria for the physical and chemical properties of fill material. Different fill criteria may be appropriate for the fill within the rooting zone of plants to optimize growth. To promote the desired species of plants, the Corps should consider the use of seed, transplants, or translocated soils from marshes free of invasive species. Interim measures may be needed to suppress unwanted species during the ecotone construction period prior to breaching.

2 Perform pre-planning to identify sources of suitable quality material to raise marsh plain elevations, for possible placement in the event that accretion rates are too low.

3. Consider conducting some pre-construction studies to update baseline information where it is not current. One example might be salt marsh harvest mouse monitoring in the vicinity of the WPCP south alignment where construction is proposed and which has had past captures, but none recently.

REFERENCES

Amato, M. and L. Valoppi. 2015. 2014 Annual Self-Monitoring Report Don Edwards San Francisco Bay National Wildlife Refuge. Fremont, California. April 10, 2015. 21 pp + appendices.

Corps [U.S. Army Corps of Engineers]. 2014. Shoreline Phase I Study Draft Interim Feasibility Report and Environmental Impact Statement Report. Prepared by HDR Engineering, Sacramento, California, for the U.S. Army Corps of Engineers, San Francisco District. 1022 pp + appendices.

ESA PWA. 2012. Shoreline Study Preliminary Alternatives and Landscape Evolution. Memorandum prepared by ESA PWA, San Francisco, California, for the U.S. Army Corps of Engineers San Francisco District. February 10, 2012. 16 pp + appendix + figures.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, California/S.F. Bay Regional Water Quality Control Board, Oakland, California. 209 pp. + appendices.

Harvey [H.T. Harvey & Associates]. 2007. San Francisco Bay Shoreline Study Existing Biological Conditions Report. November 5, 2007. Prepared by H.T. Harvey & Associates, Los Gatos California, for U.S. Army Corps of Engineers and California Coastal Conservancy. 156 pp.

Hecht, B. and K. Seel. 1990. Restoration of New Chicago Marsh: Hydrologic and Water-Quality Influences and Proposed Operations Plan. February 7, 1990. Project 8822.2. Prepared by Balance Hydrologics, Inc., Berkeley, California, for Peninsula Open Space Trust. 20 pp + appendices.

Hobbs, J. 2012. South Bay Salt Pond Restoration - Fish Monitoring Summary Progress Report for January-June 2012. 9 pp.

NHI [Northwest Habitat Institute]. 2012. San Francisco South Bay Shoreline Wildlife Habitat Assessment Baseline Condition Report. Draft. May 4, 2012. Prepared by Northwest Habitat Institute, Corvallis, Oregon, for the U.S. Army Corps of Engineers San Francisco District. 80 pp.

_____. 2014. Combined Habitat Assessment Protocols (CHAP) Wildlife Habitat Assessment San Francisco South Bay Shoreline Five Ecosystem Restoration Alternatives. February 14, 2014. Prepared by Northwest Habitat Institute, Corvallis, Oregon, for the U.S. Army Corps of Engineers San Francisco District. 42 pp.

Pitkin, M. and J. Wood (Editors). 2011. The State of the Birds, San Francisco Bay. PRBO Conservation Science and the San Francisco Bay Joint Venture.

SFBO et al. [San Francisco Bird Observatory, U.S. Fish and Wildlife Service, Point Reyes Bird Observatory, U.S. Geological Survey, and Audubon California]. 2008. 2008 San Francisco Bay Shorebird Census. Summary Report. 12 pp.

Siegel, S.W. and P.A.M. Bachand. 2002. Feasibility Analysis of South Bay Salt Pond Restoration. San Francisco Estuary, California. Wetlands and Water Resources, San Rafael California. 228 pp.

USFWS [U.S. Fish and Wildlife Service]. 2015a. Biological Opinion and Conference Opinion on the South San Francisco Bay (South Bay) Shoreline Phase 1 Study in Santa Clara County, California. Sacramento Fish and Wildlife Office. April 27, 2015. Memorandum to Refuge Complex Manager, San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

_____. 2015b. Biological Opinion on the South San Francisco Bay (South Bay) Shoreline Phase 1 Study in Santa Clara County, California. Sacramento Fish and Wildlife Office. April 27, 2015. Letter to Thomas Kendall, U.S. Army Corps of Engineers, San Francisco District.

USFWS and CDFW [U.S. Fish and Wildlife Service and California Department of Fish and Wildlife]. 2007. South Bay Salt Pond Restoration Project. Final Environmental Impact Statement/Report. Prepared by EDAW, Phillip Williams Associates Ltd., H.T. Harvey and Associates, Brown and Caldwell, and Geomatrix.

Personal Communications:

HDR [HDR, Inc]. 2015. Electronic mail and attachment, subject line: "Shoreline Phase I Study - revised pond phasing for Final Integrated Document." Received May 30, 2015, from Dawn Edwards, HDR, Inc.

Strong, C. 2015. Electronic mail and four attachments, subject line: "New Chicago Marsh." Received June 24, 2015.

Appendix B8

Endangered Species Act Compliance

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1399

May 14, 2015

REPLY TO
ATTENTION OF

Planning Branch

Mr. Gary Stern
San Francisco Bay Region Supervisor
National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404

Dear Mr. Stern:

In accordance with section 7(c)(1) of the Endangered Species Act of 1973 (16 U.S. Code 1536[c]), as amended, and section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-297), the United States Army Corps of Engineers, San Francisco District (USACE), had previously prepared and submitted to the National Marine Fisheries Service (NMFS) a biological assessment (BA)/essential fish habitat (EFH) assessment evaluating the effects of proposed agency actions associated with the South Bay Shoreline Phase I Study on endangered, threatened, proposed, and candidate species, and designated and proposed critical habitats, designated essential fish habitat (EFH), and EFH-managed species, that are known to occur in the vicinity of the project. The previously drafted BA/EFH assessment was submitted to the NMFS by email on December 15, 2014.

Based on subsequent coordination with NMFS regarding project impacts on Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) Distict Population Segment (DPS) and North American Green Sturgeon southern DPS (*Acipenser medirostris*), USACE has modified our BA/EFH findings regarding project impacts on these species as described below. We now conclude that the proposed South Bay Shoreline Phase I Study project may affect, but is not likely to adversely affect CCC steelhead, green sturgeon, or their critical habitat.

As documented in the enclosed revised BA/EFH assessment, USACE has made the following findings for these species:

Central California Coast (CCC) Steelhead
Proposed construction activities associated with the project are not likely to adversely affect CCC steelhead. The only location where there is any potential for construction activities to affect steelhead is in Artesian Slough. However, steelhead have not been recorded there, there is a low probability that adult steelhead would move up the Slough, and there is the lowest probability of steelhead presence during the time of year in which activities associated with the project will be performed (June 1 to November 30). While construction activities will involve vibratory pile driving, based on the analysis of estimated noise associated with this activity, underwater sound-

pressure levels would not approach injury levels for adult or juvenile salmonids. If coffer dams are used, they will be constructed during low tide at times when water depths are very shallow to prevent entrainment and eliminate the need to relocate fish from isolated areas. Any potential effects related to movement of construction personnel and heavy equipment, increases in turbidity, and chemical leaks and spills associated will be minimized through conservation measures and would be localized and short-term. As a result, adverse impacts to steelhead are not expected to occur from construction.

Excavation of channels in outboard marshes along Artesian Slough could mobilize mercury-laden sediment, but given minimization measures mercury is not expected to result in adverse effects to steelhead. Mercury is present in relatively high concentrations in the slough, but exposure of CCC steelhead to sediments containing legacy mercury will be minimized during the project by a minimal period of disturbance; coordinating sediment disturbance to occur during periods when CCC steelhead are least likely to be in the project area; and the short duration of CCC steelhead presence in the Action Area. Exposure is not likely to result in greater bioaccumulation of mercury than currently exists in the vicinity. Additionally, if herbicides are necessary, the types of herbicides used and their application would be in accordance with methods determined by NMFS to be unlikely to adversely affect salmonids.

Operation of the project after construction is not expected to affect steelhead, given that there is little potential for human disturbance of steelhead resulting from use of the levee trails during project operation.

Finally, while construction activities may have localized, short term impacts on CCC steelhead critical habitat, restoration activities associated with the project are anticipated to have substantial, long-term benefits for steelhead by increasing the quantity and value of their critical habitat. Construction activities may result in degradation of water quality and reductions in forage in Artesian Slough but these would be very localized and short-term. Conversely, tidal restoration in Pond A18 (Led by USACE) and A9-A15 (Led by USFWS) will provide long-term benefits for CCC steelhead by increasing the quality and conservation value of steelhead critical habitat in the South Bay. Combined, these projects will create 2840 acres of new critical habitat providing extensive natural cover in the form of aquatic vegetation, increasing the abundance of invertebrates and prey fish, and likely improving water quality conditions over the long term.

Green Sturgeon

Most of the effects described above for the CCC steelhead and its designated critical habitat also apply to the green sturgeon and its critical habitat. The potential for effects of construction and conservation measures described for steelhead above also apply to green sturgeon. Because green sturgeon are primarily benthic-oriented organisms, and given the lack of any occurrence records in the action area as well as the localized effects of construction activities, the effects on green sturgeon from the proposed project will be minimal. Potential effects of mercury on the green sturgeon would be similar to those described for steelhead above. Due to the even more infrequent occurrence of green sturgeon in the Action Area than salmonids and the brevity of project-related disturbance that could result in mercury mobilization, exposure is not expected to

result in adverse effects on green sturgeon or to result in greater bioaccumulation than currently exists in the vicinity. If herbicides are necessary, the types of herbicides used and their application would be in accordance with methods determined by NMFS to be unlikely to adversely affect salmonids and thus would also be anticipated not to result in adverse effects on green sturgeon. Similarly, there is also little potential for human disturbance of green sturgeon resulting from use of the levee trails during operation of the project after construction.

Construction activities may have the same localized, short term impacts on green sturegon critical habitat as described above for CCC steelhead critical habitat, yet restoration activities associated with the project are anticipated to have substantial, long-term benefits for green sturgeon by increasing the quantity and value of their critical habitat. Construction activities may have minor water quality and prey organism impacts but tidal restoration in Pond A18 (Led by USACE) and A9-A15 (Led by USFWS) will create 2840 acres of new critical habitat. Restoration actions will increase the diversity in depths of aquatic habitats due to scour and restoration of tidal action to large remnant sloughs in managed ponds, thereby creating more deep subtidal habitats used by green sturgeon. Moreover, restoration actions will improve habitat conditions for juvenile rearing by providing a high abundance of benthic invertebrates.

Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions affecting listed species and their critical habitat that are reasonably certain to occur in the action area considered in this biological assessment. The *Integrated Document* for the proposed action (HDR 2014) contains a detailed analysis of past, present, and reasonably foreseeable future projects within the San Francisco Bay area. The most important and relevant of these projects is the South Bay Salt Ponds Restoration Project (SBSPRP). That project will result in the restoration of thousands of acres of high-quality habitat for fish. Sea level rise associated with climate change may also have cumulative effects on species that utilize tidal marshes by reducing tidal marsh area while increasing subtidal habitat. The proposed Phase I Study project is not anticipated to contribute to adverse cumulative impacts on CCC steelhead or green sturgeon, but rather will help to ameliorate adverse effects of other projects on these species.

Based on these revised findings USACE has determined the following:

- The proposed Phase I Study project may affect, but is not likely to adversely affect CCC steelhead and designated critical habitat;

- The proposed Phase I Study project may affect, but is not likely to adversely affect green sturgeon and designated critical habitat;

Given these new determinations, we request that NMFS change the current consultation for these species from formal to informal consultation and provide written concurrence with our not likely to adversely affect determinations.

We further request completion of the EFH consultation as previously requested on December 15, 2014.

If you have any questions, comments, or requests for additional information related to this letter, or the enclosed revisions to the BA/EFH assessment, please contact William DeJager at (415) 503-6866 or at William.R.DeJager@usace.army.mil.

Sincerely,

FOR James L. Howell, Jr.
Thomas R. Kendall, P.E.
Chief, Planning Branch

Anne Morkill
Project Leader
San Francisco Bay National Wildlife
Refuge Complex

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

May 19, 2015 **Refer to NMFS No:** WCR-2014-1850

Thomas R. Kendall, Chief
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, California 94103-1398

Anne Morkill
Refuge Complex Manager
San Francisco Bay National Wildlife Refuge Complex
U.S. Fish and Wildlife Service
7715 Lakeville Road
Petaluma, California 94954

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the South San Francisco Bay Shoreline Phase 1 Study

Dear Mr. Kendall and Ms. Morkill:

On May 14, 2015, NOAA's National Marine Fisheries Service (NMFS) received your request for written concurrence that the U.S. Army Corps of Engineers' (Corps) and U.S. Fish and Wildlife Service's (USFWS) proposed funding and construction, respectively, of the South San Francisco Bay Shoreline Phase 1 Study in Santa Clara County, California, near the City of Alviso is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparations of letters of concurrence.

NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), including conservation measures and any determination you made regarding the potential effects of the action. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The concurrence letter will be available through NMFS' Public Consultation Tracking System (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts).[1] A complete record of this consultation is on file at NMFS North Central Coast Office, Santa Rosa, California.

Proposed Action and Action Area

The Corps is conducting a flood risk management (FRM) and ecosystem restoration study for the South San Francisco Bay shoreline. Phase I of the study, known as the South Bay Shoreline Phase I Study (proposed project), involves increasing the height and width of certain levees in the Alviso area in northern Santa Clara County, California, and breaching of other levees to restore tidal habitats in existing managed ponds. The proposed project's "Study Area" is bounded on the southwest by Alviso Slough; on the north by Coyote Slough, Ponds A16 and A17, the "Island Ponds" (Ponds A19, A20, and A21), and the Newby Island Landfill; on the east by the Coyote Creek levee; and on the south by State Route (SR) 237.

The proposed project consists of two main sets of actions:

1. Corps-led actions: these include flood risk management levee improvements and public access improvements funded by the Corps and Santa Clara Valley Water District (SCVWD), which will occur on Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) lands and lands of the City of San Jose, as well as tidal restoration actions on City of San Jose lands;

2. USFWS-led actions: these include tidal restoration and public access improvements proposed by the USFWS and SCVWD on Refuge lands.

The Study Area is at risk of tidal flooding due to having large areas of low-lying terrain that are bordered by pond levees originally designed and constructed for commercial salt pond purposes rather than for FRM. The proposed project will address this flooding risk by raising the heights of levees in key areas.

Ecosystem restoration and FRM issues are inseparable in the Study Area because opening up ponds to tidal action changes the hydraulic behavior of the ponds under both normal and high water conditions. Tidal restoration will alter both ecosystem conditions and potential flood risk to the surrounding areas. Engineered levees are necessary to replace the existing non-engineered pond levees, which were not intended to provide any FRM in order to address the potential change in flood risk.

[1] Once on the PCTS homepage, use the following PCTS tracking number within the Quick Search column: WCR-2014-1850

Corps-led Actions

Flood Protection Actions

The Corps will construct 3.7 miles of new levee from the Alviso Marina northeastward to the northwestern corner of the San Jose/Santa Clara Water Pollution Control Plant (WPCP). The levee, which would provide FRM assuming a one percent Annual Chance of Exceedance, consists of the following three components:

1. The Alviso Segment consists of 1.7 miles of new levee construction, which is located entirely on Refuge lands, and will provide FRM for the community of Alviso. This levee segment follows the eastern border of Pond A12 and the southern border of Pond A16.

2. The Artesian Slough crossing will entail construction of a new tide gate across the slough to protect the WPCP from storm waters flooding the slough and backing up into the facility during extreme storm events. The proposed location of the tide gate will be at least 300 feet bayward of the existing WPCP outfall for treated water at Artesian Slough (the location shown in the Biological Assessment is approximate, and the actual location may be farther upstream along Artesian Slough). The gates will only be closed during extreme storm events. When the gates are closed, the WPCP will need to pump water outputs over the gate, or provide for internal excess water storage during a storm event. With or without the proposed project, the WPCP will develop a plan to pump or store waters during such events given increases in Bay water levels that correspond with future sea level rise scenarios.

3. The WPCP Segment consists of 2 miles of new levee construction, which is located on City of San Jose lands, and will provide FRM to the WPCP. It runs west to east in a stair-step pattern along the southern border of Pond A18, from the southwest corner of the pond to its northeast corner.

The engineered levee will be earthen. The proposed change in levee size from the existing levee (*e.g.*, along the southern edge of Pond A16) will be an increase of up to approximately 10 feet in height (after settlement) and about double in existing width. The average width at the crown of the levee will be 16 feet, with 3:1 (horizontal: vertical) slopes except where ecotones having a 30:1 slope will be constructed. Along the east edge of Pond A12, the Alviso Segment levee will have an additional 345-foot-wide ecotone along its west side.

The levee design will include vegetation as erosion protection on the bayward and landward side slopes. The vegetation that will be seeded or planted on the levee following construction will consist of marsh vegetation and peripheral halophytes at the toes of the levee and upland grasses at higher elevations. Where the FRM levee will cross the active railroad line just east of Pond A12, railroad floodgates will be installed. Concrete barriers will be installed on either side of the railroad right-of-way and will tie into the earthen levees. The metal floodgates will be connected to the barrier and will remain open during normal conditions and closed during flood conditions.
Other materials such as geotextile fabric, stone column, foundation over-excavation, or replacement with stronger soil may also need to be included in the final FRM levee design.

Fill for the FRM levee will be imported from local sources and delivered by truck. Dredge material originating from areas outside the proposed project area that is used for ditch blocks, or for portions of the ecotone and FRM levee that will be in contact with tidal waters, will need to meet the contaminants screening criteria as described in the Biological Assessment (HTH 2014).

The timing and duration of construction will be governed by both weather conditions and the need to avoid construction in sensitive areas during certain times of the year to avoid and minimize impacts to listed species. Types of construction equipment may include excavators, belly scrapers, front-end loaders, bulldozers, forklifts, vibratory rollers, dump trucks, and water trucks. Ancillary types of equipment that may be used include diesel generators, water pumps, and pile drivers. It is anticipated that dewatering and temporary installation of sheet piling will be necessary during the construction of water control structures such as tide gates. Dredge-locks or coffer dams may be constructed using earth levees or sheet piling to allow access for water-based equipment within a site. When possible, amphibious excavators, vibratory pile drivers, and other less-impacting equipment will be used.

Ecosystem Restoration Actions

The ecosystem restoration strategy to be implemented by the Corps is the conversion of Pond A18, which is currently managed for migratory waterbirds, into vegetated tidal wetlands with goals of maximizing long-term habitat benefits, particularly in consideration of potential sea level rise. Breaching of Pond A18 will restore approximately 736 acres of new tidal habitat (in addition to the upland transitional habitat discussed below). Ecosystem restoration also includes creation of a broad, gently sloping ecotone. In order to convert Pond A18 to tidal marsh it will be drained. This will occur passively, which may take several months, or water may be pumped out to expedite the process. Upland transitional habitat, ditch blocks, and pilot channels will be constructed to facilitate natural tidal flow within the pond. Ditch blocks inhibit flow through existing borrow ditches, promote scour and flow through the remnant historical channels, and provide some initial pickleweed habitat where located at the correct elevations. Three pilot channels will be constructed on the outboard side of Pond A18, two along Artesian Slough, and one will be constructed along South Coyote Slough. These pilot channels will be constructed at the locations of major historical tidal channels. The outboard levee will be breached in four locations along Artesian Slough and one location along South Coyote Slough. Breach size will be determined based on the hydrologic relationship between the tidal channel and marsh drainage area and on data from tidal channels in mature marshes throughout the Bay (ESA and Philip Williams & Associates, Ltd. 2012). Breaches are sized to long-term equilibrium dimensions to balance between excavation costs, scour potential, and tidal drainage consistent with Design Guidelines for Tidal Wetland Restoration in San Francisco Bay (Philip Williams & Associates, Ltd. and Faber 2004). Dimensions are adjusted to provide a cross-section with side slopes of 4:1 to 5:1 and a bottom width of approximately 10 feet. On the inboard side of the levee, the breach excavation will extend to the levee toe. The Pond A18 transitional habitat will be constructed simultaneously with levee construction.

When Pond A18 is breached, its bottom elevation will be too low for vegetated marshes to form immediately. Several feet of sediment will need to be deposited by natural processes before the pond bottom reaches a sufficient elevation for marsh vegetation to grow. This sedimentation process is expected to proceed at rates determined in part by suspended solids concentrations as

well as by factors causing re-suspension of sediment, such as wave action and tidal currents, in the breached pond (ESA and Philip Williams & Associates, Ltd. 2012). Because these factors cannot currently be predicted, it is not known how quickly vegetated marsh will form in Pond A18.

Monitoring of the restoration process, and adaptive management if necessary to achieve vegetated tidal marsh, will occur per the Shoreline Study Monitoring and Adaptive Management Plan (MAMP). Once tidal marshes have begun to form in the former ponds, the rate of sedimentation will increase as the vegetation slows the water, catches sediment, and retains it. Eventually, with sufficient sediment, it is expected that Pond A18 will be largely vegetated, aside from tidal channels.

USFWS-led Actions

Ecosystem Restoration Actions

USFWS-led ecosystem restoration activities will involve tidal restoration of up to 2,010 acres in Ponds A9-A15, and ecotone construction along the eastern edge of Pond A12, similar to those described above for Pond A18. However, there is an additional activity that will occur in Ponds A9-A15 that will not be necessary in Pond A18 because A18 has no internal berms. For restoration of Ponds A9-A15, breaches in the internal berms will be necessary to reconnect historical channels and restore the hydrologic connections to the innermost ponds in the proposed project footprint. Breach excavations will be sized in a similar manner to those applied to the outboard levees and will extend beyond the levee into the remnant historical channels. Existing internal berms may be lowered in some areas during the breach excavation to create wave breaks to limit wave action, enhance sedimentation, and create vegetated marsh habitat on the berm crests in the short term while the ponds develop from mudflat to vegetated marsh. As Ponds A9-A15 are breached in a phased manner, berms in adjacent ponds not yet being breached will be temporarily raised to provide increased FRM inboard of the current pond breaching actions.

Pond A12 has experienced the greatest degree of subsidence and is proposed for the first phase of restoration (though see above for a discussion of the possibility that Pond A18 may be breached first). By limiting new tidal exchange to this pond (rather than breaching multiple ponds in the first phase), Pond A12 can undergo maximum tidal interaction and sediment deposition, thus helping to raise its bottom elevation to a point where colonization by marsh vegetation will occur. During the first three years (2017–2019), Pond A12 will be prepared for breaching and inundation through excavation of pilot channels in two locations along Alviso Slough and construction of borrow ditch blocks. Berms between Pond A12 and Ponds A11 and A13 will be temporarily (i.e., until tidal restoration in A11 and A13) raised to provide flood protection for A11 and A13. Surplus material excavated from pond preparation will be used to contribute to other in-pond construction activities requiring material, such as raising of internal levees, if determined suitable by Refuge staff. Subsequently, levee breaches will be implemented in Pond A12 to introduce tidal flow.

Following restoration of tidal flow to Pond A12, monitoring will be conducted to measure the effectiveness of tidal function equilibrium and restorative values. If necessary, corrective measures will be implemented. A period of approximately four years has been established for MAM associated with Pond A12.

Pond preparation for Ponds A9, A10, A11, and A18 would potentially be implemented based on the lessons learned as a result of monitoring and adaptive management conducted for Pond A18, including whether to breach these ponds and restore them to tidal marsh. This decision will be made according to the MAMP, which includes a series of decisions (based on those in the SBSPRP MAMP) regarding whether to continue breaching that involve monitoring of populations of pond-associated birds, monitoring of sediment accretion in the South Bay, and other factors. If the decision is made to breach these ponds, borrow ditch blocks and pilot channels will be constructed. Pond A11 will be connected to Ponds A10 and A12 with inboard berm breaches, but it will not be breached directly to Alviso Slough. Two breaches to Alviso Slough are planned in Pond A10, and one breach each to Alviso Slough and Coyote Slough are planned for Pond A9. Internal berms between Ponds A9-A11 and Ponds A13-A14 will be temporarily (i.e., until tidal restoration in A13 and A14) raised to provide flood protection for A13 and A14. Levee breaches for Ponds A9-A11 will be implemented in Year 8 (2025) of the proposed project.

Pond preparation for Ponds A13, A14, and A15 will potentially be implemented based on the lessons learned as a result of MAM conducted for previous ponds, including whether to breach these ponds and restore them to tidal marsh. If the decision is made to breach these ponds, borrow ditch blocks and a pilot channel will be constructed. Only one outboard breach will occur for tidal restoration in these three ponds; this breach will connect Pond A15 to Coyote Slough along a major historical channel. Inboard berm breaches at the locations of historical sloughs will connect Ponds A13 and A14 to surrounding ponds (A9, A11, A15, and A12) to provide tidal flows to A13 and A14. Levee breaches will be implemented in Year 13 (2030) of the proposed project.

Ecotone (low marsh, middle marsh, and wetland/upland transitional habitat) habitat will be created along approximately 4,000 linear feet of levee on the east side of Pond A12. Approximately 30 acres of new upland transitional habitat will be created in this area. Following construction of the ecotone area, it will be seeded with native grasses, forbs, and low shrubs.

Following the breaching of levees around Pond A18 and Ponds A9-A15, the only management activities that might occur within the restored tidal habitats are predator management and, if necessary, invasive plant management, both of which would be performed on an as-needed basis. Invasive plant management will be needed for the first few years following construction of the ecotone to ensure that perennial pepperweed and other invasives do not become dominant. Otherwise, invasive plant management would be performed if monitoring indicates that particularly invasive species colonize the newly restored ponds in a way that would jeopardize the habitat enhancements achieved through tidal restoration. The non-Federal sponsors (the CSCC, SCVWD, and City of San Jose) will be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the Pond A18 tidal restoration and ecotone, as well as the entire levee adjacent to Pond A18 and on Refuge property). An OMRR&R Manual will be prepared to describe these activities.

Recreation Actions

Multi-use trails on top of the new FRM levee, with connections to the Bay Trail network, along with viewing platforms, and trail upgrades to be made to an existing segment of the Bay Trail system along SR 237. A pedestrian bridge over Artesian Slough will be constructed to link the

multi-use trails on top of the new FRM levee. The bridge would span the slough atop sets of four parallel piles spaced every 50 feet. This would result in the installation of a total of forty 12-inch-thick steel piles that would form the pedestrian bridge piers. A barge-mounted pile driver/crane or an in-water excavator with a vibratory hammer would be used to drive the 12-inch-thick steel piles. In addition, the proposed project will construct a trail segment along the north side of SR 237 between the Guadalupe River and Zanker Road (see Figure 18 in the Biological Assessment [HTH 2014]).

Construction of the recreation and public access components may consist of grading and, for all-weather trails, gravel application. Equipment required for trail construction may include small, Bobcat-sized equipment, backhoes or front-end loaders, graders, bulldozers, asphalt placement equipment, and dump trucks. Interpretive stations of varying size and scope and viewing platforms will also be constructed. Viewing platforms will be made of wood, metal, or plastic material and assembled in-place using a backhoe or excavator and hand tools. Interpretive stations will be built on-site, or will be prefabricated structures. Assembly and installation will require a backhoe or excavator and hand tools.

Avoidance and Minimization Measures

The Corps and USFWS propose the following measures to protect listed fish and the aquatic environment:

1. Construction activities in, or directly adjacent to, waters where CCC steelhead and longfin smelt are likely to be present will be performed between June 1 and November 30.

2. Levee breaching will not occur between February 1 and May 31 for the protection of out-migrating juvenile steelhead in, or directly adjacent to, waters where steelhead are likely to be present.

3. Activities that extend into the waters where listed fish and fish species managed according to Fisheries Management Plans may be present, such as pilot channel excavation, will be performed at low tide and/or under de-watered conditions.

4. Cofferdams will be used during construction and maintenance activities, as well as during implementation of any adaptive management actions, that could potentially result in substantial siltation of protected fish habitat.

5. All pumps used for dewatering where salmonids may be present will be screened according to NMFS and CDFW criteria for juvenile salmonids.

6. During tide gate construction on Artesian Slough, all pile driving will be performed using a vibratory hammer to minimize the potential effects of noise and pressure-waves on fish.

7. NMFS personnel will be immediately notified of any observed fish mortality events.

8. Tidally restored ponds will contain channels that are adequate for the ingress and egress of fish with tidal circulation. Inspections will be documented in a record that is available for review on request.

9. Treated wood will not be used in structures that may come into contact with water.

There are no interrelated or interdependent activities associated with the proposed action.

The action area includes the construction footprints for FRM and recreational access activities; the entirety of Ponds A9 through A15 and A18; portions of Pond A16 adjacent to the proposed project footprint; the northern and western boundaries of New Chicago Marsh; areas on the outboard (bayward) sides of those ponds where pilot channel excavation will occur; all staging, stockpiling, and access areas; the portions of Alviso Slough, Coyote Slough, South Coyote Slough, and Artesian Slough downstream from proposed levee breaches that may be subject to additional scour from increased tidal prism or temporarily increased sedimentation during construction; and areas surrounding the construction footprint.

Action Agency's Effects Determination

The Corps and USFWS have determined that the proposed project is not likely to adversely affect ESA-listed fish and designated critical habitat, and has requested NMFS' concurrence with this determination. The Corps and USFWS's finding of NLAA is based on the proposed measures to protect listed fish and the aquatic environment.

Available information indicates the following listed species (Distinct Population Segments [DPS] and Evolutionary Significant Units [ESU]) and critical habitat under the jurisdiction of NMFS may be affected by the proposed project:

Central California Coast steelhead (*Oncorhynchus mykiss*) **DPS**
Threatened (71 FR 834; January 5, 2006)
Critical habitat (70 FR 52488; September 2, 2005); and

North American Green Sturgeon southern DPS (*Acipenser medirostris*)
Threatened (71 FR 17757; April 7, 2006)
Critical Habitat (74 FR 52300; October 9, 2009).

The life history of steelhead is summarized in Busby *et al.* (1996). Alviso Slough and Coyote Slough represent the lower tidal portions of the Guadalupe River and Coyote Creek systems, respectively. Central California Coast (CCC) steelhead spawn and rear in the Guadalupe River and Coyote Creek watersheds upstream from the action area. Juvenile CCC steelhead seasonally occur in the action area during their downstream migration from these watersheds during the months of February to May. Adult CCC steelhead migrate into the Guadalupe River and Coyote Creek to reach their natal streams for spawning primarily between the months of December and March, peaking in January and February.

The life history of green sturgeon in California is summarized in Adams et al. (2002) and NMFS (2005). The southern DPS of North American green sturgeon spawn in the deep turbulent sections of the upper reaches of the Sacramento River. As juvenile green sturgeon age, they migrate downstream and live in the lower delta and bays, spending from three to four years there before entering the ocean. Adult green sturgeon return from the ocean every few years to spawn, and generally show fidelity to their upper Sacramento River spawning sites. Green sturgeon appear to be relatively rare in the South Bay. Acoustic tag receivers placed in the main channel of Coyote Slough, at the confluence of Coyote and Alviso Sloughs, and in recently breached salt ponds in the Alviso area (Ponds A19 and A21 at the Island Ponds and Pond A6), detected no green sturgeon in those areas. However, given that green sturgeon are known to occur in estuaries away from spawning streams, individuals (particularly juveniles) could occasionally forage in tidal portions of the action area, such as in Alviso Slough, Coyote Slough, and Artesian Slough. Following breaching of ponds for tidal restoration, they could also potentially forage in the larger sloughs in restored tidal marshes.

The Corps and USFWS have determined that the proposed project would not have a substantial adverse impact on EFH. This finding is based on the project's avoidance and minimization measures. The project area is located within an area identified as EFH for various life stages of fish species managed through the Pacific Coast Salmon FMP, the Pacific Groundfish FMP, and the Coastal Pelagic FMP. The project area is also within an area designated as Habitat Areas of Particular Concern (HAPC) for various federally-managed fish species within the Pacific Groundfish FMP. HAPC are described in the regulations as subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC are more carefully scrutinized during the consultation process. As defined in the Pacific Groundfish FMP, San Francisco Bay, including the project area, is identified as estuary HAPC.

Consultation History

By letter dated December 11, 2014, the Corps and USFWS requested formal consultation for the proposed project. Corps, USFWS, NMFS, and the California State Coastal Conservancy (CSCC) representatives attended a site visit on January 23, 2015. A conference call with representatives of the Corps, USFWS, NMFS, and the CSCC was held on April 23, 2015, to clarify the effects of the proposed action and the consultation schedule. During this conference call, NMFS explained that their review of the project suggests construction activities may be conducted without adverse effects to listed fish or designated critical habitat if the proposed minimization measures were slightly modified. NMFS suggested the Corps and USFWS modify the minimization measures and reconsider their finding of "adverse effects" to NMFS-listed species. By letter dated May 14, 2015, the Corps and USFWS transmitted their revised determination that the proposed project is not likely to adversely affect ESA-listed fish and designated critical habitat, and requested NMFS' concurrence with this determination.

ENDANGERED SPECIES ACT

Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

The effects of construction of the FRM levee, tide gate, and pedestrian bridge, as well as restoration-related activities such as pilot channel construction, breaching, and scour from increased tidal prism are reasonably likely to include degradation of water quality, disturbance of benthic habitat, and elevated sound levels during construction and breaching activities. Internal pond improvements and recreational activities (i.e., use of recreational trails) will occur within diked areas isolated from tidal waters or on top of levees, respectively. Therefore, these activities will have no effect on steelhead and green sturgeon.

Construction of FRM levee, tide gate, and pedestrian bridge, as well as restoration-related activities such as pilot channel construction, breaching, and scour from increased tidal prism may result in temporary increases in turbidity. During these activities disturbance of the bottom substrate will likely result in suspension of sediment in the adjacent water column. In areas with a direct connection to tidal waters of San Francisco Bay, the Corps and USFWS will perform construction activities between June 1 and November 30, and limit these activities to periods of low tide when work sites are dry or very shallow. If the timing of tides does not allow the work to be done in dry conditions, a coffer dam will be installed at low tide to protect tidal waters from entering the work sites. Adequate water depths and carrying capacity in adjacent Bay waters will provide sufficient area for fish to disperse and disturbance associated with construction should not result in more than an insignificant effect on them. With these measures, NMFS anticipates turbidity will be localized, minor and temporary. Increased levels of turbidity and suspended sediment can affect listed fish species by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions. However, increased levels of turbidity in the action area associated with implementation of this project are expected to be minor, localized and very short term. Steelhead are very unlikely to be present during the June 1 to November 30 in-water construction timeframe, and are therefore not expected to be exposed to increases in turbidity related to construction activities. Green sturgeon are expected to be tolerant of levels of turbidity that exceed levels expected to result from this project. For these reasons, the potential effects of minor and localized areas of elevated turbidity within this project's construction activities are expected to be insignificant to green sturgeon and steelhead.

Construction and restoration activities that are expected to disturb the substrate and result in increases in turbidity are likely to also result in re-suspension of sediment-borne contaminants. Mobilization and transport of suspended sediments from these activities make their adsorbed

contaminants available to fish. Sediment within the action area may contain high concentrations of mercury. High concentrations of mercury in the water column and sediments can alter fish behavior and affect sensory systems involved in growth, reproduction, and survival (Eisler 2000). It can also affect prey sources through contamination or reduced availability. As described above, the Corps and USFWS have proposed several measures to reduce exposure of green sturgeon and steelhead to increases in turbidity and mercury. With these measures, NMFS anticipates mercury exposure will be less than the thresholds commonly cited as the cause of these possible behavioral and physical impacts. Re-suspension of sediment-borne mercury associated with project construction is expected to be insignificant to green sturgeon and steelhead.

The installation of forty 12-inch diameter steel piles for the pedestrian bridge with a vibratory hammer may affect listed fish through exposure to high underwater sound levels. Available information indicates that fish may be injured or killed when exposed to very high levels of elevated underwater sound pressure waves generated from use of impact hammers to install piles. However, vibratory hammers generate lower sound levels and different sound wave forms that are less injurious than impact hammers. The use of a vibratory hammer by this project is expected to avoid generation of underwater sound levels that are harmful to fish, so elevated sound levels during construction will not result in the injury or mortality of listed fish. Additionally, the Corps and USFWS propose to restrict in-water pile driving to the period between June 1 and November 30. Because of the included work window, ESA-listed steelhead are very unlikely to be present in the project's action area when in-water pile driving is occurring. If listed fish are present during use of the vibratory hammer, they may react behaviorally to elevated underwater sound levels and temporarily vacate the project action area during construction. Adequate water depths and carrying capacity in open water areas adjacent to the project site will provide startled fish sufficient area to disperse and these elevated sound levels should not result in more than an insignificant behavioral effect on green sturgeon and steelhead.

Perennial pepperweed control at restored sites will necessitate the use of glyohosate and/or imazapyr-based aquatic herbicides. Glyphosate and imazapyr-based herbicides are highly soluble in water. The USFWS and Corps propose the following general conservation measures related to herbicide application:

a. Herbicides will be applied by a certified applicator and in accordance with application guidelines and the manufacturer label.

b. Herbicide applications would be timed to coincide with ebbing tides to protect non-target vegetation, to allow a minimum of six hours dry time for glyphosate/imazapyr mixture applications, and at least one-hour dry time for imazapyr applications.

c. Herbicides will be applied directly to perennial pepperweed plants and at low or receding tide to minimize the potential application of herbicide directly on the water surface.

d. All certified applicators will be trained to correctly identify perennial pepperweed, to distinguish this species from native species in the action area.

Implementation of these conservation measures are expected to reduce the potential for green sturgeon and steelhead to be exposed to glyphosate or imazapyr at concentrations known to be harmful to fish. Since these herbicides are considered relatively non-toxic to fish and do not bioaccumulate in the tissues of aquatic organisms (Gardener and Grue 1996; Giesy et al. 2000), NMFS does not expect any listed fish mortality, changes in growth rates, reduction of reproductive success or detectable effects on designated critical habitat in the action area associated with the application of these herbicides. For these reasons, the potential effects of vegetation removal with herbicides are expected to be insignificant.

The action area is located within designated critical habitat for CCC steelhead and the southern DPS of green sturgeon. Primary constituent elements (PCEs) of designated critical habitat for CCC steelhead include estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PCEs of designated critical habitat for the southern DPS of green sturgeon in estuarine areas include food resources, water flow, water quality, migratory corridor, water depth, and sediment quality. PCEs include sites essential to support one or more life stages of the species. These sites in turn contain physical and biological features that are essential to the conservation of the species.

During construction, critical habitat will be temporarily affected by minor increases in turbidity and disturbance of benthic habitat. As discussed above, water quality effects in the form of increased turbidity are expected to be temporary and insignificant. Construction activities are expected to disturb bottom sediments and the associated benthic community in the action area. This disturbance could result in the temporary loss of benthic invertebrates. However, impacts to the benthic community are expected to be temporary and localized. Once completed, the project is expected to benefit designated critical habitat by creating 2,840 acres of new tidal marshland foraging areas for threatened green sturgeon and steelhead in South San Francisco Bay.

Conclusion

Based on this analysis, NMFS concurs with Corps and USFWS that the proposed action is not likely to adversely affect the subject listed species and designated critical habitats.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by the Corps, USFWS, or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (2) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this concurrence letter; or if (3) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA portion of this consultation.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Under the MSA, this consultation is intended to promote the protection, conservation and enhancement of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50 CFR 600.10), and "adverse effect" means any impact which reduces either the quality or quantity of EFH (50 CFR 600.910(a)). Adverse effects may include direct, indirect, site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Based on information provided by the Corps and USFWS, the proposed action may result in localized and temporary degradation of water quality, disturbance of the benthic habitat, and temporary increases in noise during pile installation and construction. Therefore, NMFS has determined the proposed action would adversely affect EFH. However, adverse effects are localized, temporary and minimal in nature. Furthermore, the proposed action will benefit EFH after completion by restoring tidal connectivity and creating 2,840 acres of tidal marsh along South San Francisco Bay. Therefore, NMFS has no practical EFH Conservation Recommendations to provide to avoid or reduce the magnitude of these effects.

USFWS or the Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH (50 CFR 600. 920(l)). This concludes the MSA portion of this consultation.

Please direct questions regarding this letter to Amanda Morrison, North Central Coast Office in Santa Rosa, California at (707) 575-6083, or via e-mail at Amanda.morrison@noaa.gov.

Sincerely,

for Jeffrey John

William W. Stelle, Jr.
Regional Administrator

cc: William DeJager, Corps San Francisco District, San Francisco, CA
Anne Morkill, USFWS National Wildlife Refuges, Petaluma, CA
Copy to ARN File # 151422WCR2014SR00303
Copy to Chron File

Literature Cited

Adams, P.B., C.B. Grimes, J.E. Hightower, S.T. Lindley, and M.L. Moser. 2002. Status Review for North American Green Sturgeon, *Acipenser medirostris*. National Marine Fisheries Service, Southwest Fisheries Science Center. 49 pages. [Document available at: http://www.nwr.noaa.gov/Other-Marine-Species/upload/grn-sturgeon-status.pdf].

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-27. 261 pages. [Document available at: http://www.nwfsc.noaa.gov/assets/25/4245_06172004_122523_steelhead.pdf]

Eisler, R. 2000. Handbook of chemical risk assessment: health hazards to humans, plants, and animals. Volume 1, Metals. Lewis Press, Boca Raton, FL.

ESA and Philip Williams & Associates, Ltd. 2012. Shoreline Study Preliminary Alternatives and Landscape Evolution. Memorandum to the California State Coastal Conservancy.

Gardner S. and Grue C. 1996. Effects of Rodeo and Garlon 3A on Nontarget Wetland Species In Central Washington. Environ Toxicol Chem, Bol. 15,4:441-451.

Giesy JP, Dobson S, Solomon KR. 2000. Ecotoxicological Risk Assessment for Roundup Herbicide. Rev Env. Contam Toxicol 167:35-120.

H.T. Harvey & Associates (HTH). 2014. Draft South San Francisco Bay Shoreline Phase 1 Biological Assessment for the Salt Marsh Harvest Mouse, California Ridgway's Rail, Western Snowy Plover, California Least Tern, Central California Coast Steelhead, Green Sturgeon, and Longfin Smelt and Essential Fish Habitat Assessment. November. Prepared by H.T. Harvey & Associates, Los Gatos, California, for the U.S. Army Corps of Engineers, San Francisco District, San Francisco, California.

NMFS (National Marine Fisheries Service). 2005. Green Sturgeon (*Acipenser medirostris*) Status Review Update. National Marine Fisheries Service, Southwest Fisheries Science Center. 31 pages. [Document available at: http://swr.nmfs.noaa.gov/psd/Final%20Green%20 Sturgeon%20Status%20Review%20Update.pdf]

Philip Williams & Associates, Ltd. and P.M. Faber. 2004. Design guidelines for tidal wetland restoration in San Francisco Bay.

United States Department of the Interior

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

In Reply Refer to:
08ESMF00-
2012-F-0450-2

APR 27 2015

Mr. Thomas R. Kendall
Department of the Army
San Francisco District
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Subject: Biological Opinion on the South San Francisco Bay (South Bay) Shoreline Phase 1 Study in Santa Clara County, California

Dear Mr. Kendall:

This letter is in response to your December 11, 2014, request for formal consultation for the proposed South Bay Shoreline Phase 1 Study (proposed project) in Santa Clara County, California. Your request for consultation was received in our office on December 22, 2014. The proposed project involves flood risk management, levee construction, upland transitional habitat (ecotone) berm construction along Ponds A12 and A18, tidal marsh restoration in Ponds A9-A15 and Pond A18, trail construction, and operation and maintenance activities on lands owned and managed by the City of San Jose and the U.S. Fish and Wildlife Service's (Service) Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) in the South Bay. The U.S. Army Corps of Engineers (Corps) and the Service are each requesting the initiation of consultation for the Corps-led actions and Service-led actions of the proposed project, respectively. Your letter requested consultation on the endangered California clapper rail (*Rallus longirostris obsoletus*), endangered salt marsh harvest mouse (*Reithrodontomys raviventris*), threatened Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*), and endangered California least tern (*Sternula antillarum browni*). Critical habitat has been designated for the Pacific coast population of the western snowy plover but does not occur within the action area for the proposed project. This document is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

This document represents the Service's biological opinion on the effects of the proposed project on the California clapper rail, salt marsh harvest mouse, Pacific Coast population of the western snowy plover, and California least tern. The same biological opinion is being submitted to the Service. Currently the biological opinion is to both the Corps and the Service because the Corps is not authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency, but it can expend funds on flood control on such lands. However, it is a possibility that the Corps may implement the entire action and, therefore, all aspects of the proposed project will be

implemented by the Corps except those that were addressed in the South Bay Salt Pond Restoration Project (SBSPRP) Phase 1 Actions (Service file number 81420-F-08-0621-1, Service 2008).

The following sources of information were used to develop this biological opinion: (1) your letter requesting consultation on the proposed project dated December 11, 2014; (2) the November 2014 *Draft South San Francisco Bay Shoreline Phase 1 Biological Assessment for the Salt Marsh Harvest Mouse, California Ridgway's Rail, Western Snowy Plover, California Least Tern, Central California Coast Steelhead, Green Sturgeon, and Longfin Smelt and Essential Fish Habitat Assessment* (Biological Assessment) (H.T. Harvey & Associates (HTH) 2014); (3) the August 2008 *Formal Endangered Species Consultation on the South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California* (Programmatic Biological Opinion) (Service file number 81420-F-08-0621-1, Service 2008); (4) electronic mail and conversations among the Corps, the Refuge, HTH, California State Coastal Conservancy (CSCC), San Francisco Bay Conservation and Development Commission (BCDC), Santa Clara Valley Water District (SCVWD), the City of San Jose, California Department of Fish and Wildlife (CDFW), the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NMFS), and the Service; and (5) other information available to the Service.

CONSULTATION HISTORY

August 12, 2008	The Service issued the Programmatic Biological Opinion for the SBSPRP Phase 1 Actions (Service file number 81420-F-08-0621-1, Service 2008).
2008 – 2014	The Service continued coordination with the Corps, the Refuge, HTH, CSCC, BCDC, SCVWD, the City of San Jose, and CDFW on the SBSPRP and the proposed project.
October 15, 2014	The Service received via electronic mail from the Corps, the Refuge, and CSCC the October 2014 Draft Biological Assessment for the proposed project.
October 17, 2014	The Service provided via electronic mail comments on the October 2014 Draft Biological Assessment for the proposed project to the Corps, the Refuge, HTH, CSCC, SCVWD, and the City of San Jose.
October 28, 2014	The Service participated in a conference call among the Corps, the Refuge, HTH, CSCC, SCVWD, and the City of San Jose discussing the Service's comments on the Draft Biological Assessment for the proposed project.
November 17, 2014	The Service received via electronic mail from the Refuge and the Corps the revised Biological Assessment for the proposed project (HTH 2014).
December 22, 2014	The Service received from the Corps and the Refuge the letter requesting the initiation of formal consultation on the proposed project.
April 9, 2015	The Service submitted the draft biological opinion for the proposed project at the request of the Corps.

April 17, 2015 The Service received via electronic mail from the Corps comments on the draft biological opinion for the proposed project.

BIOLOGICAL OPINION

Description of the Proposed Project

Background

The Corps is conducting a flood risk management and ecosystem restoration study for the South Bay shoreline. Phase I of the study, known as the South Bay Shoreline Phase I Study (proposed project), involves increasing the height and width of certain levees in the Alviso area in northern Santa Clara County, California, and breaching of other levees to restore tidal habitats in existing managed ponds. The proposed project's "Study Area" (Figure 1) is bounded on the southwest by Alviso Slough; on the north by Coyote Slough, Ponds A16 and A17, the "Island Ponds" (Ponds A19, A20, and A21), and the Newby Island Landfill; on the east by the Coyote Creek levee; and on the south by State Route (SR) 237.

The proposed project consists of two main sets of actions:

1. Corps-led actions: these include flood risk management levee improvements and public access improvements funded by the Corps and SCVWD, which will occur on Refuge lands and lands of the City of San Jose, as well as tidal restoration actions on City of San Jose lands;

2. Service-led actions: these include tidal restoration and public access improvements proposed by the Service and SCVWD on Refuge lands.

Proposed project activities on Refuge lands were included in the intra-Service Programmatic Biological Opinion for the SBSPRP, which addressed flood control, public access, and habitat restoration and management (Service file number 81420-F-08-0621-1, Service 2008). As a result, the intra-Service consultation for the South Bay Shoreline Phase I Study Project will tier off the programmatic consultation for the SBSPRP. However, portions of the South Bay Shoreline Phase I Study Project on City of San Jose lands were not included in the action area for the Programmatic Biological Opinion. Also, the Programmatic Biological Opinion did not cover effects to the longfin smelt which is currently a candidate for Federal listing but was not in 2008.

Flood Risk Management (FRM)

The Study Area is at risk of tidal flooding due to having large areas of low-lying terrain that are bordered by pond levees originally designed and constructed for commercial salt pond purposes rather than for FRM. The proposed project will address this flooding risk by raising the heights of levees in key areas.

Ecosystem Restoration

Ecosystem restoration and FRM issues are inseparable in the Study Area because opening up ponds to tidal action changes the hydraulic behavior of the ponds under both normal and high-water

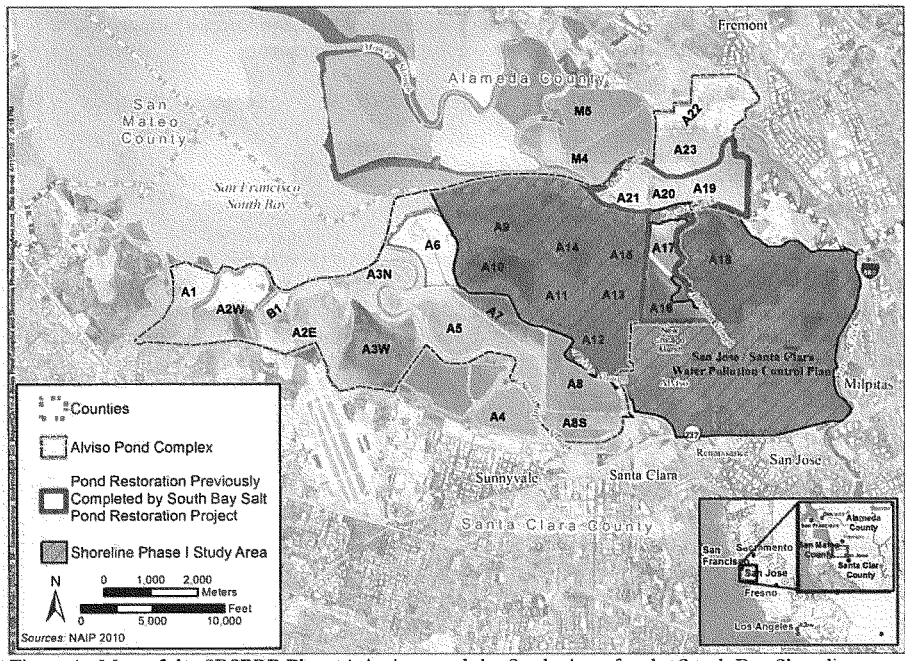


Figure 1. Map of the SBSPRP Phase 1 Actions and the Study Area for the South Bay Shoreline Phase I Study Project.

conditions. Tidal restoration will alter both ecosystem conditions and potential flood risk to the surrounding areas. Engineered levees are necessary to replace the existing non-engineered pond levees, which were not intended to provide any FRM in order to address the potential change in flood risk.

Tidal salt marshes are in dynamic equilibrium with water levels in San Francisco Bay (Bay) and can keep pace with rising sea levels through accretion of sediment if restoration activities begin soon, based on current and projected sediment availability. In addition, a vegetated marsh plain can slow down tidal surge velocity and reduce wave heights as they traverse the marsh surface. Therefore, having an established marsh in front of FRM infrastructure would increase the resiliency of the shoreline relative to the projected impacts of sea level rise (HDR 2014).

Project Components

Overview

Figures 2 and 3 below depict the portions of the Study Area where long-term physical changes are expected to occur as a result of proposed project activities led by the Corps and the Service,

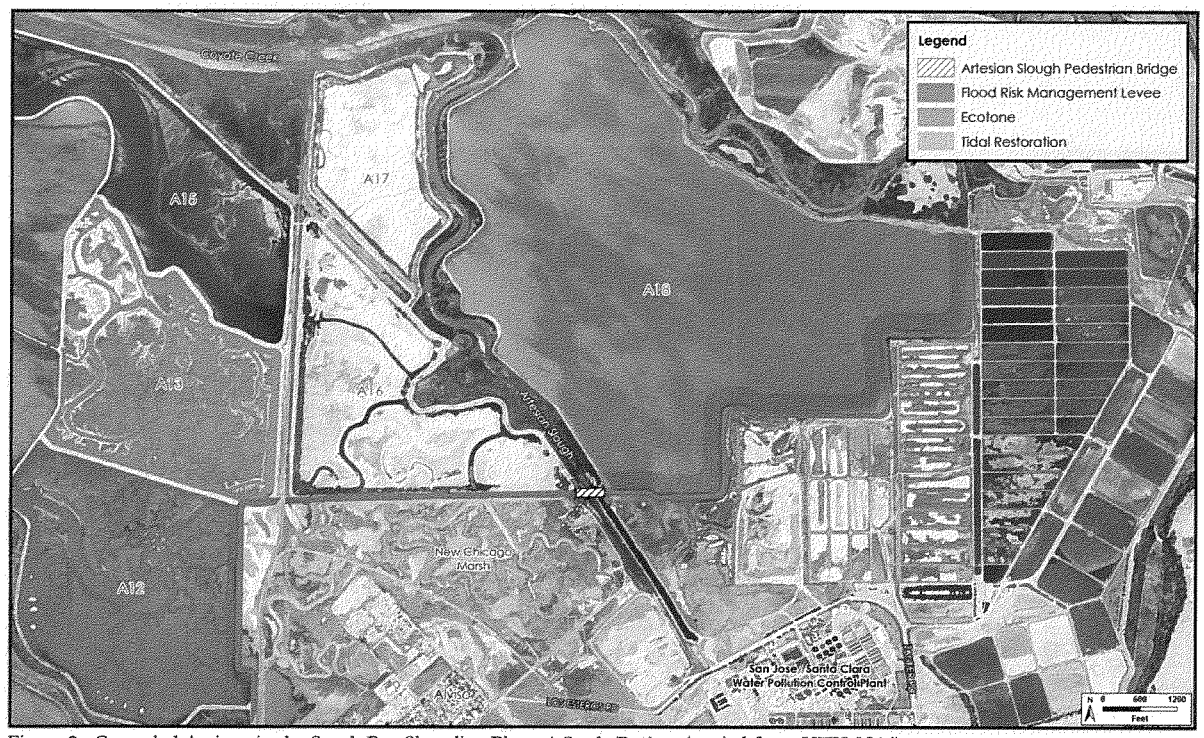


Figure 2. Corps-led Actions in the South Bay Shoreline Phase 1 Study Project (copied from HTH 2014).

Figure 3. Service-led Actions in the South Bay Shoreline Phase 1 Study Project (copied from HTH 2014).

respectively. As noted previously, the proposed project consists of two main sets of actions: tidal restoration and public access improvements proposed by the Service and SCVWD on the Refuge (Figure 3), and flood control levee improvements, public access improvements, and tidal restoration funded by the Corps and SCVWD, both on Refuge lands and lands of the City of San Jose (Figure 2). For the purposes of this biological opinion, the Corps-led actions and the Service-led actions are described separately because the Corps is not authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency, but it can expend funds on flood control on such lands. As a result, the Corps-led actions include flood improvements and public access improvements on Refuge lands, but the Corps cannot fund ecosystem restoration activities on the Refuge. The Corps can, however, fund ecosystem restoration on City of San Jose-owned portions of the Study Area, and thus the tidal restoration and ecotone (upland transitional zone) activities in Pond A18 are part of the Corps-led actions.

Regardless of the source of funding for various proposed project actions or the ownership of the lands on which these actions occur, all the actions described in this biological opinion are interrelated and interdependent. Tidal restoration in the proposed project area necessitates improved tidal FRM, the nature of tidal FRM along levees depends on whether adjacent ponds are tidal or not (*e.g.*, with higher and more robust levees needed if adjacent areas are tidal than if they are managed ponds), and public access and recreation opportunities differ depending on whether and where levee improvements and tidal restoration occur.

Project Schedule and Phasing

The construction-phasing schedule is illustrated in Figure 4 below. This schedule includes both Corps-led and Service-led activities and indicates the lead agency for each task. The South Bay Shoreline Phase I Study timeline includes a 50-year span (2017–2067).

Figure 4 and subsequent discussion regarding the sequence of proposed project activities reflect a scenario in which the first pond to be breached would be Pond A12; this is likely to be the case if the Corps is able to expend funds on restoration on Refuge lands. However, as noted above, the Corps is not currently authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency. As a result, Pond A18 (which is not on Refuge lands) may be breached first, in which case the sequencing and timing of activities associated with A12 and A18 may be reversed. Resolution of the sequence will occur when the proposed project obtains interpretation of the Water Resources Reform and Development Act from Corps Headquarters.

Construction will commence in 2017 beginning with FRM levee construction; the ecotones at Ponds A12 and A18 will be constructed during the same period. Subsequently, Pond A12 will be prepared for breaching. The first breach is scheduled for 2020, followed by monitoring and adaptive management to inform the next potential phases of restoration. This period of monitoring and adaptive management will also be used to inform potential adjustments to Pond A12 and may extend beyond this four-year period. The second phase of ponds (Ponds A9-A11 and Pond A18) will be breached in 2025, assuming that monitoring results from the previous phase indicate that tidal marsh restoration should proceed, and will also be followed by a similar period of monitoring and adaptive management. The last phase of ponds will be breached in 2030 and will be followed by continued monitoring and adaptive management for all areas. Maintenance (e.g., of levees and trails) and management according to a long-term management plan (described in the "Conservation Measures" section below) will continue throughout the life of the proposed project.

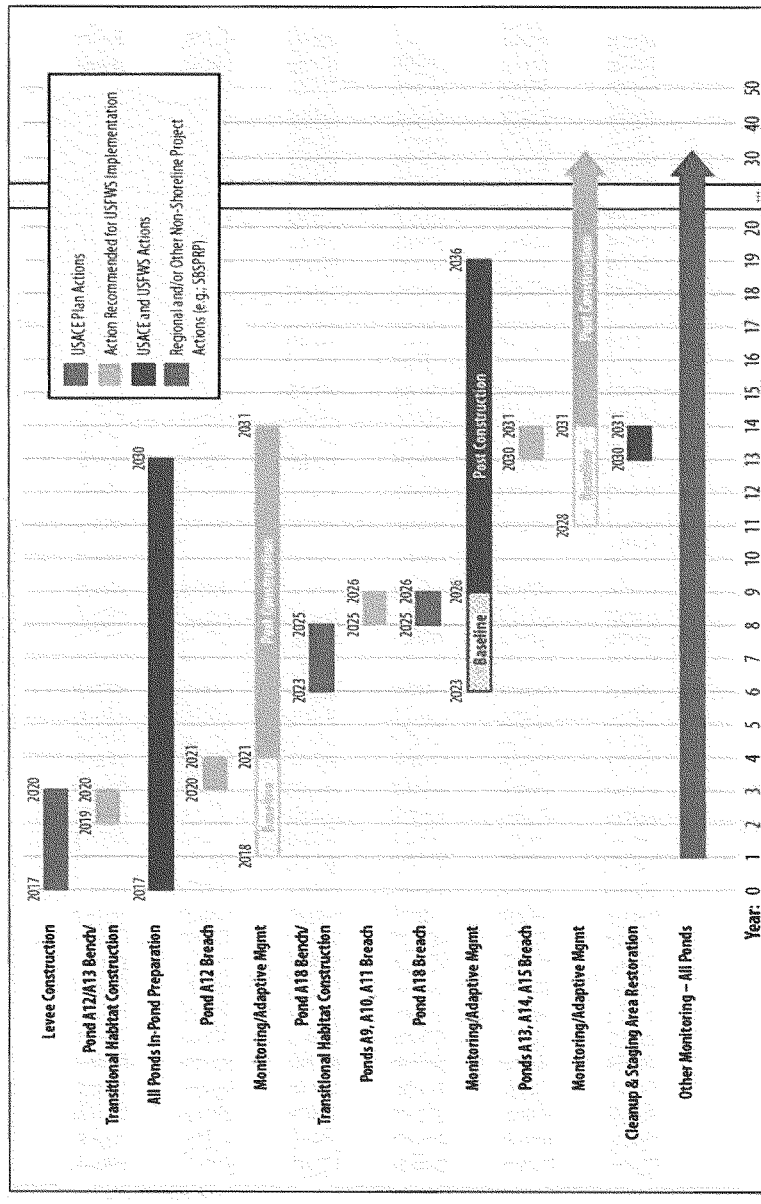


Figure 4. Construction Schedule for the South Bay Shoreline Phase 1 Study (copied from HTH 2014).

For the ecotone at Ponds A12 and A18, separate time frames are identified to construct each of these features. Material for construction of the ecotone at both ponds is assumed to be available on site and free of charge. This material is provided through agreements that the Refuge makes with local construction companies to acquire materials excavated from other regional construction sites, and with the SCVWD to acquire sediment dredged for stream maintenance purposes. After the new FRM levees are constructed, the Refuge and/or SCVWD will use these materials to construct transitional habitat. The construction phasing strategy allows for the accumulation of material needed to build the 345-foot-wide ecotones with 30:1 side slopes at Ponds A12 and A18.

Monitoring will continue throughout the life of the proposed project.

Corps-led Actions

Flood Protection Actions

The Corps conducted an analysis of potential FRM actions in order to identify the proposed project activities. Details of the analysis, including potential actions that were considered but that are not proposed and potential alternatives to the proposed project, are discussed in the Integrated Document (HDR 2014).

Construction

The Corps will construct 3.1 miles of new levee from the Alviso Marina northeastward to the northwestern corner of the San Jose/Santa Clara Water Pollution Control Plant (WPCP) (Figure 2). The levee, which would provide FRM assuming a one percent Annual Chance of Exceedance, consists of the following three components:

1. The 1.7-mile Alviso Segment, which is located entirely on Refuge lands, will provide FRM for the community of Alviso. This segment follows the eastern border of Pond A12 and the southern border of Pond A16.

2. The Artesian Slough crossing will entail construction of a new tide gate across the slough to protect the WPCP from storm waters flooding the slough and backing up into the facility during extreme storm events. The proposed location of the tide gate will be at least 300 feet bayward of the existing WPCP outfall for treated water at Artesian Slough (the location shown in the Biological Assessment is approximate, and the actual location may be farther upstream along Artesian Slough). The gates will only be closed during extreme storm events. When the gates are closed, the WPCP will need to pump water outputs over the gate, or provide for internal excess water storage during a storm event. With or without the proposed project, the WPCP will develop a plan to pump or store waters during such events given increases in Bay water levels that correspond with future sea level rise scenarios. To best meet the general operations requirements for the WPCP and allow for discharge during storm events, the tide gate will be designed in coordination with WPCP engineers.

3. The 2.1-mile WPCP Segment, which is located on City of San Jose lands, will provide FRM to the WPCP. It runs west to east in a stair-step pattern along the southern border of Pond A18, from the southwest corner of the pond to its northeast corner.

The engineered levee will be earthen. The proposed change in levee size from the existing levee (*e.g.*, along the southern edge of Pond A16) will be an increase of up to approximately 10 feet in height (after settlement) and about double in existing width. For example, the Alviso Segment levee along the southern edge of Pond A16 will increase in height from approximately 6 feet to 16 feet and increase in width at the toe from approximately 55 feet to 115 feet. The average width at the crown of the levee will be 16 feet, with 3:1 (horizontal: vertical) slopes except where ecotones having a 30:1 slope will be constructed (Figure 5). Along the east edge of Pond A12, the Alviso Segment levee will have an additional 345-foot-wide ecotone along its west side.

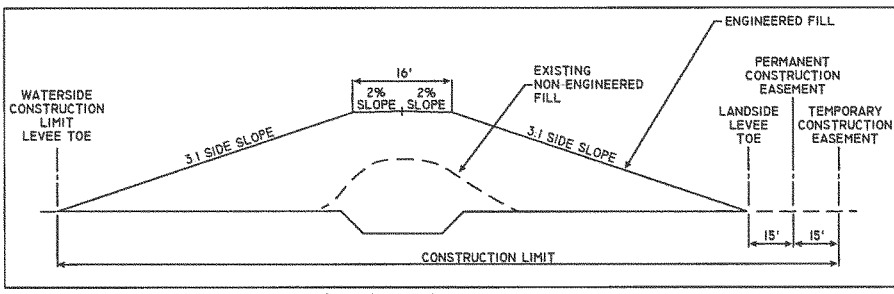


Figure 5. Example Cross-Section of Engineered FRM Levee.

Dredge material originating from areas outside the proposed project area that is used for ditch blocks, or for portions of the ecotone and FRM levee that will be in contact with tidal waters, will need to meet the contaminants screening criteria as described in the Biological Assessment (HTH 2014).

The levee design will include vegetation as erosion protection on the bayward and landward side slopes. Vegetation is anticipated to be continuous and able to provide erosion protection from overtopping of the levee. The vegetation that will be seeded or planted on the levee following construction will consist of marsh vegetation and peripheral halophytes at the toes of the levee and upland grasses at higher elevations. The combination of vegetation, buried stone, and/or transitional habitat fills (*i.e.*, planting berms) is proposed to balance requirements for levee safety with the need to limit disturbance from traditional maintenance activity (described below) such as regular mowing in/near habitat for sensitive species such as the salt marsh harvest mouse.

Proposed vegetation will include marsh species and peripheral halophytes, such as 12 to 18-inch tall pickleweed, from elevation 0 feet to 3 feet above the typical high water elevation. The high water elevation corresponds to approximately elevation 6 feet and 10 feet on the landward and bayward side slope, respectively. Upland grasses will occupy the side slopes between the levee crest and the pickleweed. Combinations of buried stone protection and buried gravel may be necessary to stunt the growth of native vegetation in lieu of regular mowing (i.e., to reduce the frequency of mowing) in an environmentally sensitive area, or to provide erosion protection where vegetation cannot be supported.

Where the FRM levee will cross the active railroad line just east of Pond A12, railroad floodgates will be installed. Concrete barriers will be installed on either side of the railroad right-of-way and will tie into the earthen levees. The metal floodgates will be connected to the barrier and will remain open during normal conditions and closed during flood conditions.

Certain locations may require special structures or treatment as follows:

1. Where the levee crosses an existing water feature such as a slough, structures will be installed to allow drainage during normal conditions and closure during flood conditions.

2. Where the levee crosses below-ground infrastructure (utilities, etc.), load-bearing structures may be needed to support the weight of levee materials.

Other materials such as geotextile fabric, stone column, foundation over-excavation, or replacement with stronger soil may also need to be included in the final FRM levee design.

Fill for the FRM levee will be imported from local sources and delivered by truck. Proposed staging areas and ingress/egress routes are shown on Figure 6 below. Potential staging areas #1 and #2 are both on WPCP land. Ingress and egress truck routes for these two areas are proposed on existing levee roads used currently by WPCP for materials hauling. Potential staging area #3 is on Zanker Landfill land and will be restricted in use for dirt stockpiling only.

The timing and duration of construction will be governed by both weather conditions and the need to avoid construction in sensitive areas during certain times of the year to avoid and minimize impacts to listed species. Types of construction equipment may include excavators, belly scrapers, front-end loaders, bulldozers, forklifts, vibratory rollers, dump trucks, and water trucks. Ancillary types of equipment that may be used include diesel generators, water pumps, and pile drivers. It is anticipated that dewatering and temporary installation of sheet piling will be necessary during the construction of water control structures such as tide gates. Dredge-locks or coffer dams may be constructed using earth levees or sheet piling to allow access for water-based equipment within a site. When possible, amphibious excavators, vibratory pile drivers, and other less-impacting equipment will be used.

Maintenance

Once construction of the Corps-led components is complete, the non-Federal sponsors (the CSCC, SCVWD, and City of San Jose) will be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of these components (*i.e.*, the Pond A18 tidal restoration and ecotone, as well as the entire levee both adjacent to Pond A18 and on Refuge property). An OMRR&R Manual will be prepared to describe these activities. It is anticipated that the following OMRR&R activities will be performed on the FRM levees:

1. Trash and anthropogenic debris removal along levee slopes and where it is causing obstruction in culverts or other problems.

2. Repairs on levee due to damage by small burrowing mammals, runoff/erosion, storm activities, or other factors.

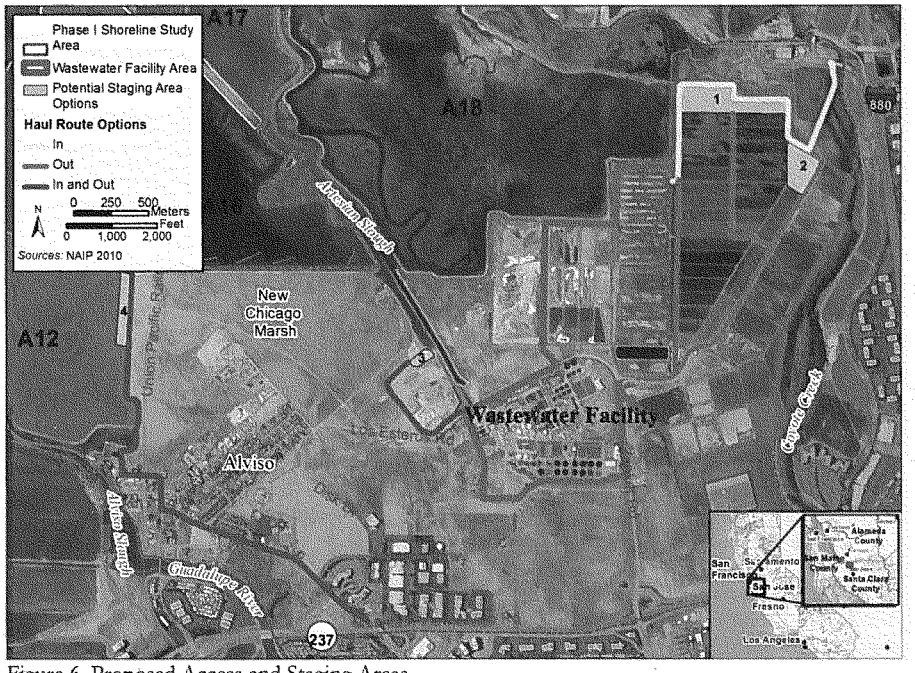


Figure 6. Proposed Access and Staging Areas.

3. Repairs along concrete flood wall structures (if included in plan) and other features, such as bridges and culverts.

4. Levee inspections conducted by SCVWD and the Corps.

5. Graffiti removal.

6. Access improvements and upkeep.

7. Vector monitoring (presence of mosquitoes and their larvae).

8. Vegetation management – As mentioned previously, the levee design will include vegetation as erosion protection on the bayward and landward side slopes.

    a. Combinations of buried stone protection and buried gravel may be used to stunt the growth of native vegetation to reduce the frequency of mowing in this environmentally sensitive area, or to provide erosion protection where vegetation cannot be supported.

b. It is anticipated that a reduced need for regular mowing will still include annual mowing of the levee side slopes within 12 to 15 feet of the levee crown. Such a narrow swath of vegetation management will likely require only two or three passes of a mower, once per year, which would minimize the disturbance of sensitive species in adjacent areas. Mowing will proceed from the top (closest to the crown, where habitat is of lowest quality) downward toward higher-quality habitat so that if any wildlife is using the area to be mown, the noise and movement of the mower may encourage wildlife to move downslope into the higher-quality habitat and out of the impact area. This area of mowing will correspond to the area above elevation 9 feet on the levee side slopes and higher elevations in reaches with ecotone fills.

c. No woody plant species greater than two inches in diameter will be allowed to become established on the levees to prevent roots from damaging the structural integrity of the levee. Due to salinity levels in lower-elevation areas, there is a low likelihood of woody vegetation establishment in many areas. Any woody vegetation that germinates in the higher-elevation mowing zone will be managed by mowing. Below the mowing zone, any woody plant removal that becomes necessary will be performed by hand; such hand-removal is expected to be necessary very infrequently (*e.g.*, once every few years, at most).

9. Burrowing mammal management – California ground squirrels may burrow into levees deep enough to affect the structural integrity of the levees, and thus squirrel management may be necessary. Ground squirrels are uncommon along the existing levees in the proposed project area and are thus not expected to require frequent or intensive management efforts. If ground squirrel management becomes necessary, it will be implemented using live traps with screens that have holes large enough to allow small mammals such as salt marsh harvest mice to easily exit the traps. Any mammals caught during such trapping that are potential predators of the salt marsh harvest mouse or California clapper rail, such as rats, striped skunks, red foxes, feral cats, raccoons, or opossums will be lethally removed.

Ecosystem Restoration Actions

The ecosystem restoration strategy to be implemented by the Corps is the conversion of Pond A18, which is currently managed for migratory waterbirds, into vegetated tidal wetlands with goals of maximizing long-term habitat benefits, particularly in consideration of potential sea level rise. Ecosystem restoration also includes creation of a broad, gently sloping ecotone.

Tidal Habitat Restoration

The following ground preparation actions will be involved in converting Pond A18 to tidal marsh:

1. Drain the pond to the extent feasible. The pond will be drained passively, so it may take several months to dry out; pumping would expedite the process and may be considered. Due to historic pond subsidence, some pond areas are not able to be completely dried. This step is also dependent on temporal proximity to the western snowy plover nesting season and/or if access to the area can be obtained without impacts to western snowy plovers, as dried pond areas may invite western snowy plover nesting.

2. Remove vegetation where needed (*i.e.*, around the breach locations) to discourage salt marsh harvest mice from using the impact areas.

3. Construct upland transitional habitat (described below).

4. Construct ditch blocks to inhibit flow through existing borrow ditches, promote scour and flow through the remnant historical channels, and provide some initial pickleweed habitat where located at the correct elevations. Without the construction of ditch blocks, the borrow ditches around the perimeter of the restored pond would capture the bulk of the flow, reducing the formation of complex dendritic channels in the restored marsh habitat.

5. Construct pilot channels on the outboard side of the A18 levee to facilitate flow between tidal sloughs and the restored tidal habitat in Pond A18. Three pilot channels will be constructed along Artesian Slough, and one will be constructed along South Coyote Slough. These pilot channels will be constructed at the locations of major historical tidal channels.

6. Breach the outboard levee in four locations along Artesian Slough and one location along South Coyote Slough. Breach size will be determined based on the hydrologic relationship between the tidal channel and marsh drainage area and on data from tidal channels in mature marshes throughout the Bay (ESA and Philip Williams & Associates, Ltd. 2012). Breaches are sized to long-term equilibrium dimensions to balance between excavation costs, scour potential, and tidal drainage consistent with *Design Guidelines for Tidal Wetland Restoration in San Francisco Bay* (Philip Williams & Associates, Ltd. and Faber 2004). Dimensions are adjusted to provide a cross-section with side slopes of 4:1 to 5:1 and a bottom width of approximately 10 feet. On the inboard side of the levee, the breach excavation will extend to the levee toe.

Pond A18 will be breached in five locations to facilitate flow of water into and through the pond, allow the tides to carry sediment into the pond, and allow for the retention of remnant channels in the pond bottom. Breaching of Pond A18 will restore approximately 736 acres of new tidal habitat (in addition to the upland transitional habitat discussed below). When Pond A18 is breached, its bottom elevation will be too low for vegetated marshes to form immediately. Several feet of sediment will need to be deposited by natural processes before the pond bottom reaches a sufficient elevation for marsh vegetation to grow. This sedimentation process is expected to proceed at rates determined in part by suspended solids concentrations as well as by factors causing re-suspension of sediment, such as wave action and tidal currents, in the breached pond (ESA and Philip Williams & Associates, Ltd. 2012). Because these factors cannot currently be predicted, it is not known how quickly vegetated marsh will form in Pond A18. Monitoring of the restoration process, and adaptive management if necessary to achieve vegetated tidal marsh, will occur per the *Shoreline Study Monitoring and Adaptive Management Plan* (MAMP) described previously. Once tidal marshes have begun to form in the former ponds, the rate of sedimentation will increase as the vegetation slows the water, catches sediment, and retains it. Eventually, with sufficient sediment, it is expected that Pond A18 will be largely vegetated, aside from tidal channels.

Because of the tidal flood protection functions currently provided by the outboard levees around Ponds A9-A15, tidal restoration within those ponds would not be feasible without enhancement of flood protection inboard from those ponds. As a result, the Service-led tidal restoration on Refuge lands described below could not occur but for the Corps-led construction of the levee and tide gate. Thus, tidal restoration on Refuge lands is dependent on Corps-led levee construction.

Upland Transitional Habitat Creation

Transitional habitat can attenuate waves and reduce wave run-up, increase habitat resiliency by providing space for marshes to retreat inland in the face of sea level rise, and provide refugia for animals such as the California clapper rail and salt marsh harvest mouse during very high tides, when the marsh plain is inundated. The upland transitional habitat adjacent to Pond A18 will be constructed along the interface between the new levee (along the southern and eastern edges of Pond A18) and the newly restored tidal habitat in the pond.

The non-Federal sponsors (the CSCC and SCVWD) recognize the enhanced value of having a gently sloped upland transitional habitat. As a result, the transitional habitat along Pond A18 will be constructed to incorporate a 30:1 slope, which will add up to 345 feet to the width of the bay side of the levee footprint. This ecotone will be constructed along approximately 14,000 linear feet of levee along Pond A18, for a total extent of 67 acres of new upland transitional habitat. Following construction of the ecotone area, it will be seeded and/or planted with native grasses, forbs, and low shrubs. Such an ecotone will provide substantial benefits for wildlife in the Study Area, as this sort of upland transitional habitat is not well represented in the South Bay. Vegetation allowed to establish in the upland transitional areas would be limited to non-woody and semi-woody plants (and possibly shallow-rooted shrubs) and would be otherwise unmanaged, except to control invasive plants from establishing. Figures 13 and 14 in the Biological Assessment (HTH 2014) depict cross-sectional views of how the upland transitional habitat will relate to restored tidal habitats (using Pond A12 as an example) at construction completion (2020) and as anticipated to evolve by 2067, respectively. Within a narrow (15 feet or less) strip of ecotone fill along the edge of the exposed levee surface, vegetation will be managed the same as on the levee (see "Maintenance" section above) to ensure compliance with the Corps' levee vegetation policy.

As indicated in Figure 4, the Pond A12 ecotone will be constructed concurrently with construction of the FRM levee, using the same staging areas and access routes as for levee construction. The Pond A18 ecotone will similarly be constructed simultaneously with levee construction.

Maintenance

Following the breaching of levees around Pond A18, the only management activities that might occur within the restored tidal habitats are predator management and, if necessary, invasive plant management, both of which would be performed on an as-needed basis. If monitoring determines that predator management is necessary to protect special-status and sensitive species, such as California clapper rails and salt marsh harvest mice, from predators such as California gulls, northern harriers, American crows, common ravens, red foxes, striped skunks, feral cats, and raccoons, then adaptive predator management would be implemented. Predator management would be focused on specific areas where predation problems are occurring (or areas, such as poles or towers, used as nesting sites or hunting perches by raptors), and culling would be limited to certain individuals; target mammalian predators that are captured would be lethally removed, while target avian predators would be either lethally removed (*e.g.*, crows and ravens) or relocated (*e.g.*, raptors). Because it is not currently known whether, and to what extent, predator management at Pond A18 will be needed, and habitat for the California clapper rail and salt marsh harvest mouse will take years to develop after A18 is breached, the local sponsor (*e.g.*, the SCVWD), rather than the Corps, will fund any necessary predator management. Invasive plant management will be needed for the first few years following construction of the ecotone to ensure that perennial pepperweed and other

invasives do not become dominant. Otherwise, invasive plant management would be performed if monitoring indicates that particularly invasive species colonize Pond A18 in a way that would jeopardize the habitat enhancements achieved through tidal restoration.

Monitoring and Adaptive Management Actions

The Corps and/or local sponsors (*i.e.*, the SCVWD, CSCC, or the City of San Jose) will provide initial funding for monitoring and adaptive management (MAM) at Pond A18, whereas MAM at the other proposed project ponds will be funded by the Service, SCVWD, City of San Jose, or CSCC. Funding for maintenance and MAM provided by the SCVWD will take the form of an allocation in the SCVWD's annual budget. Given the stability of, and the public need for, the SCVWD, the commitment of long-term funding through the SCVWD's annual budget process will ensure the availability of adequate funding to meet its responsibilities to the proposed project. The entity that will manage Pond A18 in the long-term is not currently known. The City of San Jose and the Corps will identify an appropriate manager for Pond A18 after breaching occurs, and that manager will then be subject to Service approval. Funding for maintenance and MAM at Pond A18 will be provided by the SCVWD, CSCC, and/or City of San Jose. If in the future, Pond A18 is conveyed to the Refuge, an agreement between the City of San Jose, SCVWD, and the Refuge to provide funding for maintenance and MAM at Pond A18 would need to be reached.

MAM for the proposed project falls into three categories: (1) MAM associated with meeting ecosystem restoration objectives, (2) MAM associated with "adaptive implementation" (*i.e.*, decisions about whether to continue or halt the restoration of tidal marsh habitat depending on the monitoring of the effects of pond-to-marsh conversion), and (3) MAM associated with permit compliance. The Corps will cost-share activities associated with meeting ecosystem restoration objectives at Pond A18, for a period of 10 years; the non-Federal sponsors will provide funding for other required MAM. The MAMP includes a discussion of MAM's scientific basis and institutional structure, specific MAM activities, and cost estimates. Because the South Bay Shoreline Phase I Study Project includes a subset of ponds within the SBSPRP, the MAMP for the South Bay Shoreline Phase I Study Project draws heavily from the monitoring and applied studies being conducted by the larger SBSPRP. Monitoring activities to be funded by the Corps at Pond A18 include the following:

1. Water levels, sediment accretion rates, and suspended sediment concentrations;

2. Tidal marsh habitat acreage;

3. Presence and abundance of California clapper rails and salt marsh harvest mice in newly established tidal habitat; given the length of time that may be required for suitable habitat for these species to become established in Pond A18, it is possible that this monitoring may not occur within the 10-year period of Corps cost-shared monitoring, although salt marsh harvest mice may occupy the ecotone within 10 years;

4. Abundance and health of estuarine fish;

5. Count of migrating salmonids;

6. Abundance of non-native plants;

7. Plant species composition in upland transition zones; and

8. Mammalian and avian predators of California clapper rails and salt marsh harvest mice.

Recreation Actions

The only specific recreation-related action that will be funded by the Corps is the construction of a pedestrian bridge over Artesian Slough. This bridge will be constructed to link the multi-use trails on top of the new FRM levee (construction of the trails will not be Corps-funded). The bridge would span the slough atop sets of four parallel piles spaced every 50 feet. This would result in the installation of a total of forty 12-inch-thick steel piles that would form the pedestrian bridge piers. A barge-mounted pile driver/crane or an in-water excavator with a vibratory hammer would be used to drive the 12-inch-thick steel piles.

Service-led Actions

Ecosystem Restoration Actions

The activities involved in tidal restoration in Ponds A9-A15, and ecotone construction along the eastern edge of Pond A12, are similar to those described in above for Pond A18. However, there is an additional activity that will occur in Ponds A9-A15 that will not be necessary in Pond A18 because A18 has no internal berms. For restoration of Ponds A9-A15, breaches in the internal berms will be necessary to reconnect historical channels and restore the hydrologic connections to the innermost ponds in the proposed project footprint. Breach excavations will be sized in a similar manner to those applied to the outboard levees and will extend beyond the levee into the remnant historical channels. Existing internal berms may be lowered in some areas during the breach excavation to create wave breaks to limit wave action, enhance sedimentation, and create vegetated marsh habitat on the berm crests in the short term while the ponds develop from mudflat to vegetated marsh. As Ponds A9-A15 are breached in a phased manner, berms in adjacent ponds not yet being breached will be temporarily raised to provide increased FRM inboard of the current pond breaching actions.

Pond A12 has experienced the greatest degree of subsidence and is proposed for the first phase of restoration (though see above for a discussion of the possibility that Pond A18 may be breached first). By limiting new tidal exchange to this pond (rather than breaching multiple ponds in the first phase), Pond A12 can undergo maximum tidal interaction and sediment deposition, thus helping to raise its bottom elevation to a point where colonization by marsh vegetation will occur. During the first three years (2017–2019), Pond A12 will be prepared for breaching and inundation through excavation of pilot channels in two locations along Alviso Slough and construction of borrow ditch blocks. Berms between Pond A12 and Ponds A11 and A13 will be temporarily (*i.e.*, until tidal restoration in A11 and A13) raised to provide flood protection for A11 and A13. Surplus material excavated from pond preparation will be used to contribute to other in-pond construction activities requiring material, such as raising of internal levees, if determined suitable by Refuge staff. Subsequently, levee breaches will be implemented in Pond A12 to introduce tidal flow.

Following restoration of tidal flow to Pond A12, monitoring will be conducted to measure the effectiveness of tidal function equilibrium and restorative values. If necessary, corrective measures

will be implemented. A period of approximately four years has been established for MAM associated with Pond A12.

Pond preparation for Ponds A9, A10, A11, and A18 would potentially be implemented based on the lessons learned as a result of MAM conducted for Pond A18, including whether to breach these ponds and restore them to tidal marsh. As described previously, this decision will be made according to the MAMP, which includes a series of decisions (based on those in the SBSPRP MAMP) regarding whether to continue breaching that involve monitoring of populations of pond-associated birds, monitoring of sediment accretion in the South Bay, and other factors. If the decision is made to breach these ponds, borrow ditch blocks and pilot channels will be constructed. Pond A11 will be connected to Ponds A10 and A12 with inboard berm breaches, but it will not be breached directly to Alviso Slough. Two breaches to Alviso Slough are planned in Pond A10, and one breach each to Alviso Slough and Coyote Slough are planned for Pond A9. Internal berms between Ponds A9-A11 and Ponds A13-A14 will be temporarily (*i.e.*, until tidal restoration in A13 and A14) raised to provide flood protection for A13 and A14. Levee breaches for Ponds A9-A11 will be implemented in Year 8 (2025) of the proposed project.

Pond preparation for Ponds A13, A14, and A15 will potentially be implemented based on the lessons learned as a result of MAM conducted for previous ponds, including whether to breach these ponds and restore them to tidal marsh. If the decision is made to breach these ponds, borrow ditch blocks and a pilot channel will be constructed. Only one outboard breach will occur for tidal restoration in these three ponds; this breach will connect Pond A15 to Coyote Slough along a major historical channel. Inboard berm breaches at the locations of historical sloughs will connect Ponds A13 and A14 to surrounding ponds (A9, A11, A15, and A12) to provide tidal flows to A13 and A14. Levee breaches will be implemented in Year 13 (2030) of the proposed project.

Ecotone habitat will be created along approximately 4,000 linear feet of levee on the east side of Pond A12. Approximately 30 acres of new upland transitional habitat will be created in this area. Following construction of the ecotone area, it will be seeded with native grasses, forbs, and low shrubs.

Breaching of Ponds A9-A15 would restore up to 2,010 acres of new tidal habitat (including the upland transitional habitat discussed below). As discussed for Pond A18 above, sediment accretion will need to occur within these ponds in order to raise pond bottoms to elevations that will support marsh vegetation. Once tidal marshes have begun to form in the former ponds, the rate of sedimentation will increase as the vegetation slows the water, catches sediment, and retains it. Eventually, with sufficient sediment, it is expected that, if breached, Ponds A9-A15 will be largely vegetated, aside from tidal sloughs. The considerable increase in tidal prism that will occur once these ponds are breached is expected to draw saline water from the Bay into these ponds, resulting in dominance of restored marsh by salt marsh species. An analysis performed by HTH (2012) predicted that the majority of the Pond A9-A15 system will be dominated by salt marsh vegetation. In addition, this increase in tidal prism will draw more saline water into and around the marshes downstream, thus converting some existing brackish marsh along Alviso and Coyote Sloughs to salt marsh habitat.

Maintenance

Following the breaching of levees around Ponds A9-A15, the only management activities that might occur within the restored tidal habitats are predator management and invasive plant management, as discussed previously. Predator management currently performed according to the Refuge's predator management plan (Foerster and Takekawa 1991, as updated in Service 2012a; Refuge 2012) will continue to be implemented on Refuge lands.

Recreation Actions

Recreation activities were incorporated into the proposed project to replace the loss of public access as the ponds in the Service-managed Refuge are breached and restored to tidal marsh. The proposed recreation measures associated with Service-led actions are multi-use trails on top of the new FRM levee, with connections to the Bay Trail network, along with viewing platforms, and trail upgrades to be made to an existing segment of the Bay Trail system along SR 237 (Figure 3).

Under existing conditions, a loop trail extends around Ponds A9 through A15, with an interior trail also existing between A15 and A13/14. These trails can be accessed from the Alviso Marina or via a spur that crosses the railroad tracks between Ponds A16 and A15. Restoration of tidal action to Ponds A9 through A15 will involve breaches in the outboard levees, thus interrupting the perimeter trail. Around Ponds A9-A15, the only trails that would remain following the completion of tidal restoration would consist of short segments in the eastern part of this group of ponds, as shown on Figure 3 (see also Figure 18 in the Biological Assessment (HTH 2014)).

The proposed project includes a new section of maintenance trail along the crest of the new WPCP Segment, which will be available for pedestrian traffic. Consistent with the WPCP Master Plan, the eastern extent of the levee maintenance trail will connect to a designated route at the existing bridge at McCarthy Boulevard. The existing pedestrian walkway on the bridge will take recreationists to the Coyote Creek Trail that runs along the east bank of the creek. This proposed trail connection will be refined in final design with consideration of both public safety and the addition of features (*e.g.*, fencing) to limit public access to sensitive wildlife areas. In addition, because the westernmost extent of the proposed levee's maintenance trail will end (with the levee itself) at existing high ground adjacent to the Alviso Marina, this will facilitate another connection to the Bay Trail if the City of San Jose's proposed plans to connect the Alviso Marina to the larger trail network are realized. In addition, the proposed project will construct a trail segment along the north side of SR 237 between the Guadalupe River and Zanker Road (see Figure 18 in the Biological Assessment (HTH 2014)).

Construction Equipment/Activities for Recreation Components

Construction of the recreation and public access components may consist of the following activities:

1. Grading and, for all-weather trails, gravel application. Equipment required for trail construction may include small, Bobcat-sized equipment, backhoes or front-end loaders, graders, bulldozers, asphalt placement equipment, and dump trucks.

2. Constructing trails, including some trails designed to accommodate vehicular use, trails to provide access to a staging area, and trails for disabled access.

3. Constructing interpretive stations of varying size and scope, which will include interactive features that can operate independently or can be enhanced with the assistance of docents.

4. Constructing viewing platforms at vista points where important information about the landscape can be described. Viewing platforms will be made of wood, metal, or plastic material and assembled in-place using a backhoe or excavator and hand tools. Interpretive stations will be built on-site, or will be prefabricated structures. Assembly and installation will require a backhoe or excavator and hand tools.

Maintenance of Recreation Components

Once construction of the recreation components is complete, the SCVWD, likely in a cooperative agreement with the City of San Jose, will be responsible for their operation, maintenance, repair, replacement, and rehabilitation. It is anticipated that the following operations and maintenance activities will be performed on the trails and the Artesian Slough pedestrian bridge:

1. Trash and anthropogenic debris removal;

2. Repairs due to damage by people, small mammals, storm activities, or other factors;

3. Trail and bridge inspections;

4. Graffiti removal;

5. Access improvements and upkeep;

6. Predator and invasive species management;

7. Enforcement of conservation measures; and

8. A long-term management plan will be prepared to describe the implementation of these activities.

Monitoring and Adaptive Management Actions

MAM will be implemented in Ponds A9-A15 as described previously for Pond A18. The MAMP includes a discussion of the scientific basis and institutional structure for implementation, specific MAM activities, and cost estimates. Monitoring activities to be performed for the restoration activities at Ponds A9-A15 include those listed previously. Other monitoring of more regional issues, such as regional changes in mudflat and tidal marsh acreages, changes in bird populations (including sensitive species and predators such as gulls), and mercury bioavailability, will continue to occur through the SBSPRP as it currently does.

Conservation Measures

The operational implementation of proposed project activities incorporates a number of measures, including general and species-specific measures, to avoid and minimize impacts during construction. All of these measures apply both to Corps-led and Service-led activities. Residual impacts remaining

after implementation of the general and species-specific avoidance and minimization measures are addressed through compensatory conservation measures. These conservation measures are further described below.

General Avoidance and Minimization Measures

Below, the general conservation measures that will be implemented during proposed project activities to avoid and minimize adverse effects on sensitive species and habitats are described, followed by conservation measures specific to individual special-status species. Additional details and measures are provided in the proposed project's *Integrated Document* (HDR 2014). All permit conditions, legal requirements, and appropriate excavation and engineering practices shall be followed to avoid and minimize environmental impacts associated with the proposed project. The term "project site" below refers to any of the potential work locations related to FRM and restoration activities that will occur throughout the proposed project's action area.

1. Earthen materials (*e.g.*, existing levees) will be reused to the extent feasible to reduce the amount of imported material and stockpile and landfill material.

2. Staging, access, and parking areas will be located outside of sensitive habitats to the extent feasible.

3. Areas of disturbance will be limited to the smallest footprint necessary.

4. All equipment will be maintained free of petroleum leaks. All vehicles operated within 150 feet of any water body will be inspected daily for leaks and, if necessary, repaired before leaving the staging area. Inspections will be documented in a record that is available for review on request.

5. Spill prevention kits will always be in close proximity to construction activities (*e.g.*, crew trucks and other logical locations) when using hazardous materials. Feasible measures will be implemented to ensure that hazardous materials are properly handled and the quality of aquatic resources is protected.

6. No fueling will be performed in wetland or aquatic habitats unless equipment stationed in these locations is not readily relocated (*e.g.*, Aquamog, pumps, generators, dredge barges). For stationary equipment that must be fueled on site, containment will be provided in such a manner that any accidental spill of fuel will not be able to enter the water or contaminate sediments that may come in contact with water.

7. A hazardous materials management/fuel spill containment plan will be developed and implemented by the construction contractor and given to all contractors and biological monitors working on the proposed project, with at least one copy of the plan located onsite at all times. The purpose of the plan is to provide onsite construction managers, environmental compliance monitors, and regulatory agencies with a detailed description of hazardous materials management, spill prevention, and spill response/cleanup measures associated with the construction of the proposed project elements. The primary objective of the plan is to prevent a spill of hazardous materials. Elements of the plan include, but are not limited to the following:

a. A discussion of hazardous materials management, including delineation of hazardous material and hazardous waste storage area, access and egress routes, waterways, emergency assembly areas, and temporary hazardous waste storage areas;

b. Materials Safety Data Sheets for all chemicals used and stored on site;

c. An inventory list of emergency equipment;

d. Spill control and countermeasures including employee spill prevention/response training;

e. Notification and documentation procedures; and

f. Monthly reporting plan.

8. Vehicles will be washed only at an approved area. No washing of vehicles will occur at job sites.

9. A berm or other sediment-control devise will be installed around stockpiled soil material to prevent runoff from transporting sediment into sensitive habitats.

10. Any large wood or weed-free topsoil displaced by construction will be stockpiled for use during site restoration. Native vegetation displaced by construction will be stockpiled if it would be useful during site restoration.

11. The work site, areas adjacent to the work site, and access roads will be maintained in an orderly condition, free and clear from debris and discarded materials. Personnel will not sweep, grade, or flush surplus materials, rubbish, debris, or dust into storm drains, water bodies, or waterways. Upon completion of work, all building materials, debris, unused materials, concrete forms, and other construction-related materials will be removed from the work site.

12. A stormwater management plan will be developed to ensure that, during rain events, construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion-control materials (*e.g.*, baffles, fiber rolls, or hay bales; temporary containment berms) and erosion-control measures such as straw application or hydroseeding with native grasses on disturbed slopes; and floating sediment booms and/or curtains to minimize any impacts that may occur due to increased mobilization of sediments. Suitable erosion control, sediment control, source control, treatment control, material management, and non-stormwater management best management practices will be implemented consistent with the latest edition of the California Stormwater Quality Association "Stormwater Best Management Practices Handbook," available at www.capmphandbooks.com.

13. All disturbed areas will be stabilized within 12 hours of any break in work unless construction will resume work within seven days. Earthwork will be completed as quickly as possible, and site restoration will occur immediately following use.

14. For each activity, the supervising construction personnel will participate in a Service-approved worker environmental awareness program. Under this program, construction personnel will be informed about the presence of listed species and habitats associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the Act. Prior to construction activities, a qualified biologist approved by the Service will instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts on these species during proposed project construction and implementation. The awareness program will apply to construction occurring within or adjacent to tidal marsh or slough habitat and within or adjacent to managed pond habitat. A fact sheet conveying this information will be prepared for distribution to the construction crew and anyone else who enters the proposed project site. A Service representative will be appointed who will be the contact source for any employee or contractor who might encounter a listed species. The representative(s) will be identified during the environmental awareness program. The representative's name and telephone number will be provided to the Service prior to the initiation of any activities.

15. No firearms (except for Federal, State, or local law enforcement officers and security personnel) will be permitted at the proposed project site to avoid harassment, killing, or injuring of wildlife, with the exception of hunters who are authorized by the Service to pass through an area to access hunting areas.

16. No animals (*e.g.*, dogs or cats) will be brought to the proposed project site to avoid harassment, killing, or injuring of wildlife.

17. Ingress and egress points will be clearly identified in the field using orange construction fence. Work will not be conducted outside the designated work area.

18. In order to minimize the spread of invasive plants, all equipment (including personal gear) will be cleaned of soil, seeds, and plant material prior to arriving on the proposed project site to prevent introduction of undesirable plant species.

19. The proposed project site will be maintained trash-free, and food refuse will be contained in secure bins and removed daily during construction.

20. Nighttime work near tidal marsh habitat will be avoided to the extent feasible. If nighttime work cannot be avoided, lighting will be directed to the work area and away from habitat for the salt marsh harvest mouse, California clapper rail, and western snowy plover.

21. Interpretive signage prohibiting access to areas that are closed to the public, and indicating the importance of protection of sensitive biological resources, will be placed in key locations, such as along trails near sensitive habitats.

22. Prior to construction, all high-quality habitat for listed species will be mapped and provided to the Service. Vehicles driving on levees adjacent to such habitat for construction or monitoring activities will then travel at speeds no greater than 10 miles per hour to minimize noise and dust disturbance.

23. All clean fill material proposed for upland and wetland placement will meet the qualifications set forth in the Regional Water Quality Control Board's (RWQCB's) waste discharge requirements (Tentative Order), and will meet the screening criteria listed in the Biological Assessment (HTH 2014). If the above-mentioned thresholds are not attained but the material is approved for use by the RWQCB, consultation will be reinitiated to analyze the potential effects of the contaminated material to listed species.

24. The restored tidal marsh wetlands will be monitored for possible infestation by non-native cordgrass, perennial pepperweed, and other invasive, non-native plant species that could result in a substantial reduction in the ecological value of the tidal restoration and ecotone construction. It is expected that some non-natives that are not particularly invasive will colonize the ecotones, but if any particularly invasive plant species are found, a qualified botanist will recommend specific measures to control the spread of non-native plant species. All infestations of non-native cordgrass within the restored tidal marsh wetlands will be controlled and removed in coordination with the San Francisco Estuary Invasive *Spartina* Project without substantially hindering or harming the establishment of native vegetation in the restored wetlands. If perennial pepperweed control is necessary, spraying with glyphosate or imazapyr formulated for aquatic use may be necessary, as described by Hogle *et al.* (2007) for the San Pablo Bay National Wildlife Refuge. Otherwise, preferred vegetation management will involve non-mechanized methods of removal including hand-pulling, saline spray, pond flooding (during non-breeding seasons), and substrate-based controls. Aside from glyphosate and imazapyr for pepperweed control, the use of any herbicides will be subject to Service and NMFS approval.

25. If spraying for perennial pepperweed is necessary, the following general conservation measures will be implemented (measures specific to the California clapper rail are described below):

    a. Herbicides will be applied by a certified applicator and in accordance with application guidelines and the manufacturer label.

    b. Herbicide applications would be timed to coincide with ebbing tides to protect non-target vegetation, to allow a minimum of six hours dry time for glyphosate/imazapyr mixture applications, and at least one-hour dry time for imazapyr applications.

    c. Herbicides will be applied directly to perennial pepperweed plants and at low or receding tide to minimize the potential application of herbicide directly on the water surface.

    d. All certified applicators will be trained to correctly identify perennial pepperweed, to distinguish this species from native species in the action area, and to adhere to the conservation measures in this biological opinion.

26. Long-term maintenance and monitoring will be performed outside of peak migration periods of, and breeding seasons of, sensitive wildlife species to the maximum extent feasible.

27. A Service-approved biological monitor will be present during all work activities in or immediately adjacent to habitat that could be occupied by federally listed species to look for

individuals that may be impacted by construction; activities are considered "immediately adjacent" to sensitive habitat if those activities could result in the physical disturbance of the habitat (*e.g.*, as a result of mobilization of sediment into the habitat) or if individual listed species could move from that habitat into the proposed project area (*e.g.*, seeking refuge under construction equipment). The biologist will have stop-work authority if any individual of a federally listed species is detected in an area where it may be injured or killed by construction activities.

28. Any fencing near habitat for the salt marsh harvest mouse, California clapper rail, or western snowy plover will incorporate raptor perch deterrents to minimize raptor predation on listed species.

29. To avoid the loss of individual California clapper rails and salt marsh harvest mice, construction, maintenance, and management activities (including mowing) within or adjacent to habitat for these species will not occur within two hours before or after extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge and adjusted to the timing of local high tides), when the marsh plain is inundated, because protective cover for these species is limited and activities could prevent them from reaching available cover.

30. No dogs will be allowed on trails (or elsewhere) on Refuge lands. On City of San Jose lands, all dogs must be on leashes and must remain on established trails.

31. Long-term Predator Management and Invasive Plant Species Control Plans: A long-term management plan will be prepared to describe predator management, invasive plant species control, litter cleanup, and patrols/enforcement along the trails in the proposed project area. This plan will be implemented under a cooperative agreement between the SCVWD, the Refuge, and the City of San Jose, and it will be funded by the SCVWD.

Avoidance and Minimization Measures for the California Clapper Rail

The following measures will be implemented to avoid and minimize effects on California clapper rails:

1. To avoid causing the abandonment of an active California clapper rail nest, activities (including construction and maintenance activities) within 700 feet of vegetated tidal marsh providing suitable breeding habitat for California clapper rails will be avoided during the rail's breeding season from February 1 through August 31 unless protocol-level surveys are conducted by a Service-approved biologist to determine California clapper rail locations and territories. If breeding California clapper rails are determined to be present, activities will not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel (*e.g.*, Alviso, Coyote, or Artesian Sloughs) or across a substantial barrier between the California clapper rail calling center and any activity area is greater than 200 feet, then work may proceed at that location within the breeding season. Aside from continued use of recreational trails established prior to the start of the breeding season (which may continue), only inspection, maintenance, research, or monitoring activities that have little potential for effects on California clapper rails due to their short durations, distance from rail habitat, or low-magnitude effects may be performed during the California clapper rail's breeding season in areas within or adjacent to California clapper rail breeding

habitat, with approval of the Service under the supervision of a qualified biologist. Otherwise, with Service approval on a case-by-case basis, construction activities may take place after July 15 in a given area if the activity is thought to be minimally disturbing to breeding California clapper rails.

2. To be effective, perennial pepperweed control has to occur when the plant is in bud (May-July), during the California clapper rail breeding season. If perennial pepperweed control must be performed in California clapper rail habitat, the following measures will be implemented to minimize impacts on rails:

    a. Vehicle and foot access pathways to perennial pepperweed through tidal marsh will be minimized and use of existing roads and trails for control work will be maximized. Shortest possible access paths through the marsh to treatment patches will be identified prior to marsh access. Control methods to be used in each area will be selected to minimize potential impacts to marsh habitat and listed species from control operations.

    b. If breeding California clapper rails are determined to be present in a marsh, marsh access using aquatic-tracked vehicles (ARGOs) will not be allowed in contiguous marsh areas within 700 feet of an identified California clapper rail calling center (also referred to as the "700-ft Buffer Area") to avoid nest destruction, nest abandonment, and harassment of breeding California clapper rails. If the intervening distance across a major slough channel or across a substantial physical barrier between the California clapper rail calling center and the proposed access area is greater than 200 feet, then access may proceed within the breeding season.

    c. ARGOs will not travel within 50 feet of slough channels to avoid crushing high vegetation, such as gumplant, that grows along channels.

    d. Boats will be used to access marsh areas (where feasible) to treat large areas of perennial pepperweed along slough edges (*e.g.*, use of intelli-sprayer with 300 feet of hoseline) to further reduce the necessity of walking long distances through the marsh.

    e. Crews will be instructed to walk carefully through the marsh, avoiding high pickleweed cover (*e.g.*, greater than one foot) and wrack where salt marsh harvest mice are likely to nest or find cover.

    f. All personnel entering the marsh will be trained to identify and avoid direct and indirect disturbance to listed species and associated habitats. Training material will include taped recordings of California clapper rail calls and the "Walking in the Marsh" protocol (see Appendix A of this biological opinion) which addresses potential disturbance effects to California clapper rails and salt marsh harvest mice.

    g. Before spray operations commence each year, a qualified California clapper rail biologist familiar with the project area will familiarize the spray crew with the area and ensure that all crew members know the location of each "700-ft Buffer Area"

for protection of nesting California clapper rails. Crews will be instructed to avoid these areas unless accompanied by a qualified California clapper rail biologist.

h. During the California clapper rail breeding season, before crews are allowed to enter a California clapper rail "700-ft Buffer Area" to conduct control work, the Refuge Biologist, or designee, will work with other qualified California clapper rail biologists and the spray crew to develop a strategy for control that will minimize the amount of time the crew spends in each "700-ft Buffer Area" while conducting control. This planning session will include use of detailed maps showing perennial pepperweed locations within each "700-ft Buffer Area".

i. During the California clapper rail breeding season, a qualified California clapper rail biologist such as a Refuge Biologist, will accompany spray crews into "700-ft Buffer Areas" and will supervise and guide control operations within these areas.

j. Crews will limit time within a California clapper rail nesting area (call center + 700-ft Buffer Area) to 30 minutes or less to minimize disturbance to adult rails and to avoid potential nest destruction or nest abandonment.

k. If California clapper rail nests are encountered during control work, observers will immediately leave the vicinity of the nest and report findings to the Service.

l. If California clapper rail adults are encountered during control work, observers will move away from the birds if they are giving alarm calls or otherwise appear agitated.

Avoidance and Minimization Measures for the Salt Marsh Harvest Mouse

To minimize potential effects on the salt marsh harvest mouse, the following measures (in addition to those described above for the California clapper rail during perennial pepperweed control) will be implemented:

1. To avoid the loss of individual salt marsh harvest mice from any excavation, fill, or construction activities in suitable habitat, vegetation removal will be limited to the minimum amount necessary to permit the activity to occur. Wherever feasible, sufficient pickleweed habitat, as determined by a Service-approved biologist, will remain adjacent to the activity area to provide refugia for displaced individuals.

2. Within areas where vegetation potentially supporting salt marsh harvest mice will be impacted, vegetation and debris that could provide cover for salt marsh harvest mice will be removed using only hand tools at least three weeks prior to the commencement of construction activities. Vegetation removal will occur under the supervision of a Service-approved biologist. This vegetation will be removed on a progressive basis, such that the advancing front of vegetation removal moves toward vegetation that would not be disturbed. In some cases, temporary berms may need to be constructed over borrow ditches to enable suitable escape routes, or temporary shelter consisting of dead vegetation may be positioned to provide escape routes to suitable habitat. A Service-approved biologist will monitor the vegetation removal and make specific recommendations with respect to the rate of vegetation removal (to ensure that any salt marsh harvest mice present are able to escape

to cover that will not be impacted), whether vegetation needs to remain in a certain area temporarily to facilitate dispersal of salt marsh harvest mice into habitat outside the impact area, and whether any berms are necessary to allow salt marsh harvest mice to disperse across channels.

3. Following the hand-removal of vegetation, exclusion fencing will be erected as needed between construction areas and salt marsh harvest mouse habitat that is to remain unimpacted to define and isolate protected salt marsh harvest mouse habitat. This fencing will consist of heavy plastic sheeting or metal material that cannot be climbed by salt marsh harvest mice, buried at least four inches below the ground's surface, and with at least one foot (but no more than four feet) above the ground. All supports for the fencing will be placed on the inside of the work area. A four-foot buffer will be maintained free of vegetation around the outside of the exclusion fencing. The fencing will be inspected daily during construction, and any necessary repairs will be made within 24 hours of when they are found. If any breaks in the fencing are found, the Service-approved biologist will inspect the work area for salt marsh harvest mice.

4. Although individual salt marsh harvest mice cannot be handled on non-Federal land, because the species is fully protected according to the California Fish and Game Code, individuals can be handled on Federal land (*i.e.*, the Refuge). If any individual salt marsh harvest mice are found within the impact footprint on Refuge land, and they do not move on their own to vegetated areas outside the impact footprint, they will be relocated by hand to suitable habitat outside the impact zone by a qualified biologist.

5. During construction, a Service-approved biologist will check underneath vehicles and equipment for salt marsh harvest mice before such equipment is moved, unless the equipment is surrounded by salt marsh harvest mouse-proof exclusion fencing.

6. During mowing of vegetation along the FRM levee, mowing will start from the top (the area of least suitable habitat) and proceed downslope toward more suitable habitat so any salt marsh harvest mice present in the narrow swath to be mown can move away from the disturbance of the mower and out of the mowing area.

7. Below the zone at the top of the levee that will be mown, any woody plant removal that becomes necessary will be performed by hand; such hand-removal is expected to be necessary very infrequently (*e.g.*, once every few years, at most).

Avoidance and Minimization Measures for the Western Snowy Plover

The following measures will be implemented to avoid and minimize effects on western snowy plovers:

1. No activities will be performed within 600 feet of an active western snowy plover nest during the western snowy plover's breeding season, March 1 through September 14 (or as determined through surveys). Vehicles driving on levees and pedestrians walking on recreational trails established prior to the start of the breeding season (which may continue) will remain at least 300 feet away from western snowy plover nests and broods to the extent feasible, although because these trails are already accessible to the public, nesting western

plovers are expected to continue to adjust the location of nesting based on their tolerance of distance from these trails. If necessary, signage, temporary fencing such as roped-off areas, or other markers will indicate areas that vehicles and pedestrians should avoid to protect nesting western snowy plovers, and Refuge staff will enforce these closures. In addition, personnel that must stop at a specific site for brief inspections, maintenance, or monitoring activities will remain 600 feet away from western snowy plover nests and broods. *Exception*: Only inspection, minor maintenance (such as water level management within a pond), research, or monitoring activities may be performed during the western snowy plover breeding season in areas within or adjacent to western snowy plover breeding habitat with approval of the Service under the supervision of a qualified biologist. If western snowy plover chicks are present and are foraging along any levee that will be accessed by vehicles (*e.g.*, for construction, inspection, or access), vehicle use will be under the supervision of a qualified biologist (to ensure that no chicks are present within the path of the vehicle).

2. Breaching of ponds that contain suitable western snowy plover habitat will not be performed during the breeding season (March 1 through September 14) unless surveys have documented that no active nests or unfledged chicks are present within the ponds to be flooded by breaching.

3. Viewing platforms, kiosks, benches, interpretive displays, and other focal areas for public use will be located a minimum of 600 feet from suitable western snowy plover nesting habitat.

Avoidance and Minimization Measures for the California Least Tern

Although California least terns are not known or expected to nest in or very near the action area, the following measures required by the Service's biological opinion for the SBSPRP are incorporated into the proposed project:

1. No activities will be performed within 300 feet of an active California least tern nest during the California least tern's breeding season, which is April 15 to August 15 (or as determined through surveys). *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the California least tern's breeding season in areas within or adjacent to California least tern breeding habitat with approval of the Service under the supervision of a qualified biologist.

2. Breaching of ponds that contain suitable California least tern nesting habitat will not be performed during the breeding season unless surveys have documented that no active nests or unfledged chicks are present within the ponds to be flooded by breaching.

3. To avoid or minimize potential adverse effects from public access and recreation features constructed near tidal marsh, trails adjacent to some nesting areas for sensitive bird species will be closed during the breeding season. Public trails within 300 feet of suitable California least tern nesting habitat will be closed during the breeding season. In addition, if trails are to be open during the breeding season of this species, viewing platforms, kiosks, benches, interpretive displays, and other focal areas for public use will be located a minimum of 600 feet from suitable nesting habitat. The locations of trail segments to be closed, and the periods of closure will depend on whether sensitive bird species, such as California least terns, are nesting in certain areas in a given year and whether nesting areas are located in

close proximity to the trails. Decisions about whether to close a particular trail segment will be made early in the breeding season (and possibly later in the season as conditions change) following surveys for nesting birds within a given pond adjacent to a trail.

Avoidance and Minimization Measures for the Longfin Smelt and Other Special-Status Fish Species

To minimize potential effects on the longfin smelt and other special-status fish species managed according to the Fishery Management Plans, the following measures will be implemented:

1. Construction activities in, or directly adjacent to, waters where Central California Coast steelhead and longfin smelt are likely to be present will be performed between June 1 and November 30.

2. Levee breaching will not occur between February 1 and May 31 for the protection of out-migrating juvenile steelhead in, or directly adjacent to, waters where steelhead are likely to be present.

3. Activities that extend into the waters where listed fish and fish species managed according to Fishery Management Plans may be present, such as pilot channel excavation, will be performed at low tide and/or under de-watered conditions, to the extent practicable.

4. Cofferdams will be used to the extent feasible during construction and maintenance activities, as well as during implementation of any adaptive management actions, that could potentially result in substantial siltation of protected fish habitat.

5. All pumps used for dewatering where salmonids may be present will be screened according to NMFS and CDFW criteria for juvenile salmonids.

6. During tide gate construction on Artesian Slough, all pile driving will be performed using a vibratory hammer to minimize the potential effects of noise and pressure-waves on fish.

7. NMFS personnel will be immediately notified of any observed fish mortality events.

8. Tidally restored ponds will contain channels that are adequate for the ingress and egress of fish with tidal circulation. Inspections will be documented in a record that is available for review on request.

9. Treated wood will not be used in structures that may come into contact with water.

Western Snowy Plover Compensatory Conservation Measures

The Corps will implement the following compensatory mitigation for effects to western snowy plovers from levee construction:

1. Breeding habitat for the western snowy plover will be enhanced on an island in Pond A16. Islands were constructed in Pond A16 in 2012 and 2013 as part of Phase I activities of the SBSPRP, for the purpose of providing nesting, roosting, and foraging habitat for a variety of pond-associated bird species, including western snowy plovers. Western snowy plovers

nested on one of these islands in 2013. However, the dark substrate of the islands, and their relatively homogeneous surfaces, could make western snowy plovers on the islands relatively conspicuous to predators. The South Bay Shoreline Phase I Study Project will provide small gravel (or other appropriate substrate) that will be distributed in patches on one of the islands in A16 (with the island to be selected by the Refuge), and the proposed project will fund the maintenance of this gravel. Pea gravel has been intentionally provided in some areas as a substrate for use by nesting western snowy plovers (Paton and Bachman 1996, Sexson and Farley 2012), and in the Bay, some western snowy plovers at the Eden Landing Ecological Reserve nest in fine gravel along roads.

2. Predator management is currently performed on Refuge lands, but as partial compensation for adverse proposed project effects on western snowy plovers, the intensity of this management will be increased in Pond A16 and New Chicago Marsh during the western snowy plover breeding season. This enhanced predator management will include more frequent monitoring for predators nesting (*e.g.*, gulls and corvids), roosting, or foraging in these areas islands; more frequent trapping of mammalian predators in New Chicago Marsh and along Artesian Slough; and ongoing identification and implementation of deterrence or removal measures for those predators. This measure will consist of funding a predator management technician for an additional 10 hours per week during the period March 1 through September 14 (approximately 28 weeks).

The Corps will fund the initial enhancement of nesting islands in Pond A16 with gravel. The SCVWD will fund the long-term maintenance of the gravel substrate on those islands and the incremental increase in predator management in Pond A16 and New Chicago Marsh. This funding will take the form of annual allocations in the SCVWD's budget specifically for these purposes.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The "effects of the action" to be analyzed in this biological opinion are defined as the direct and indirect effects of the action, together with the effects of other activities that are interrelated or interdependent with that action (such as activities implemented or funded by the local sponsors, the CSCC and SCVWD, in conjunction with the Corps' and Service's activities). The action area includes the construction footprints for FRM and recreational access activities; the entirety of Ponds A9 through A15 and A18; portions of Pond A16 adjacent to the proposed project footprint and on the island where western snowy plover habitat enhancement will occur; the northern and western boundaries of New Chicago Marsh; areas on the outboard (bayward) sides of those ponds where pilot channel excavation will occur; all staging, stockpiling, and access areas; the portions of Alviso Slough, Coyote Slough, South Coyote Slough, and Artesian Slough downstream from proposed levee breaches that may be subject to additional scour from increased tidal prism or temporarily increased sedimentation during construction; and areas surrounding the construction footprint and trails where indirect effects such as disturbance (*e.g.*, areas within 600 feet for nesting western snowy plovers and 700 feet for nesting California clapper rails) may occur.

Analytical Framework for the Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analyses in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the California clapper rail's, salt marsh harvest mouse's, western snowy plover's, and California least tern's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of these species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the California clapper rail, salt marsh harvest mouse, western snowy plover, and California least tern; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on these species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the California clapper rail's, salt marsh harvest mouse's, western snowy plover's, and California least tern's current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the California clapper rail, salt marsh harvest mouse, western snowy plover, and California least tern and the role of the action area in the survival and recovery of the California clapper rail, salt marsh harvest mouse, western snowy plover, and California least tern as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Status of the Species

California Clapper Rail

The status of the California clapper rail and information about its biology, ecology, distribution, and current threats is available in the *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan; http://www.fws.gov/sacramento/es/Recovery-Planning/Tidal-Marsh/es_recovery_tidal-marsh-recovery.htm; Service 2013). Critical habitat has not been designated for this species. Recent genetic analyses of rail species resulted in a change in the common name and taxonomy of the large, "clapper-type" rails (*Rallus longirostris*) of the west coast of North America to Ridgway's rail (*Rallus obsoletus*) (Maley and Brumfield 2013, Chesser *et al.* 2014). Thus the California clapper rail is now referred to in the scientific community as the California Ridgway's rail (*Rallus obsoletus obsoletus*). The change in the common name and taxonomy of the California clapper rail, however, does not change the listing status of the species.

Salt Marsh Harvest Mouse

There are two subspecies of the salt marsh harvest mouse: the northern subspecies (*R. r. halicoetes*) and the southern subspecies (*R. r. raviventris*). Both subspecies are listed as endangered. The status of the salt marsh harvest mouse and information about its biology, ecology, distribution, and current threats is available in the Recovery Plan (http://www.fws.gov/sacramento/es/Recovery-

Planning/Tidal-Marsh/es_recovery_tidal-marsh-recovery.htm; Service 2013). Critical habitat has not been designated for this species.

Pacific Coast Population of the Western Snowy Plover

The status of the Pacific coast population of the western snowy plover and information about its biology, ecology, distribution, and current threats is available in the *Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (Charadrius alexandrinus nivosus)* (http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf, Service 2007).

California Least Tern

The status of the California least tern and information about its biology, ecology, distribution, and current threats is available in the five-year review (http://ecos.fws.gov/docs/five_year_review/doc775.pdf, Service 2006).

Environmental Baseline

Proposed Project Location and Existing Conditions

The proposed project is located in the community of Alviso, part of the City of San Jose, Santa Clara County, California. The Study Area is bounded on the southwest by Alviso Slough; on the north by Coyote Slough, Ponds A16 and A17, the "Island Ponds" (Ponds A19, A20, and A21), and the Newby Island Landfill; on the east by the Coyote Creek levee; and on the south by SR 237 (Figure 1).

Figure 1 depicts the Study Area in relation to the Alviso complex of the SBSPRP (on Refuge lands). The Alviso pond complex of the SBSPRP area bisects the Study Area, with managed ponds A9 through A17, Alviso Slough, and portions of Coyote Slough within the SBSPRP's Alviso complex, and Pond A18, New Chicago Marsh, and the WPCP being outside the SBSPRP's Alviso complex. However, the entire Study Area is within the action area for the SBSPRP's section 7 consultation (Service 2008).

Tidal marshes along both Alviso Slough and Coyote Slough are fresh/brackish in their upper reaches, where they are dominated by California bulrush, alkali bulrush, cattails, and invasive perennial pepperweed, but this vegetation transitions into salt marsh species such as Pacific cordgrass, pickleweed, and marsh gumplant toward the downstream portions of these sloughs. Artesian Slough, into which the WPCP discharges treated wastewater, is dominated primarily by freshwater marsh, which transitions to brackish marsh toward its confluence with Coyote Slough. Marshes along all three of these sloughs are relatively narrow and thus, in most places, lack the extensive channel networks that characterize larger marshes. Pond A17 has only recently been opened to tidal action, and thus rather than being vegetated, is inundated during the higher portion of the tidal cycle and consists mostly of mudflat at low tide; eventually, it is expected and intended that A17 will be dominated by tidal marsh. New Chicago Marsh is a diked, muted tidal salt marsh dominated by pickleweed, saltgrass, jaumea, and other halophytes in some areas, but with extensive open water and salt panne habitat as well.

Ponds A9, A10, A11, A14, A16, and A18 are managed ponds, with varying water depths and salinities similar to or slightly higher than Bay salinities. Ponds A9, A10, A11, and A14 are joined by breaches in their levees; water control structures along Alviso Slough at Pond A9 and Coyote Slough at Pond A14 allow water to enter these ponds. Ponds A12, A13, and A15 are also managed ponds, but are referred to as "batch ponds", because they are managed for higher salinities. Pond A16, which will be a managed pond under the SBSPRP, receives water from Pond A17 through a control structure, and water flows out of A16 through another structure in its southeastern corner; a structure along the southern edge of Pond A16 allows water to discharge into New Chicago Marsh as well. Pond A18 is not managed in concert with the other ponds; water in this pond is managed via two control structures, one in the northwest and one in the southwest portion of the pond. Currently, all managed and batch ponds on Refuge lands (A9-A15) are managed primarily as habitat for pond-associated waterbirds; Pond A18 is managed to maintain ambient conditions, with ancillary benefits to waterbirds. The Study Area also includes developed areas associated with the community of Alviso and an electrical generation plant, landfills, the WPCP water/sewage treatment areas, and upland grassland/ruderal habitat in the WPCP buffer lands.

The South Bay Shoreline Study is closely interrelated, and in some cases overlaps, with the ongoing implementation of the SBSPRP. The planning process for the South Bay Shoreline Phase I Study is being coordinated with the SBSPRP actions, as both efforts have similar FRM, ecosystem restoration, and recreation objectives. A final SPSPRP Environmental Impact Statement/ Environmental Impact Report, including both programmatic and project-specific actions, was released in December 2007 (EDAW *et al.* 2007). The total SBSPRP area consists of 15,100 acres of former salt ponds and adjacent habitats in the South Bay that the Service and CDFW acquired from Cargill, Inc. in 2003. The SBSPRP area includes the Eden Landing pond complex in the cities of Hayward and Fremont, Alameda County; the Ravenswood pond complex in the City of Menlo Park, San Mateo County; and the Alviso pond complex, which extends from the City of Mountain View southeastward to the Alviso area in Santa Clara County. The SBSPRP also includes ponds A22 and A23 in the City of Fremont, Alameda County, and the aforementioned Island Ponds (Figure 1).

The Refuge owns and manages the 8,000-acre Alviso pond complex, within which are located New Chicago Marsh and 2,100 acres of ponds included in the current South Bay Shoreline Phase I Study Area. Pond A18 (about 856 acres), owned by the City of San Jose, is also included in the South Bay Shoreline Phase I Study Area, although it is not included in the SBSPRP Study Area and was not covered by the SBSPRP's section 7 consultations. Although Pond A18 was not considered in the SBSPRP, primarily due to not being a Service-managed property, the actions being proposed for the pond are similar to those proposed for the rest of the Alviso complex ponds, and the addition of Pond A18 to the South Bay Shoreline Phase I Study Area is consistent with the goals for the greater South Bay tidal restoration.

SBSPRP Phase I construction started in 2008; the final SBSPRP Phase I restoration actions were initiated in 2011 at Alviso Complex Ponds A16 and A17. Because both Ponds A16 and A17 were restored or reconfigured as part of SBSPRP Phase I implementation, no focused South Bay Shoreline Phase I restoration actions are proposed for these two ponds (although one of the islands in A16 will be enhanced for use by western snowy plovers).

California Clapper Rail

Central/South San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the Recovery Plan's Central/South San Francisco Bay Recovery Unit for the California clapper rail (Service 2013). The Central/South San Francisco Bay Recovery Unit supports the majority of California clapper rail populations. Populations in this unit are widely separated from northern ones, but there may be occasional dispersal between these areas. Predation by mammalian and avian predators is one of the primary threats to California clapper rails in the Central/South San Francisco Bay Recovery Unit (Albertson 1995, Service 2013, Overton *et al.* 2014). Overton *et al.* (2014) tracked 108 radio-marked California clapper rails at four marshes within the Central/South San Francisco Bay Recovery Unit (*i.e.*, Colma Marsh, Arrowhead Marsh, Laumeister Marsh, and Cogswell Marsh) and estimated survival rates over 166 weeks between 2007 and 2009. Overton *et al.* (2014) found that most of the California clapper rails (53 percent) died due to predation with raptors depredating 30 individual California clapper rails (28 percent) and mammals depredating 27 individual California clapper rails (25 percent). The annual survival rate for California clapper rails at Laumeister Marsh, a native tidal marsh managed by the Refuge near the City of East Palo Alto, San Mateo County, was 0.227 (Overton *et al.* 2014). The Refuge intermittently conducts mammal predator management on some Refuge lands within the Central/South San Francisco Bay Recovery Unit; however, the extent of mammal predator management implemented at the Refuge is limited by the lack of funding. The Refuge recently finalized an avian predator management plan to control avian predators of the California clapper rail on Refuge lands within the Central/South San Francisco Bay Recovery Unit; however, the Refuge lacks the resources to adequately monitor and control avian predators at the Refuge.

Breeding-season surveys of South Bay marshes for California clapper rails through the early 1990s, summarized by Foin *et al.* (1997), indicated that the most substantial populations of California clapper rails in the South Bay were, predictably, in the largest sections of tidal salt marsh at: Mowry Marsh and Dumbarton Marsh (in the eastern Bay between the Dumbarton Bridge and Mowry Slough in Alameda County), the Faber/Laumeister Tracts and other marshes in the Palo Alto/East Palo Alto area in San Mateo and Santa Clara counties, and Greco Island in the City of Redwood City, San Mateo County. California clapper rails occurred in many other marshes as well, including Ideal Marsh, La Riviera Marsh, and Calaveras Marsh in the City of Fremont, Alameda County, and Triangle Marsh in the community of Alviso, Santa Clara County. Surveys by HTH and others since the early 1990s, as well as observation by birders (including HTH staff), have documented California clapper rails in a number of areas in the far South Bay, including lower San Francisquito Creek; the Palo Alto Baylands; Hook's Isle; the mouth of Charleston Slough; lower Permanente and Stevens creeks; Guadalupe Slough (primarily from its confluence with Moffett Channel downstream); Alviso Slough; a number of locations along Coyote Slough, extending upstream through the reach of the slough between Newby Island Landfill and the WPCP (known as South Coyote Slough or the lower Coyote Creek Bypass); and in the Warm Springs marshes. Although site-specific surveys have not been conducted in all suitable habitat for California clapper rails in the South Bay, this species is likely to occur in tidal salt marsh habitats in a number of additional areas as well.

Habitats and Occurrences within the Action Area

Within the action area, California clapper rails are most likely to occur in tidal salt marsh and brackish marsh along the lower and middle reaches of Alviso Slough (*e.g.*, from the northwest corner

of Pond A12 downstream) and Coyote Slough (*e.g.*, from the vicinity of the Artesian Slough confluence downstream), and near the mouth of Artesian Slough. Although California clapper rails are known to be present in the downstream reaches of these sloughs, where the tidal marsh is dominated by salt-marsh plant species, they are less likely to occur in areas dominated by freshwater vegetation (*e.g.*, California bulrush and cattail) along the upper portions of Coyote, Artesian, and Alviso sloughs. In recent years, few surveys for California clapper rails have been conducted along the upper reaches of Alviso Slough, or anywhere in Artesian Slough or along upper Coyote Slough (upstream from its confluence with Artesian Slough).

In 2007, PRBO Conservation Science conducted surveys for California clapper rails along the middle and lower reaches of Guadalupe and Alviso sloughs (L. Liu, PRBO Conservation Science, pers. comm. cited in HTH 2013). Single California clapper rails were detected near the mouths of these sloughs (*i.e.*, along Guadalupe Slough near the Pond A5/A6 levee and along Alviso Slough east of Pond A6), but none were heard farther upstream.

More recently, surveys for the Invasive *Spartina* Project have been conducted along Alviso Slough from Pond A11 downstream to its confluence with Coyote Slough, and along Coyote Slough from the vicinity of the railroad tracks downstream along Ponds A12, A14, and A9 (data provided by Olofson Environmental, Inc.). From 2010 through 2014, all California clapper rail detections along Alviso Slough were at its mouth, near the northwest corner of Pond A9: between nine and 10 California clapper rails were detected in 2010, between four and six were detected in 2011, between one and two were detected in 2012, and between two and four California clapper rails were detected in 2014 near the mouth of Alviso Slough (Olofson Environmental, Inc. 2012, 2014).

On one occasion, a California clapper rail was recorded in brackish/freshwater transition marsh along upper Alviso Slough between the Alviso Marina and the Gold Street Bridge (February 14, 1997; Scott B. Terrill, pers. obs.). Earlier (approximately 1989) an individual California clapper rails was detected in the Alviso Marina (Ron Duke, pers. obs. cited in HTH 2013). However, no California clapper rails have been observed along upper Alviso Slough within recent years. For example, surveys conducted by the San Francisco Bay Bird Observatory at the Alviso Marina found no California clapper rails during early spring 2003 and 2004 (C. Strong, Refuge, pers. comm. 2012). Also, pre-construction California clapper rail surveys conducted by the Refuge prior to Pond A8 notch construction in 2010 did not find any California clapper rails in this reach of upper Alviso Slough (C. Strong, Refuge, pers. comm. 2012). Therefore, any occurrence of California clapper rails in upper Alviso Slough would likely be by occasional non-breeding birds.

California clapper rails have also been detected along Guadalupe Slough as far as the nontidal freshwater ponds between Calabazas and San Tomas Aquino Creeks north of SR 237 (16 August 1998; Steve Rottenborn, HTH, pers. obs.). Between one and two California clapper rails were detected along upper Guadalupe Slough again in 2012 near the Moffett Channel (Olofson Environmental, Inc. 2012). However, such rails are likely wandering and foraging individuals, and their occurrence in these areas is expected to be sporadic.

Along Coyote Slough, all California clapper rails detections since 2010 have been from Triangle Marsh (north of Pond A15) downstream to Pond A9 except for a single detection near the northwest corner of Pond A18, at the Coyote Slough/Artesian Slough confluence. Call count surveys along South Coyote Slough detected between nine and 10 California clapper rails in 2011,

between six and 10 rails in 2012, and between eight and 10 rails in 2014 between Pond A15 and Triangle Marsh (Olofson Environmental, Inc. 2012, 2014).

Therefore, based on the known occurrences of the California clapper rail within the action area, the Service believes the California clapper rail is likely to occur within the action area in all suitable tidal salt marsh and tidal brackish marsh habitat along Alviso Slough, Artesian Slough, Coyote Slough, and South Coyote Slough.

Salt Marsh Harvest Mouse

Central/South San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the Recovery Plan's Central/South San Francisco Bay Recovery Unit for the salt marsh harvest mouse (Service 2013). The Central/South San Francisco Bay Recovery Unit is within the range of the southern subspecies of the salt marsh harvest mouse (*R. r. raviventris*) (Service 2013). The population status of the southern subspecies is more precarious than that of the northern subspecies (*R. r. halicoetes*). Few major, resilient, or secure populations of the southern subspecies of the salt marsh harvest mouse persist within the Central/ South San Francisco Bay Recovery Unit. The current populations within this recovery unit are very small and isolated compared with the historical pattern of distribution and abundance of the subspecies. All major population centers of the southern subspecies are remote from one another based on dispersal distances known for the species. Predation by mammalian and avian predators and spread of invasive plant species (*e.g.*, perennial pepperweed) are major threats to salt marsh harvest mice in the Central/South San Francisco Bay Recovery Unit (Albertson 1995, Service 2010, Service 2013).

Occurrences near the Action Area

The salt marsh harvest mouse has been detected during trapping studies in a number of locations within and near the action area, including Alviso Slough near the northwest corner of Pond A12, Triangle Marsh, New Chicago Marsh, the mitigation wetlands on the south side of Pond A18, the Coyote Creek Bypass area, and Guadalupe Slough (San Francisco Estuary Institute, http://www.sfei.org/content/salt-marsh-harvest-mouse-database-and-maps, site numbers 21, 57, 249, and 306; California Natural Diversity Database (CNDDB) occurrence numbers 91, 92, 115, 116, 147, 132, and 133; CDFW 2014). The highest-quality habitat for this species within the action area occurs in tidal salt marsh along the lower reaches of Alviso and Coyote Sloughs, and at the mouth of Artesian Slough, as well as in diked salt marsh within New Chicago Marsh and within the mitigation wetlands on the south side of Pond A18. Brackish marshes farther upstream along Alviso, Coyote, and Artesian Sloughs represent lower-quality habitat, and salt marsh harvest mice have a lower probability of occurrence (and if present, likely occur in lower densities) in such brackish marshes. However, as a result of this species' detection in brackish marshes in the Warm Springs area in 2006 (HTH 2007), it could occur in at least small numbers in brackish marshes. The freshwater marshes in the upper reaches of Alviso Slough (*i.e.*, from the southwestern part of Pond A12 upstream to the Alviso Marina and above) and Artesian Slough (*i.e.*, from the vicinity of the southeastern corner of Pond A17 upstream), as well as those in the South Coyote Slough area north of the northeastern corner of Pond A18, are less suitable habitat for the species.

There is no recent survey data available for salt marsh harvest mice within or near the action area. However, based on known occurrences of the salt marsh harvest mouse within and near the action area and the occurrence of suitable habitat within the action area, the Service believes that the salt marsh harvest mouse is likely to occur within all suitable tidal salt and brackish marshes, diked salt and brackish marshes, and adjacent upland habitats (*e.g.*, contiguous grassland habitat within 328 feet of suitable marsh habitat (Service 2010, 2013)) throughout the action area.

Pacific Coast Population of the Western Snowy Plover

San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the San Francisco Bay Recovery Unit for the Pacific coast population of the western snowy plover (http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf, Service 2007). One of the delisting criteria for the Pacific coast population of the western snowy plover is for the maintenance of 500 individual breeding western snowy plovers within the San Francisco Bay Recovery Unit (Service 2007). The SBSPRP has committed to the maintenance of at least 250 individual breeding western snowy plovers in the South Bay through adaptive management of salt pond breeding habitat and predator management within the SBSPRP area. The Refuge intermittently conducts avian and mammal predator management within some of the larger western snowy plover nesting populations in the South Bay.

In the South Bay, the highest numbers of nesting western snowy plovers occur in portions of Alameda and San Mateo counties outside the action area. Nearly all of the Bay nesting occurs south of State Route 92 (San Mateo Bridge) in the South Bay (Page and Stenzel 1981, Page *et al.* 1991, Service 2007). Abundance of western snowy plovers during surveys around the Bay may vary considerably from year to year. Summer window-survey data for the years 2009-2014 detected 147, 275, 249, 147, 202, and 178 individual western snowy plovers within the San Francisco Bay Recovery Unit during those six years (http://www.fws.gov/arcata/es/birds/WSP/plover.html, Service 2014b).

Habitats and Occurrences within the Action Area

Western snowy plover summer window-survey data for the years 2009-2014 detected eight, zero, 11, 20, 10, and zero individual western snowy plovers during those six years in the Alviso area of northern Santa Clara County (http://www.fws.gov/arcata/es/birds/WSP/plover.html, Service 2014b). In the action area itself, western snowy plovers have nested recently (*i.e.*, 2012-2014) in New Chicago Marsh, Ponds A9, A12, A13, and A16, and in the impoundment between Pond A12 and the railroad tracks (just north of the old Alviso Marina; hereafter "Alviso impoundment"). Of 13 western snowy plover nests in 2012, four each were in Ponds A16 and A17, which were being dried out for construction of islands in A16 and tidal restoration in A17 (Donehower *et al.* 2012). The other five western snowy plover nests were in Pond A13. Of the 10 western snowy plover nests in the vicinity of the action area in 2013, six were in Pond A16; one was on a recently constructed island and five were on the dried-out pond bottom when the pond was drawn down for island creation, but this area was eventually re-flooded (Robinson-Nilsen *et al.* 2013). The others included single western snowy plover nests in New Chicago Marsh and the Alviso impoundment, and two in Pond A9. In 2014, western snowy plovers have been documented nesting in Pond A9 (one nest that was flooded) and A13 (two nests that hatched young). Due to variability in water level management in Ponds A9-A15, the suitability of habitat for nesting in these ponds has varied

from year to year, and Pond A12 has provided nesting habitat in some years. Western snowy plovers have never been known or suspected to breed in the action area east of Artesian Slough (*i.e.*, in the vicinity of Pond A18).

California Least Tern

In the Bay, the primary California least tern breeding colonies are at Alameda Point in the City of Alameda and Hayward Regional Shoreline in Alameda County, and at the Montezuma Wetlands near Suisun City, Solano County. California least terns also nested in 2000 and 2001 in the City of Albany (near Alameda), Alameda County, with up to 12 pairs in 2000. In the City of Pittsburg, Contra Costa County on Suisun Bay, 13 pairs nested in 2001 and eight pairs nested in 2003. Historically, small numbers of birds have nested at the Oakland International Airport (last reported in 1995), Bay Farm Island (last reported 1975), Bair Island (last reported 1984), Port Chicago (last reported in 1988), the Bay Bridge Sand Spit (one-time attempt in 1985), and Tern Island (one-time attempt in 1990, U.S. Geological Survey preliminary data, unpubl.)

California least terns have never been recorded nesting in the vicinity of the South Bay Shoreline Phase I Study Project's action area, or anywhere else in Santa Clara County or nearby areas of Alameda County. In recent years, the main post-breeding staging area for California least terns in the South Bay has been in the complex of ponds immediately north of Moffett Field (Ponds AB1, A2E, and AB2), which are located approximately two miles west of the action area. These areas are used for roosting and foraging by adults and juveniles in July and August every year, with typical counts of 20 to 100 California least terns, although 276 were observed there in July 2004 (S. Rottenborn, HTH, pers. obs.). California least terns have also been recorded foraging or roosting at other South Bay ponds, including A1, A2E, A3N, A3W, A4, A5, A7, A9, A10, A11, and A14 (Marschalek 2006; J. Krause, CDFW, pers. comm.; U.S. Geological Survey preliminary data, unpubl.). Ravenswood ponds in San Mateo County are also used occasionally for foraging and roosting, with counts of 96 California least terns in July 2002, 42 in July 2003, and 110 in July 2004 (U.S. Geological Survey preliminary data, unpubl.). Eden Landing ponds in Alameda County are used irregularly for foraging including E2, E4, E5, E8A, E9, E10, and E11. California least terns do not generally forage in smaller sloughs or channels adjacent to managed ponds but rather prefer more open waters, including the Bay waters; 50 of 58 California least terns observed foraging at one South Bay location in July 2004 were doing so over the open waters of the Bay while the other eight were foraging in ponds (S. Rottenborn, HTH, pers. obs.).

California least terns are not known to nest in the action area. California least terns have been observed foraging in the action area's ponds (A9, A11, and A14) only rarely, and they have not been observed foraging in Pond A18, despite occasional visits by birders and biologists to A18 and birder coverage of A18 (using spotting scopes) from the Pond A16 levee. Although California least terns could potentially forage in any of these ponds that contain fish, survey data collected for the SBSPRP and incidental observations by birders indicate that California least terns visit the action area (as a post-breeding forager) irregularly and in low numbers.

Effects of the Proposed Project

The footprint of ground disturbance from the proposed project consists of a total of approximately 165 acres. Table 1 below lists the acreages of each of habitat type that will be disturbed by the proposed Corps-led actions (*e.g.*, construction of the levees, the Artesian Slough tide gate, the

Table 1. Habitat Disturbance from the Proposed Project.

Habitat Type	Impacts of Corps-Led Actions (acres)		Impacts of Service-Led Actions (acres)	Total Habitat Disturbance (acres)
	Levee/Tide Gate/ Bridge Construction	A18 Ecotone/ Tidal Restoration	A12 Ecotone/ Tidal Restoration	
Brackish marsh	0.20	0.07	0.03	0.3
Freshwater marsh	1.04	0.06	<0.01	1.1
Muted tidal/diked marsh	1.80	0.00	0.00	1.8
Tidal salt marsh	1.64	0.03	0.03	1.7
Non-tidal salt marsh	8.20	0.00	0.00	8.2
Seasonal wetland	3.65	0.00	0.05	3.7
Mudflat	0.59	0.01	0.00	0.6
Batch pond	3.60	0.00	29.00	32.6
Managed pond	12.07	66.13	0.00	78.2
Open water	9.40	0.00	0.00	9.4
Upland vegetation	1.00	0.00	0.00	1.0
Water/sewage treatment	0.10	0.00	0.00	0.1
Levee	18.49	0.33	0.88	19.7
Developed	6.15	0.24	0.01	6.4
TOTAL	67.93	66.87	30.00	164.8

pedestrian bridge, and the Pond A18 ecotone and tidal restoration activities) and Service-led actions (*e.g.*, construction of the Pond A12 ecotone and Ponds A9-A15 tidal restoration activities). Construction of trails and other recreational facilities, which is a Service-led activity, will occur entirely on existing levees and berms, or in ruderal grassland along SR 237, and thus the acreage of such habitat disturbance from trail construction is not included in Table 1.

In the following sections discussing effects on individual listed species, effects are separated for Corps-led and Service-led activities as appropriate. Because of the tidal flood protection functions currently provided by the outboard levees around Ponds A9-A15, tidal restoration within those ponds would not be feasible without enhancement of flood protection inboard from those ponds. As a result, the effects of Service-led tidal restoration on Refuge lands could not occur but for the Corps-led construction of the levee and tide gate, and thus, the benefits that accrue from tidal restoration on Refuge lands are dependent on Corps-led levee construction.

California Clapper Rail and Salt Marsh Harvest Mouse

Habitat Restoration

Effects of Corps-led Actions

The highest-quality habitat for the California clapper rail and salt marsh harvest mouse consists of tidal salt marsh, although these species will also use tidal brackish marshes to some extent. Tidal restoration in Pond A18 is expected to result in the creation of approximately 119 acres of tidal salt marsh and 398 acres of brackish marsh habitat for the California clapper rail and salt marsh harvest mouse (HTH 2012). In addition, approximately 67 acres of ecotone habitat will be created along the southern and eastern edges of Pond A18. The ecotone created along the southern and eastern edges of Pond A18 will provide high quality extreme high tide refugia cover for California clapper rails and salt marsh harvest mice which will reduce the risk of predation. The grassland habitat along the ecotone will also provide foraging and dispersal habitat for salt marsh harvest mice. The ecotone will also allow for the landward transgression of the tidal marsh in the face of sea level rise and provide a buffer between the marsh and developed areas. This ecotone habitat is expected to develop more quickly than the tidal marsh in A18, which will not become vegetated until sedimentation has elevated the former pond bottom to the point where vegetation can colonize it. Within a few years, it is expected that vegetation along the ecotone will provide habitat that is of higher quality for salt marsh harvest mice than the narrow strip of vegetation that is currently present along the southern and eastern edges of Pond A18.

Effects of Service-led Actions

Assuming that all of Ponds A9-A15 are eventually restored to tidal action, approximately 2,010 acres of new tidal marsh will be restored within these ponds. All of this restored tidal marsh is predicted to be salt marsh (HTH 2012). In addition, 30 acres of ecotone habitat will be created along the eastern edge of Pond A12; habitat along the ecotone is expected to become suitable for use by salt marsh harvest mice within a few years after seeding and planting occur. If only Ponds A12 and A18 are restored, then approximately 300 acres of suitable tidal marsh will be restored in A12 and 517 acres of suitable tidal/brackish marsh habitat will be restored in A18. The ecotone habitat created along the eastern edge of the restored tidal marsh in Pond A12 will benefit the California clapper rail and salt marsh harvest mouse by providing transitional habitat for the rail and the mouse to utilize as cover during extreme high tide and flooding events which will reduce the risk of predation. The ecotone will also provide foraging and dispersal habitat for the salt marsh harvest mouse. The ecotone will also allow for the landward transgression of the tidal marsh in the face of sea level rise and provide a buffer between the marsh and developed areas.

Habitat Restoration Effects Common to Corps-led and Service-led Actions

All of these marshes (in Pond A18 and A9-A15) will support complex channel networks. These channels will provide extensive foraging habitat for California clapper rails, and the larger channels will provide natural levees supporting taller cordgrass and gumplant, which serve as rail nesting habitat and high-tide refugia.

Because the rate of evolution of tidal habitats is dependent largely on sediment availability, which is difficult to predict, the precise rates of evolution of these marshes are unknown. However, the

following general timeline of expected marsh evolution predicted for restored South Bay marshes by the SBSPRP indicates the likely habitat progression expected over the 50-year timeline of the South Bay Shoreline Phase I Study Project.

Habitat restoration in the action area described above for California clapper rail will result in similar benefits for the salt marsh harvest mouse. Because salt marsh harvest mice reach their highest densities in mature marshes with pickleweed, which form in the highest marshes, the evolution of suitable habitat for salt marsh harvest mice within restored marshes will be slower than for California clapper rails, as it will take longer for marsh elevations to reach elevations appropriate for pickleweed dominance. However, development of suitable habitat for salt marsh harvest mice in the ecotones will be relatively rapid. Once suitable habitat is restored, the high fecundity of salt marsh harvest mice will ensure that this species will rapidly colonize and spread throughout the restored pickleweed marshes from occupied habitat along Coyote or Alviso sloughs or other suitable habitat.

The amount of habitat for the California clapper rail and salt marsh harvest mouse that will be restored by both the Corps-led and Service-led actions is expected to substantially increase South Bay populations of these species, and contribute greatly to their survival and recovery. In addition, the restoration of ecotones in Ponds A18 and A12 will provide high-quality refugia during extreme high tides that inundate the rest of the marsh plain, thus helping to improve winter survival rates. The ecotones will also provide seasonal foraging and dispersal habitat for the salt marsh harvest mouse in addition to providing some residence habitat for this species.

Estimated Timeline for Tidal Marsh Establishment

In 2020, Pond A12 will be breached, restoring full tidal action to approximately 300 acres of salt pond (though see the previous discussion of the possibility that Pond A18 may be breached first). By Year 10 (2027), enough sediment is expected to have accumulated in other areas of this former pond that low tidal marsh vegetation dominated by Pacific cordgrass will start to become established. Use of the restored marshes by California clapper rails is expected to occur as soon as enough vegetation is present to provide cover for foraging California clapper rails. Even though this vegetation may not be dense and/or extensive enough to provide nesting habitat by Year 10, California clapper rails are expected to forage on intertidal mudflats near vegetative cover, which may occur near the breach locations.

In 2023, the Pond A18 ecotone will be constructed and seeded providing suitable habitat for colonization by salt marsh harvest mice from nearby areas. In 2025, additional breaching may restore tidal action to approximately 875 acres in Ponds A9, A10, A11, and 736 acres in Pond A18. By 2027, tidal marsh vegetation will begin to colonize the edges of levees and berms, but by the end of Year 10 (2027), the bottoms of Ponds A9, A10, A11, and A18 may still be too low for substantial vegetation establishment.

As sediment continues to accumulate in the restored ponds, bottom elevations will be raised, and the areas at elevations suitable for colonization by tidal marsh vegetation will increase. By Year 20 (2037), vegetation will be expanding outward from the ecotone area and the edges of other levees and berms, and it is expected that sufficient sediment will have accumulated in other portions of Ponds A9-A12 and A18 that low marsh suitable for use by California clapper rails for nesting and foraging will have developed.

In 2030, an additional 850 acres of tidal restoration may occur via breaching of Ponds A13, A14, and A15. Thus, by Year 13 (2030), approximately 2,010 acres of new tidal habitat in Ponds A9-A15 and 736 acres in Pond A18 will have been restored. Evolution of marshes within Ponds A13-A15 will occur gradually as described above for other ponds.

In Years 20-50 (2037-2067), vegetated marsh will continue to expand in area and increase in elevation as sediment accumulates. Although sea level rise will raise the elevation of water within the restored marshes, thus restricting the rate of marsh development to some extent, it is predicted that the rate of sediment accumulation will outpace sea level rise, so that vegetated marshes will colonize all but the lowest-elevation areas such as tidal sloughs and channels (ESA and Philip Williams & Associates, Ltd. 2012, HTH 2012). Suitable nesting habitat and cover for the California clapper rail and salt marsh harvest mouse will continue to expand, and higher-marsh areas that form on natural levees along the larger tidal sloughs will provide high-tide refugia. By Year 50, it is expected that approximately 2,130 acres of restored tidal salt marsh and 398 acres of restored brackish marsh suitable for use by California clapper rails and salt marsh harvest mice will have been restored.

Increased Salinity and Beneficial Marsh-Type Conversion

Effects of Corps-led Actions

Breaching of Pond A18 will result in an increased tidal prism and salinization of brackish and fresh marshes throughout all of Artesian Slough and Coyote Slough, thus resulting in the expansion and enhancement of California clapper rail and salt marsh harvest mouse habitat over large areas of existing brackish and freshwater marsh along these sloughs. In addition, this change in the tidal gradient will result in the development of higher-quality habitat in already-breached Pond A17 and the Island Ponds than would develop in the absence of breaching of A18. The effects on salinities within existing marshes would be immediate, and within a period of just a few years, it is expected that considerable expanses of brackish marshes dominated by bulrush and pepperweed will have begun conversion to marshes dominated by Pacific cordgrass, pickleweed, and gumplant.

Effects of Service-led Actions

Restoration of tidal action to Ponds A9-A15 will result in an increased tidal prism and salinization of brackish and fresh marshes along Alviso Slough upstream to Pond A12 and along lower Coyote Slough, thus resulting in the expansion and enhancement of California clapper rail and salt marsh harvest mouse habitat in these areas. In addition, this change in the tidal gradient will result in the development of higher-quality habitat in already-breached Pond A6 and the Island Ponds than would develop in the absence of breaching of Ponds A9-A15. These effects are expected to occur rapidly.

Increased Salinization Effects Common to Corps-led and Service-led Actions

As levees are breached and ponds are subjected to tidal action, these ponds will draw considerable amounts of water through the breaches on rising tides. As a result, the rate of water flowing "upstream" along Alviso, Artesian, and Coyote sloughs, from the Bay into the breached ponds, on rising tides will be considerably higher than it currently is. This will result in the transportation of more saline Bay water upstream, and higher upstream, along these sloughs than currently occurs.

The effect of this change in tidal prism and the upstream migration of the salinity gradient will be the salinization of marshes along these sloughs that are currently brackish and fresh marshes due to the inputs of freshwater from Coyote Creek, the Guadalupe River, and WPCP effluent. Because outboard levee breaches will be located high up these sloughs, such as at Pond A12 along Alviso Slough, in the southwest corner of Pond A18 along Artesian Slough, and in the northeast corner of Pond A18 along Coyote Slough, more saline water will be drawn far up these sloughs, and this salinization will affect the plant species composition of marshes on a very large scale. The result will be the conversion of extensive areas of brackish marsh to salt marsh and conversion of extensive areas of freshwater marsh to brackish marsh. As a result, habitat conditions within existing brackish and fresh marshes along Alviso Slough, Artesian Slough, and Coyote Slough will become much more suitable for California clapper rails and salt marsh harvest mice. Furthermore, the upstream migration of the salinity gradient will result in higher-salinity marshes in recently restored areas such as the Island Ponds, Pond A6, and Pond A17, thus helping to enhance habitat for California clapper rails and salt marsh harvest mice beyond the conditions that would be created in the absence of the South Bay Shoreline Phase I Study Project.

In particular, given the vast extent of brackish and freshwater marsh along Coyote Slough, the breaching of Pond A18 will result in considerable expansion of California clapper rail and salt marsh harvest mouse habitat up Coyote Slough and much higher-quality rail and mouse habitat in Pond A17 and the Island Ponds. Marsh evolution predictions for the proposed project took the increased tidal prism along Coyote Slough, resulting from Pond A18 breaching into account when predicting that the entirety of restored tidal habitat in Ponds A9-A15 would be salt marsh instead of brackish marsh (HTH 2012). Thus, the increase in California clapper rail and salt marsh harvest mouse habitat and enhancement of rail and mouse habitat quality as a result of both the Corps-led and Service-led actions will be far greater than just the increase in tidal marsh within the ponds to be breached.

The salinization of tidal marsh that will result from the proposed project will also expedite project benefits to the California clapper rail and salt marsh harvest mouse. As described previously, there will be a lag between breaching of levees and development of California clapper rail and salt marsh harvest mouse habitat due to the need for sediment accumulation to elevate pond bottoms enough that vegetation can colonize the restored habitat. In the case of increased salinization, however, the effects on salinities within existing marshes would be immediate, and within a period of just a few years, it is expected that considerable expanses of brackish marshes dominated by bulrush and pepperweed will have begun the conversion to marshes dominated by Pacific cordgrass, pickleweed, and gumplant.

Loss of Habitat

Effects of Corps-led Actions

Artesian Slough Tide Gate and Pedestrian Bridge

Construction of the Artesian Slough tide gate and Artesian Slough pedestrian bridge will result in the loss of suitable habitat for the California clapper rail and salt marsh harvest mouse through the placement of fill in salt and brackish marsh habitat, but no suitable nesting habitat for California clapper rails will be directly affected. Construction of the tide gate and pedestrian bridge in Artesian Slough will result in the direct disturbance of about 1.04 acres of non-breeding tidal freshwater

marsh habitat that may be occasionally utilized by a low number of foraging and dispersing California clapper rails and salt marsh harvest mice. As indicated in Table 1, 1.64 acres of tidal salt marsh will be disturbed; however, this marsh is located in a narrow strip along the Alviso impoundment and is not truly tidal, receiving tidal inflow only during the highest tides. As a result, the disturbance of muted tidal marsh along the Alviso impoundment will disturb potential habitat for the salt marsh harvest mouse but not the California clapper rail.

Excavation of Pilot Channels and Pond A18 Breaches

Excavation of pilot channels in the outboard marsh around Pond A18 will occur in five locations, four along Artesian Slough and one at South Coyote Slough. The marsh vegetation at these breach locations consists of brackish marsh at three locations and freshwater marsh at two locations. Excavation of pilot channels and breaching will result in the direct disturbance of about 0.07 acre of brackish marsh and 0.04 acre of tidal salt marsh that could potentially support low densities of California clapper rails and salt marsh harvest mice. It is possible that the salt and brackish marsh provides suitable nesting and foraging habitat for California clapper rail. However, given the paucity of California clapper rail occurrences along Artesian Slough and the extreme eastern end of South Coyote Slough in recent years, it is likely that very few rails use this habitat, and then only occasionally (and likely only during the non-breeding season).

FRM Levee Construction

Construction of the FRM levee will result in the loss of non-tidal salt and brackish marsh habitat and adjacent upland habitat along the edges of Ponds A16 and A18 and New Chicago Marsh that are suitable habitat for the salt marsh harvest mouse but not the California clapper rail. Areas with vegetation that potentially supports the salt marsh harvest mouse, and that will be disturbed by fill placed for the levee, include non-tidal and muted tidal/diked salt marsh along the southern, western, and northern edges of the Alviso impoundment; the northern edge of New Chicago Marsh, adjacent to the southern levee of Pond A16; and both the northern and southern sides of the existing Pond A18 levee. The loss of suitable salt marsh harvest mouse habitat will result from the widening of the levee, relative to its existing footprint, and will affect a total of about 13.65 acres of vegetation dominated by pickleweed, alkali heath, grasses, and non-native weedy species that provide at least marginal-quality habitat for salt marsh harvest mice. No suitable California clapper rail habitat will be disturbed by the widening of the levee footprint because the marshes along the existing levee are non-tidal and thus not likely to support the rail.

No high-quality salt marsh harvest mouse habitat will be impacted by widening of the levee. The habitat that will be disturbed consists of narrow strips of vegetation located between the existing bare levee and either bare salt panne/mud (along the Alviso impoundment), the waters of Ponds A16 and A18, or a borrow ditch (on the south side of the levee at Ponds A16 and A18). The impacted habitat is very narrow, which increases the risk of predation on any salt marsh harvest mice that might be present in those strips of vegetation, and is separated by unsuitable habitat (*e.g.*, open ground without vegetation or open water) from more extensive, higher-quality expanses of habitat, such as that in New Chicago Marsh and in the wetlands south of Pond A18 and east of Artesian Slough. Even along the southern edge of the Pond A16 levee, the strip of pickleweed and other vegetation between the levee and New Chicago Marsh is narrow, includes much dead and sparse vegetation, and supports only a patchy distribution of dense, tall, high-quality pickleweed. As a result, the quality of habitat, and the expected density of salt marsh harvest mice within the habitat

to be impacted, is low, and the effects on salt marsh harvest mouse populations from the loss of these narrow strips of vegetation will be low.

Furthermore, these narrow strips of vegetation do not provide high-quality dispersal habitat for the salt marsh harvest mouse. The strips on the outboard (northern) side of the Pond A18 levee are separated by the bare levee itself from potential source populations of salt marsh harvest mice in New Chicago Marsh, the wetlands east of Artesian Slough, or the Coyote Creek Bypass. Open, unvegetated areas may act as barriers to movement of salt marsh harvest mice (Shellhammer 1978, Geissel *et al.* 1988), and thus salt marsh harvest mice likely cross the levee to and from this habitat very infrequently. In order for this vegetation to serve an important dispersal function, salt marsh harvest mice would have to cross bare levees from one source population, move long distances through the narrow strip of vegetation (or survive over generations within that narrow strip so that progeny eventually disperse long distances over time), and cross the bare levee again to reach another high-quality habitat area. Such occurrences are unlikely, or happen very infrequently. The narrow strip of vegetation along the western edge of the Alviso impoundment is even further removed from high-quality habitat, being separated from New Chicago Marsh by a broad salt panne and the railroad tracks.

Following levee construction, unimpacted pickleweed-vegetated areas between the Zanker Landfills/WPCP and the new levee will continue to provide suitable dispersal and residence habitat for salt marsh harvest mice. More importantly, a broad ecotone along the southern and eastern sides of A18 will be constructed. This ecotone will provide much higher-quality residence and dispersal habitat than what will be impacted. This 345-foot-wide ecotone will extend from the levee top downslope to Pond A18. The native plants that will be seeded or planted on this ecotone area will provide suitable dispersal habitat for salt marsh harvest mice, and wetland vegetation and peripheral halophytes near the lower edge of the ecotone area will provide residence habitat for the salt marsh harvest mouse that is at least as suitable (or of much higher quality) as what will be impacted. This ecotone will thus compensate (and more) for any loss of habitat along Pond A18, both in terms of the acreage of habitat impacted and linearly, replacing low-quality habitat with higher-quality habitat in the same areas linearly along the levee. Although no broad ecotone habitat is proposed at Pond A16 to replace the narrow strips of vegetation lost due to levee widening, the lower slopes of the levee will be allowed to be vegetated, and pickleweed of similar quality and extent to that currently present is expected to colonize these lower slopes. This pickleweed will not be mowed, as mowing would occur only on the higher portions of the levee. Along the eastern edge of Pond A12, the vegetation to be lost (*i.e.*, between the A12 levee and the Alviso impoundment) is so narrow that it likely serves little function, either as residence or dispersal habitat, for salt marsh harvest mice. As a result, the loss of this habitat to FRM levee construction does not warrant immediate compensation in situ by the Corps. Rather, the broad ecotone to be constructed by the Service and local sponsors on the west side of the FRM levee at Pond A12 will more than compensate for any lost salt marsh harvest mouse habitat in the A12 vicinity. Although the construction of the Pond A12 ecotone is a Service-led activity, it would not be feasible but for the construction of the FRM levee by the Corps, and thus the Corps' levee construction is enabling that important habitat restoration component.

Construction of the FRM levee on the existing Pond A18 levee footprint will modify the structures that convey water in and out of the non-tidal wetlands east of Artesian Slough and south of Pond A18. These wetlands contain extensive pickleweed and are thus expected to support resident salt marsh harvest mice. The proposed project will replace any modified or removed water control

structures so that flow in and out of these wetlands can continue and existing conditions within the wetlands will be maintained.

Scour of Tidal Marsh Habitat

Following breaching of Pond A18, the increased tidal prism will result in the scour of sediment, and some vegetated marsh, from channels leading between the Bay and the breach locations. As a result, some loss of existing fringe marsh for the California clapper rail and salt marsh harvest mouse will occur along Artesian and Coyote sloughs. This marsh will consist primarily of brackish and freshwater marsh, but some salt marsh along lower Coyote Slough will be lost to scour as well. The acreage of marsh expected to be lost due to scour resulting from the breaching of Pond A18 is unknown. The SBSPRP predicted that 220-250 acres of marsh loss to scour would occur over a 50-year period resulting from restoration of tidal action to as much as 11,500 acres for the entire SBSPRP (*i.e.*, scour of about 2 percent of the marsh restored). Given the 736 acres of tidal restoration proposed at Pond A18, the extent of marsh loss for the California clapper rail and salt marsh harvest mouse due to scour might be roughly estimated at 17 acres. Such marsh loss would be gradual, and this total represents the total loss due to scour over the 50-year proposed project period.

The fringe marshes of the South Bay, which will be the marshes adversely affected by this scour, often provide the only habitat connecting the larger patches of marsh habitat that contain the "core" populations of salt marsh harvest mice. The loss of these marshes in the short term, before the restored marshes have matured to vegetated high marsh, could temporarily reduce the connectivity between the salt marsh harvest mouse populations of the South Bay. However, the short-term loss of salt marsh harvest mouse habitat and connectivity from fringe marsh scour will be offset by an order of magnitude when the restored marsh matures to a point that it can support salt marsh harvest mice. In the meantime, the marsh loss due to scour will be far less than the expected extent of marsh-type conversion (*i.e.*, from fresh or brackish marsh to salt marsh) due to increased salinization related to increased tidal prism. As a result, the enhancement of California clapper rail and salt marsh harvest mouse habitat from increased salinization will outpace any adverse effects of marsh loss due to levee construction, breaching, and localized scour while new tidal salt marsh is developing within restored Pond A18. The short-term nature of any reduction in connectivity from construction and scour suggests that it will not adversely affect the metapopulation dynamics or genetic diversity of the salt marsh harvest mouse in the South Bay.

To put the loss of marsh from excavation of pilot channels and downstream scour of fringing marsh into perspective, this 17 acres of marsh loss is far less than the expected extent of marsh-type conversion (*i.e.*, fresh or brackish marsh to salt marsh) due to increased salinization related to increased tidal prism. As a result, the beneficial effects on California clapper rail and salt marsh harvest mouse populations due to enhancement of habitat resulting from increased salinization will outpace any adverse effects of marsh loss due to breaching and localized scour in the near term while the much more extensive tidal salt and brackish marsh is developing within restored Pond A18.

During any construction or excavation activities that may result in impacts to tidal marsh habitat, the limits of work will be clearly delineated to limit effects to existing California clapper rail and salt marsh harvest mouse habitat. Side-casting of dredged materials into tidal marsh habitat (*e.g.*, during excavation) will be limited so that a minimum amount of marsh is filled. Conservation measures

incorporated into the proposed project will minimize effects of human activity within marshes on California clapper rail and salt marsh harvest mouse habitat.

Effects of Service-led Actions

The only Service-led activities that could result in the loss of existing California clapper rail and salt marsh harvest mouse habitat will occur as a result of tidal restoration at Ponds A9-A15. Excavation of pilot channels in the outboard tidal marsh around these ponds will disturb about 0.03 acre of salt marsh, 0.03 acre of brackish marsh, and <0.01 acre of freshwater marsh at five breach locations along Alviso Slough and one breach location along Coyote Slough. Because recent surveys for California clapper rails conducted for the Invasive *Spartina* Project along Alviso Slough have only detected California clapper rails at the mouth of the slough, pilot channel construction and breaching at the four breach locations on Ponds A10 and A12 are likely to have little effect on habitat that is used by nesting California clapper rails; rather, this habitat is likely used only by occasional, foraging, non-breeding individuals. The breach in the northwest corner of Pond A9 is closer to areas where California clapper rails have been recently detected, but it is located at an existing tide gate where the marsh along Alviso Slough is extremely narrow, too narrow to provide suitable nesting habitat or high-quality foraging habitat for California clapper rails. The only location where pilot channel excavation could affect habitat that has any likelihood of being used by breeding California clapper rails is in the northeastern corner of Pond A9, where the pilot channel will be excavated out to Coyote Slough. It is likely that salt marsh harvest mouse abundance in most of the breach locations is low owing to the brackish and/or very narrow nature of the marshes at these locations. However, the breach in the northeast corner of Pond A9 is located in tidal salt marsh that is more suitable for this species. Vegetation is almost completely absent from the internal berms within the Ponds A9-A15 system, and thus within-pond preparation activities for tidal breaching will not disturb any suitable salt marsh harvest mouse habitat.

Prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If California clapper rail and salt marsh harvest mouse habitat has developed within Pond A12 by that time, there may be a temporary loss of habitat due to breaching. However, that habitat will be quickly offset by continued marsh development. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal action in Ponds A13-A15, potentially resulting in temporary losses of California clapper rail and salt marsh harvest mouse habitat. Again, any such losses will quickly self-restore.

As mentioned above, the increased tidal prism resulting from restoration of tidal action to Ponds A9-A15 will cause the scour of sediment, and some vegetated marsh, from channels leading between the Bay and the breach locations. As a result, some loss of fringe marsh along Alviso Slough and Coyote Slough will occur. Such scour will reduce habitat for the California clapper rail and salt marsh harvest mouse and may limit dispersal of salt marsh harvest mice along these sloughs to some extent in the short term. Assuming that the loss of marsh to scour might comprise approximately 2 percent of that restored, up to 40 acres of tidal marsh might be lost to scour over the 50-year proposed project period. This marsh would be limited to Alviso Slough downstream from Pond A12 and a small area of Coyote Slough from the northwest corner of Pond A9 downstream. Such marsh loss will occur gradually due to the phasing of breaching at these ponds (Pond A12 in 2020, A9-11 in 2025, and A13-15 in 2030). However, the beneficial effects on California clapper rail and salt marsh harvest mouse populations due to enhancement of habitat resulting from increased

salinization are expected to outpace any adverse effects of marsh loss due to breaching and localized scour while new tidal salt and brackish marsh is developing within the restored marshes in Ponds A9-A15. Once cordgrass and pickleweed-dominated habitat colonizes the restored marsh within these former ponds, California clapper rail and salt marsh harvest mouse habitat will be expanded by orders of magnitude.

Small-scale, localized disturbance of habitat for the California clapper rail and salt marsh harvest mouse may also occur from walking through marshes or grounding boats in marshes during monitoring, research, or predator management efforts. Such disturbance would be very limited, particularly with implementation of proposed conservation measures (*e.g.*, for perennial pepperweed control). Effects to California clapper rails and salt marsh harvest mice resulting from monitoring, research, and predator management on the Refuge will be covered by the existing biological opinion for the SBSPRP and a future biological opinion for the Refuge's Comprehensive Conservation Plan. Effects to California clapper rails and salt marsh harvest mice resulting from perennial pepperweed control are discussed below under the "Perennial Pepperweed Control" section."

Direct Effects to Individuals

Effects of Corps-led Actions

California Clapper Rail

Construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge has the potential to disturb areas where California clapper rails are occurring only at Artesian Slough. Due to the low quality of this freshwater marsh for use by California clapper rails, there is a very low probability that a rail would be anywhere in the vicinity of the tide gate/pedestrian bridge construction area when activities are occurring in the tidal marsh. Furthermore, because the freshwater habitat in that location is not suitable for use by breeding California clapper rails, no nests, eggs, or young would be affected by activities at that location, and any California clapper rail present in the vicinity would move away from construction activities long before it could be physically injured or killed. Therefore, no loss of individuals, nests, eggs, or young will occur from construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge.

Excavation of pilot channels in the outboard marsh around Pond A18 is also unlikely to result in the loss of any California clapper rails. The brackish marsh habitat at three of the pilot channel locations does not provide high-quality nesting habitat, due both to its brackish nature and the narrow nature of the marsh at those locations, and there is a low probability that California clapper rails would be breeding in those areas. Further, if pilot channel excavation in brackish or salt marsh habitat is conducted during the breeding season (February 1 – August 31), surveys for California clapper rails will be conducted prior to proposed project activities to determine whether nesting California clapper rails are present in the vicinity. If California clapper rails are detected, buffers between rail activity centers and construction will be followed. During any construction or excavation activities that may result in effects to California clapper rails, the limits of work will be clearly delineated to limit effects to this species. These conservation measures will minimize effects of human activity within marshes on California clapper rails.

Disturbance such as loud noise or the presence and movement of people and heavy equipment in or near California clapper rail habitat may alter bird behavior in ways that result in altered foraging or

sheltering behavior and reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to California clapper rail avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or flushing from cover, or altered activity patterns, that reduce energy reserves and increase predation risk. The potential for disturbing breeding California clapper rails will be avoided by delaying construction activities within suitable California clapper rail breeding habitat until after the breeding season unless protocol-level surveys determine California clapper rails are absent from a 700-foot-buffer around the proposed work area. The level of disturbance of California clapper rails will also be minimized by having a Service-approved biological monitor supervise the work.

Loss of individual California clapper rails due to predation could be exacerbated by the proposed project. The restoration of tidal marsh habitat will increase habitat for northern harriers, which may prey on California clapper rails (especially chicks). However, because habitat for northern harriers is suitable for California clapper rails as well, the increase in California clapper rail populations due to habitat restoration in a given area is expected to outpace any adverse effects of predation by northern harriers. Local increases in predation on California clapper rails may occur due to marsh restoration in close proximity to areas frequented by California gulls, such as the Newby Island Landfill, Pond A16, and New Chicago Marsh; electrical towers within Pond A18 that provide known nesting sites for common ravens and red-tailed hawks, and perches for peregrine falcons; and upland areas providing sources of predators such as cats, rats, foxes, raccoons, white-tailed kites, and American crows. Although terrestrial pathways used by mammalian predators to access marshes will be reduced through the breaching of levees in some areas, marshes that abut upland areas will be subject to predation by land-based predators. In addition, rock at the bridge abutments and surrounding electrical towers in Pond A18 may provide refugia for rats that may prey on California clapper rail eggs. The risk of predation on California clapper rails will be reduced by the implementation of a Service-approved long-term predator management and litter cleanup program under a cooperative agreement among the SCVWD, the Refuge, and the City of San Jose that will be funded by the SCVWD.

Maintenance activities along the FRM levee have the potential to disturb California clapper rails in Ponds A12, A13, and A18 after tidal restoration has occurred and rail habitat has developed within those former ponds. Recreational use of the Bay Trail segment atop the levee will affect California clapper rails in adjacent areas to the point that rails present in those restored marshes during levee maintenance activities will already be habituated to some level of human activity on the levee. In addition, the 345-foot wide ecotones will limit the potential for levee maintenance activities to adversely affect California clapper rails. As a result, routine inspections and minor maintenance activities are not expected to result in an increase in California clapper rail disturbance, relative to other types of levee use. Even mowing along the levee tops is unlikely to cause substantial disturbance of California clapper rails given the very narrow swaths to be mown, the brevity of mowing operations, and the distance (330 feet or more) between mowing and California clapper rail habitat. However, maintenance activities involving heavy equipment would be conducted outside of the California clapper rail's nesting season to the extent practicable, and if seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting California clapper rails, and appropriate buffers would be implemented between proposed project activities and nesting rails as necessary.

Salt Marsh Harvest Mouse

Construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge will result in fill of vegetated areas that could potentially support small numbers of salt marsh harvest mice. Excavation of pilot channels in the outboard marsh around Pond A18 will also result in removal of brackish marsh that could potentially support low densities of salt marsh harvest mice. Although the number of individual salt marsh harvest mice that may be present in habitat to be impacted by levee construction and pilot channel excavation is low, individual salt marsh harvest mice could potentially be injured or killed by crushing or smothering during the placement of sediment or other materials in suitable habitat, or by excavation of habitat. Conservation measures such as hand-removal of vegetation in potential salt marsh harvest mouse habitat under the supervision of a Service-approved biologist, measures to ensure that salt marsh harvest mice leave areas prior to impacts, and salt marsh harvest mouse exclusion fencing will be implemented to minimize the potential for injury and mortality of individual salt marsh harvest mice.

Disturbance such as loud noise or the presence and movement of people and heavy equipment in or near salt marsh harvest mouse habitat may alter mouse behavior in ways that result in alteration of foraging and sheltering activities or reduced breeding success. Disturbance may result in displacement of salt marsh harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of salt marsh harvest mice from their territory/home range in the areas where their habitat is destroyed. Displaced salt marsh harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance of female salt marsh harvest mice, particularly during the period of March through November, may cause abandonment or failure of the current litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Noise from construction activities associated with the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge close to suitable salt marsh harvest mouse habitat may alter mouse breeding, foraging, and sheltering behavior. Salt marsh harvest mice may be similarly disturbed during excavation of pilot channels, preparation of ponds for breaching (*e.g.*, construction of ditch blocks), and access of construction areas by heavy equipment along existing levee roads.

Loss of individual salt marsh harvest mice due to predation could be exacerbated by the proposed project, at least in localized areas, as described for California clapper rail. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation.

Vegetation management along the levees has some potential to result in the injury or mortality of individual salt marsh harvest mice and the disturbance of foraging, sheltering, and dispersal activities. However, the potential for take and number of individuals that could be taken is very low, for several reasons. First, the strip of vegetation that will be mowed along the levee top will be very narrow (expected to be 15 feet or less). Only ruderal grassland foraging/dispersal habitat and no suitable pickleweed breeding habitat will be mowed; therefore, the potential for disturbing breeding salt marsh harvest mice or a salt marsh harvest mouse nest will be avoided because breeding mice will not be present in these areas. Mowing from the levee top downslope will result in slight disturbance of downslope areas that might encourage salt marsh harvest mice to move downslope,

away from the mowing activity. In addition, vegetation along the levee top is not expected to be particularly dense, especially in comparison to vegetation lower on the levee/ecotone slopes. As a result, it is possible that salt marsh harvest mice will make little use, if any, of the vegetation that needs to be mown. Maintenance such as mowing in or adjacent to salt marsh harvest mouse habitat will also be avoided during extreme high tides when salt marsh harvest mouse are most likely to approach the levee top to escape the flooding marsh. If trapping of California ground squirrels is necessary to control burrows within the levees, live traps with openings large enough to allow salt marsh harvest mice to exit the traps will be used.

Disturbance of salt marsh harvest mice from recreational trail use may occur, due to the expected occurrence of salt marsh harvest mice in ecotones and vegetated lower levee slopes and in the salt marsh harvest mouse habitat adjacent to lower Coyote Creek, where the levee trail connection to the existing Bay Trail segment will be provided. However, such disturbance will be minimized by the physical separation of the bare-topped trail and the vegetated slopes where salt marsh harvest mice may occur. Trail use may also result in indirect effects, such as increased trash (which may attract predators) and increased invasive plants, which may adversely affect habitat quality. Predator management and invasive plant species control implemented along the trails will minimize these adverse effects.

Effects of Service-led Actions

California Clapper Rail

Excavation of pilot channels in the outboard marsh around Ponds A9-A15 has the potential to affect individual California clapper rails, including nests, eggs, and young, directly. Such effects are most likely along the pilot channel excavation area near the northeast corner of Pond A9, which provides suitable nesting habitat for California clapper rails. As noted above, the probability of nesting California clapper rails is low in the brackish marsh and narrow areas of salt marsh where breaches and pilot channels are proposed along Alviso Slough.

As mentioned previously, prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If California clapper rail habitat has developed within Pond A12 by that time, there is some potential for effects to individuals or nests due to breaching. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal action in Ponds A13-A15, potentially resulting in effects to individual California clapper rails.

If pilot channel excavation in brackish or salt marsh habitat, or breaching of berms for Phases 2 and 3 near suitable California clapper rail habitat, is conducted during the breeding season, protocol-level surveys for California clapper rails will be conducted prior to proposed project activities to determine whether nesting rails are present in the vicinity. If any California clapper rails are detected, 700-foot buffers between rail activity centers and construction will be followed. During any construction or excavation activities that may result in effects to California clapper rails, the limits of work will be clearly delineated to limit effects to this species. These conservation measures will minimize effects of human activity within marshes on California clapper rails.

As noted previously, tidal restoration will result in an increase in the abundance of marsh-associated predators such as northern harriers. However, mammalian predators will have less access to these

restored marshes due to the breaching of levees and the presence of Alviso and Coyote sloughs on two sides of the A9-A15 complex. Further, because no high-tension powerlines run through these ponds, perch sites for most predatory raptors will be limited.

A large colony of California gulls nests on the interior berms separating Ponds A9, A10, and A14. Tidal restoration would result in the intentional lowering of these berms or eventual erosion of these berms through tidal action, thus causing these gulls to move elsewhere to nest. These displaced gulls may select nesting sites in close proximity to California clapper rail habitat elsewhere. The displacement of gulls from areas of lower quality California clapper rail habitat to areas of higher quality habitat could result in increased predation pressure by gulls on the rail. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation.

Monitoring, research, and predator management efforts involving people walking through tidal marshes or boats grounding on marshes could result in effects to individual California clapper rails. Adult California clapper rails are unlikely to be injured or killed during such activities, as they are expected to flee an area subject to such activities before injury or mortality occurs. However, these activities could destroy or damage California clapper rail nests or eggs, or result in the injury or mortality of less mobile young California clapper rails. Such activities are expected to be very localized, and implementation of conservation measures (such as minimizing such activities during the California clapper rail's breeding season) will minimize the potential for such effects.

Following complete restoration of Ponds A9-A15, the extent of trails at these ponds will be limited to a trail along the eastern edges of Ponds A12, A13, and A15, with shorter spurs in three areas. Observation platforms would be constructed at the ends of these spurs. Human activity use may increase in areas where trails and observation platforms are to be opened or improved. Use of the trail along the new FRM levee is likely to increase once this levee is connected to other Bay Trail segments at its northeast end, but the removal of a loop trail in the A9-A15 complex may tend to reduce trail use. Management of potential disturbances in adjacent habitat areas from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails.

Increased recreational trail use in areas where existing trails occur adjacent to California clapper rail habitat could result in the flushing of California clapper rails at high tides, increasing predation risk. No new trails are proposed to be opened adjacent to existing California clapper rail habitat, but rails that colonize the restored tidal marshes in Ponds A12, A13, A15, and A18 would be subjected to human disturbance from trail users. The breadth of the ecotone (345 feet) will limit disturbance of California clapper rails by people using the new FRM levee along eastern Pond A12 and southern Pond A18, as humans on the top of the levee will be far removed from suitable rail habitat. People using the spur trails and the levee trail along the southern Pond A12 levee, the Pond A12/A13 levee, and the northern Pond A15 levee will be closer to California clapper rail habitat, however, due to the absence of a constructed ecotone.

Interpretive signage will be installed at the edges of sensitive California clapper rail habitat areas discouraging human entry into those areas. If monitoring indicates that disturbance of California clapper rails by humans is adversely affecting rail populations, seasonal closures of portions of these trails would be considered as an adaptive management measure.

Salt Marsh Harvest Mouse

Excavation of pilot channels in the outboard marsh around Ponds A9-A15 has the potential to injure or kill salt marsh harvest mice by crushing or smothering them during the placement of sediment or other materials in suitable habitat, or by excavation of habitat. Such effects are most likely along the pilot channel excavation area near the northeast corner of Pond A9, which provides the highest-quality habitat for this species of all the breach locations. Abundance of salt marsh harvest mice is low in the brackish marsh and narrow areas of salt marsh where breaches and pilot channels are proposed along Alviso Slough. As mentioned previously, prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If salt marsh harvest mouse habitat has developed within Pond A12 by that time, there is some potential for effects to individuals due to breaching. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal action in Ponds A13-A15, potentially resulting in effects to salt marsh harvest mice. Conservation measures will be implemented to minimize the potential for impacts to individual salt marsh harvest mice.

Disturbance of salt marsh harvest mice from pilot channel excavation, ditch block construction, breaching of berms prior to second or third phase breaching, and equipment access for these restoration-related activities would be similar to that described above. Disturbance of salt marsh harvest mice from recreational trail use would be similar to that described for California clapper rail above.

As described for California clapper rail, loss of individual salt marsh harvest mice due to predation could be exacerbated by the proposed project, at least in localized areas, and displacement of the California gull colony from the interior berms separating Ponds A9, A10, and A14 could cause these gulls to relocate in areas where they may be more likely to prey on salt marsh harvest mice.

Monitoring, research, and predator management efforts involving people walking through tidal marshes or boats grounding on marshes could also result in injury or mortality of salt marsh harvest mice or disturbance of breeding, foraging, and sheltering activities. Such activities are expected to be very localized. Effects to salt marsh harvest mice resulting from monitoring, research, and predator management on the Refuge will be covered by the existing biological opinion for the SBSPRP and a future biological opinion for the Refuge's Comprehensive Conservation Plan. Effects to salt marsh harvest mice resulting from perennial pepperweed control are discussed below under the "Perennial Pepperweed Control" section.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

It is well known that the Guadalupe River system, including Alviso Slough, has a relatively high concentration of mercury resulting from sediments washed from historical mercury mines in the upper watershed. Recent testing in Artesian Slough has revealed high mercury concentrations there as well, with total mercury being lower but methylmercury, the bioavailable form, being higher in Artesian Slough than Alviso Slough (City of San Jose 2013). Such mercury may be mobilized when pilot channels are excavated in outboard marshes along Artesian Slough prior to breaching, and the

tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Artesian Slough, could mobilize mercury-laden sediment from the slough.

Although the abundance of California clapper rails in the immediate vicinity of Artesian Slough is currently very low, mercury could be mobilized downstream into and along Coyote Slough. Mercury accumulation in eggs is known to affect California clapper rails in the Bay Estuary, with the South Bay containing the highest mercury levels. Although intake is generally not acute enough to result in lethal toxosis of adults or young, mercury is extremely toxic to embryos and thus results in low levels of egg viability, and reduced California clapper rail fecundity. Schwarzbach *et al.* (2006) found high mercury levels and low hatching success (due both to predation and, presumably, mercury) in California clapper rail eggs throughout the Bay. They also suggested that mercury exposure could slow or stunt development of young, possibly increasing predation risk. Mercury exposure has been also linked to reduced body condition in California clapper rails (Ackerman *et al.* 2011), suggesting there are potential detrimental effects on survivorship of adult birds as well. Mean mercury concentrations in captured California clapper rail blood samples were 0.56 micrograms/gram (μg/g; or parts per million), 9.87 μg/g in head feathers, and 9.04 μg/g in breast feathers (Ackerman *et al.* 2011). Birds with mercury concentrations in blood over 1.0 μg/g and 9.0 μg/g in feathers are considered at risk for impaired reproduction (Evers *et al.* 2004, Burger and Gochfeld 1997), and several individuals captured in that study had mercury levels above those thresholds. The mercury concentrations in both head and breast feathers in the Ackerman study suggest that rails were exposed to mercury over long periods of time, as those two feather tracts are grown in different stages of molt. This suggests that mercury exposure was chronic and accumulated over time.

Mercury is taken in by California clapper rails primarily through contaminated prey in the form of methylmercury. Methylmercury, unlike elemental mercury, is bioavailable in that it readily binds to living tissue and accumulates in aquatic food webs. For instance, in failed-to-hatch California clapper rail eggs in the Schwarzbach *et al.* (2006) study, methylmercury accounted for 95 percent of total mercury in those eggs, and this ratio of elemental to methylmercury has been found in previous studies as well (see Ackerman *et al.* 2011). In addition to reproductive failure, studies have shown that captive egrets fed doses of 0.5 milligrams of methylmercury were less motivated to hunt food, and had a reduced appetite (Bouton *et al.* 1999, Spalding *et al.* 2000). These effects may be related to reduced body condition, which could ultimately lower survivorship.

Inorganic mercury tends to be converted to methylmercury, primarily under somewhat anoxic conditions (Marvin-DiPasquale *et al.* 2003). California clapper rails are currently exposed to methylmercury when foraging on mudflats and in sloughs with high levels of mercury contamination. The proposed project has the potential to increase the exposure of California clapper rails to mercury by stirring up sediments during vegetation removal and dredging activities. Methylmercury may also be mobilized by the frequent wetting and drying of mercury-contaminated sediments during construction activities. Mercury-contaminated sediments that are currently buried too deep to adversely affect California clapper rails and other species could be mobilized by these activities, thus entering the food chain. The extent to which excavation of pilot channels and scour of sediments in Artesian Slough will release mercury such that it may be more bioavailable to California clapper rails, and to which any increased level of bioavailable mercury affects California clapper rails, is difficult to quantify.

Compared to a managed pond environment, mercury deposited in well-oxygenated marsh plains is not expected to methylate as readily (Grenier *et al.* 2010). Also, it is likely that there will be a relatively low temporal exposure after breaching occurs for mercury to circulate in the slough or restored ponds, methylate, and be incorporated into the food web. Therefore, if there is an increase in methylmercury, it will likely occur for only a short duration. Preliminary data collected for SBSPRP mercury monitoring suggest this is the case. Mercury levels in fish collected in Alviso Slough increased after the Pond A8 notch was opened in June 2011 but had already decreased by October 2011 (SBSPRP 2013). The increase in mercury levels was more pronounced around the notch than at downstream sampling locations, suggesting the effect was localized. Therefore, the loss of individual California clapper rails or reduction in reproductive success of rails is not expected to occur as a result of increased mercury exposure associated with the proposed project.

The effects of mercury on salt marsh harvest mice are largely unknown. However, this species is likely exposed to methylmercury through the tidal marsh food web and mercury concentrations in tidal marshes. Although Artesian Slough methylmercury concentrations are high, tidal marshes show no evidence of increased bioaccumulation of mercury compared to other South Bay tidal marshes, possibly due to a paucity of organic material in the sediment (Grenier *et al.* 2010). For example, resident songbirds captured in tidal marshes in Alviso Slough showed similar bioaccumulation of mercury as other South Bay marshes (Grenier *et al.* 2010). Because increases in mercury availability are expected to be short-term, as described for the California clapper rail, the potential for increased salt marsh harvest mouse exposure to mercury is relatively low. Therefore, salt marsh harvest mice are not expected to be affected by an increase in mercury exposure related to pilot channel excavation and sediment scour.

Effects of Service-led Actions

Because of the mercury contamination of the Guadalupe River from the New Almaden mine, some of the sediment in Alviso Slough may contain high concentrations of mercury. Such mercury may be mobilized when pilot channels are excavated in outboard marshes along Alviso Slough prior to breaching, and the tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Alviso Slough, could mobilize mercury-laden sediment from Alviso Slough and Ponds A9-A15. Effects of this mercury mobilization on California clapper rails would be as described above for Corps-led activities. The effects of mercury mobilization on salt marsh harvest mice from Service-led activities are expected to be relatively low similar to those described above for Corps-led activities.

Perennial Pepperweed Control

Effects of Corps-led and Service-led Actions

Potential effects on California clapper rail and salt marsh harvest mouse foraging and nesting due to perennial pepperweed control could result from habitat alterations (*e.g.*, native plant mortality) and marsh access through California clapper rail and salt marsh harvest mouse habitat for treatment/ eradication, monitoring, or re-vegetation activities. Ground based spraying via foot or ARGOs and post-treatment monitoring requires access through the marsh and may result in vegetation trampling or salt marsh harvest mouse nest disturbance. Use of ARGOs for control will cause temporary disturbance of marsh vegetation. All treatment crew members will be supervised by a qualified biologist and will be trained to follow the guidelines presented in the "Walking In the Marsh:

Methods to Increase Safety and Reduce Impacts to Wildlife & Plants" protocol (Appendix A), thereby minimizing disturbance of California clapper rails, salt marsh harvest mice, and their habitats.

Disturbance of the marsh by field crews on-foot will be minimal because crews will be traversing through the marsh only once or twice per year to conduct treatment and monitoring, trails will not be established through the marsh, and no residual effects on marsh habitat quality are anticipated. Field crews will not crush any salt marsh harvest mice or their nests because they will be supervised by a qualified biologist and will avoid walking on high pickleweed vegetation and on wrack, where salt marsh harvest mice are likely to forage or nest. In addition, since crews will be walking slowly, any salt marsh harvest mice present will be able to move out of the immediate area. Due to the minimal amount of habitat disturbance caused by field crews and avoidance of direct impacts to salt marsh harvest mice, access of marshes by field crews on-foot for perennial pepperweed control will avoid the injury and mortality of salt marsh harvest mice and minimize the level of disturbance.

Field crews accessing the marsh via ARGOs for perennial pepperweed control may result in the temporary disturbance of marsh vegetation (habitat degradation) or crushing of individual salt marsh harvest mice or their nests beneath the ARGOs. These vehicles are designed to operate with low ground pressure (about 0.67 pounds per square inch) and distribute weight on specialized tracks. ARGOs exert a ground pressure approximately five times less than that of humans; however, a greater area of marsh vegetation would be disturbed by fields crews on ARGOs than on-foot.

ARGOs may crush and cause dieback of marsh vegetation, particularly sub-shrubby vegetation with brittle stems, such as pickleweed, the primary habitat of the salt marsh harvest mouse. Due to this identified impact, the quantity of suitable California clapper rail and salt marsh harvest mouse habitat directly affected by ARGOs is calculated by the distance within tidal marsh they will be driven to access and treat perennial pepperweed patches. There is a five-foot wide "track impact" from an ARGO traveling through the marsh. This impact would consist of temporary compaction or crushing of pickleweed and other marsh plants, with the vegetation expected to recover fully within a few months of impact. The travel path of ARGOs will be planned to minimize the amount of impact to California clapper rail and salt marsh harvest mouse habitat by traveling in mudflats whenever feasible.

The only perennial pepperweed control action that may temporarily disturb nesting California clapper rails is a portion of the marsh access for eradication activities. Backpack spraying will be used to treat perennial pepperweed within "700-ft Buffer Areas", and disturbance will be localized and very temporary (usually less than 30 minutes). California clapper rails may be harassed by treatment access within "700-ft Buffer Areas" where there is greater than one acre of infested perennial pepperweed and where treatment is likely to exceed 30 minutes. Boat-mounted spraying will be used to treat relatively larger clones along slough edges and may result in a larger scale disturbance (noise), but little immediate habitat destruction. ARGOs will not be used in "700-ft Buffer Areas" for California clapper rails. It is expected that control activities in areas with large acreages targeted for control will result in relatively more disturbance than in those areas with small acreages, given similar California clapper rail densities.

Any ARGOs used in control activities will stay 700 feet from known California clapper rail calling centers and will stay at least 50 feet from channel edges, thereby avoiding rail nest destruction or rail disturbance. However, if the intervening distance across a major slough channel or across a

substantial physical barrier between the California clapper rail calling center and the proposed access area is greater than 200 feet, then access may proceed within the breeding season.

Areas where California clapper rails have been detected contain channels and low marsh vegetation used for mating, foraging, and nesting. The majority of perennial pepperweed patches occur in the transition zone and along channel edges dominated by gumplant. Perennial pepperweed patches also occur adjacent to *Spartina foliosa* patches of low marsh tidal deposition areas (wrack lines). Sensitive eradication areas include channel edges and areas where low marsh (*S. foliosa*-dominated) interfaces the pickleweed plain. Herbicide applications are not expected to cause direct mortality of *S. foliosa* and other native plant species if conservation measures are implemented to reduce herbicide spray drift and subsequent mortality of non-target plants. The eradication of perennial pepperweed is not likely to harm California clapper rails as a result of habitat loss because: (1) California clapper rails are not known to use perennial pepperweed as a habitat component, and (2) conservation measures will be implemented that avoid non-target plant eradication.

The herbicides, adjuvants, and dyes proposed for eradication of perennial pepperweed within the action area are also being used to eradicate invasive *Spartina* species in other parts of the Bay Estuary. The herbicides proposed were determined not to have any direct toxic effects to California clapper rails (California State Coastal Conservancy and Service 2003, California State Coastal Conservancy 2005). Direct toxicity of herbicide, surfactant, and colorant applications is unlikely to have significant toxic effects to California clapper rails since herbicides are directed to the upper portion of the plant and dry quickly on the plant leaf surface (usually within a few minutes of application), and exposure of rails to spray solutions would be very temporary. Even if California clapper rails are exposed to small amounts of spray solutions, they will not be injured since these chemicals are considered practically non-toxic to birds (California State Coastal Conservancy and Service 2003). The chemical treatment of perennial pepperweed will reduce expansion and formation of perennial pepperweed monocultures which alter soil conditions and crowd out native plant species used by California clapper rails for nesting and sheltering.

Salt marsh harvest mice are unlikely to come into contact with spray solutions applied to perennial pepperweed since the mice primarily inhabit pickleweed and other high marsh vegetation not targeted for control. Even if salt marsh harvest mice are exposed to small amounts of imazapyr, glyphosate, surfactants, or colorants used in the spray solutions, they would not likely be harmed since these chemicals are considered non-toxic to mammals (California State Coastal Conservancy and Service 2003, California State Coastal Conservancy 2005).

California clapper rails and salt marsh harvest mice will not lose habitat when perennial pepperweed is removed, since the rail and the mouse are not known to utilize perennial pepperweed. Removal of invasive perennial pepperweed and revegetation of the marsh-upland transition zone will provide high quality high tide refugia, a critical component of the habitat for the California clapper rail and salt marsh harvest mouse. Non-native perennial pepperweed threatens the transition zone refugia and tidal marsh habitat for the California clapper rail and salt marsh harvest mouse. Perennial pepperweed displaces higher quality tidal marsh vegetation including marsh gumplant and pickleweed. Perennial pepperweed also provides poor quality high tide refugia cover for the California clapper rail and salt marsh harvest mouse because it is leafless in the winter when the rail and the mouse are in most need of suitable upland cover during the frequent winter extreme high tide and storm events. Without suitable cover, the California clapper rail and salt marsh harvest mouse are vulnerable to predation during extreme high tide events. Therefore, perennial

pepperweed control will provide a long-term benefit to the California clapper rail and salt marsh harvest mouse.

Revegetation will occur within the transition zone. Revegetation is not expected to disturb breeding California clapper rails because this activity will occur outside of the rail's breeding season. The transition zone is used by California clapper rails and salt marsh harvest mice primarily during extreme high tide events; therefore, restricting revegetation of the transition zone to low tides will minimize the potential for disturbing any California clapper rails and salt marsh harvest mice. The restoration of native plants within the transition zone will provide California clapper rails and salt marsh harvest mice with high quality high tide refugia, a critical component of population recovery for the rails and the mice.

Pacific Coast Population of the Western Snowy Plover

Loss of Habitat

Effects of Corps-led Actions

Western snowy plovers are not known or expected to nest or forage along the WPCP segment of the FRM levee or in or around Pond A18 under current conditions. As a result, construction and restoration east of Artesian Slough will not result in a net loss of western snowy plover habitat. However, prior to breaching, Pond A18 may be drawn down to facilitate within-pond preparations such as construction of ditch blocks. When Ponds A16 and A17 were drawn down prior to SBSPRP Phase I activities, western snowy plovers used the dried-out pond bottoms for nesting. If Pond A18 is drawn down prior to breaching, then the dried-out pond bottom is likely to attract nesting western snowy plovers. As a result, breaching will flood this temporarily created western snowy plover habitat.

Aside from impacts to temporarily created habitat if Pond A18 is drawn down, construction of the FRM levee will not directly affect any suitable nesting habitat for the western snowy plover. Although this species has nested in the Alviso impoundment, in Ponds A12, A13, and A16, and in New Chicago Marsh, portions of which will be directly impacted by levee construction, the western snowy plover does not nest near the existing non-engineered levees that occur within the proposed construction footprint. Rather, western snowy plovers nest farther from levees, apparently due to the disturbance associated with human use of the levees, use of levees by predatory mammals, and the species' inability to see over levees (and thus detect approaching predators) if the nest is placed too close to the levee. Thus, even under existing conditions, there is a zone close to the levees that has not been used for nesting by western snowy plovers.

However, for these same reasons, FRM levee construction could result in indirect effects to western snowy plovers by causing plovers to avoid using habitat that is otherwise suitable. The ultimate height of the FRM levee is expected to be approximately 10 feet higher than the existing levee on the south side of Pond A16, and the very low levee along the eastern side of A12 is likely to be raised even more, relative to its existing height. The levees may initially be built even higher, as some subsidence is expected over time as materials settle. As a result, the FRM levee will be substantially taller and wider than the existing levees. Western snowy plovers are unlikely to nest very close to the levee for the reasons discussed above, especially when the Bay Trail is developed

atop the levee and human activity is even greater than it currently is. As a result, the zone near levees that western snowy plovers avoid for nesting would shift farther from the levee.

The extent of this indirect effect (*i.e.*, the amount of otherwise suitable nesting habitat that will no longer be used by nesting western snowy plovers) is unknown. Western snowy plovers nesting in New Chicago Marsh, on islands in Pond A16, and in Ponds A12 and A13 tend to nest well away from the Pond A16 levee. As a result, it is possible that they nest so far from the levee already that an increase in height of, and human activity along, the levee would have no effect on the plovers' perception of suitable habitat availability. In addition, tidal restoration in Ponds A12 and A13 would make those ponds completely unsuitable for use by nesting western snowy plovers. However, it is possible that increasing the height of the levee would cause plovers to retreat even farther from the levee. It is unknown whether western snowy plovers would continue to nest in the Alviso impoundment after FRM levee construction, and it is possible that plovers might view the entire impoundment as being no longer suitable due to the taller, wider levee. Use of this impoundment by nesting western snowy plovers has been sporadic (*i.e.*, less than annual), and usually by only a single pair when it is used at all.

Although the number of pairs of western snowy plovers that may no longer nest in the vicinity of the action area as a result of raising the height of the levee is unknown, it is likely that no more than one or two pairs would be affected because areas near the action area levees have been inconsistently used by few plovers in the past. The proposed project will implement compensatory conservation measures by distributing pea gravel or other appropriate substrate on an island in Pond A16, maintaining this island for use by nesting western snowy plovers, and increasing the intensity of predator management in the vicinity. Gravel may make it more difficult for predators such as California gulls and northern harriers to detect western snowy plovers due to camouflage (*e.g.*, plovers may be difficult to distinguish within the gravel from a distance) and increased topographic relief associated with the gravel and footprints left by people distributing the gravel. As a result, predation rates on both western snowy plover eggs and chicks are likely to be lower in areas with such gravel, and more plovers may be attracted to nest in areas with gravel. Providing gravel on an island in Pond A16 is expected to increase western snowy plover nesting abundance, and possibly nesting success, thus compensating for the adverse effects of other proposed project activities on nesting western snowy plovers. These measures are expected to minimize any adverse effects of Corps-led actions on the availability of suitable western snowy plover habitat, or western snowy plover abundance or productivity.

Expansion of the FRM levee into pond, seasonal wetland, and muted tidal/diked marsh habitat will result in filling of ostensibly suitable foraging habitat and, as discussed above, the possible avoidance of foraging habitat that is otherwise suitable but would be too close to the levee following construction. However, western snowy plovers are very rarely seen foraging close to the eastern edges of Ponds A12 and A13, the southern edge of Pond A16, or the northern edge of New Chicago Marsh. As a result, effects of levee construction on western snowy plover foraging habitat are likely limited to reduced use of the Alviso impoundment. As foraging habitat in the vicinity is not likely limiting western snowy plover populations (based on the expanses of suitable foraging habitat present in managed ponds and New Chicago Marsh that is unoccupied at any given time, as well as the abundance of prey in these area), the effects of Corps-led actions on western snowy plover foraging habitat are unlikely to have a substantive effect on western snowy plover populations.

Effects of Service-led Actions

Service-led tidal restoration will result in the loss of all western snowy plover nesting habitat in Ponds A9-A15, as western snowy plovers do not nest in tidal habitats. Further, because this species forages infrequently on tidal mudflats, western snowy plovers are expected to make little use of Ponds A9-A15, even for foraging, once they are restored to tidal action. Based on data from 2012, when five of 13 nests in the proposed project vicinity were in Pond A13 (Donehower *et al.* 2012), and 2013, when two of 10 nests in the proposed project vicinity were in Pond A9 (Robinson-Nilsen *et al.* 2013), up to five pairs of western snowy plovers may be displaced by tidal restoration. Because restoration will be phased, some western snowy plover nesting habitat is expected to be present in Ponds A9-A15 until 2030, when the last of these ponds may be breached.

As discussed previously, the MAM for the SBSPRP will help to achieve the goal of supporting at least 250 individual breeding western snowy plovers in the SBSPRP area, which is half of the number of breeding western snowy plovers required within the San Francisco Bay Recovery Unit for delisting (Service 2007). The SBSPRP will implement adaptive management measures, such as more intensive management of certain ponds for western snowy plovers, as necessary to achieve that goal. The MAM associated with the SBSPRP would therefore assist in compensating for impacts to western snowy plovers from loss of nesting habitat in Ponds A9-A15 by helping to manage for plovers in other SBSPRP ponds. Because some western snowy plover nesting habitat will remain in the Ponds A9-A15 complex until 2030, there is ample time for the MAM associated with the SBSPRP to determine how to increase western snowy plover densities elsewhere prior to complete loss of plover nesting habitat from Ponds A9-A15. As described in previous sections, if the MAM indicates impacts to waterbirds (including western snowy plovers) are too severe, then fewer ponds will be restored to tidal action.

Development of a Bay Trail segment on the FRM levee, which is a Service-led activity, will increase recreational use of the levee top. This will contribute to disturbance of western snowy plovers nesting in adjacent areas, leading to an effective loss of habitat use. Research shows that nesting western snowy plovers within the South Bay are very sensitive to disturbance by recreational trail users and construction activities within 600 feet of their nests (Robinson 2008, San Francisco Bay Bird Observatory and Service 2010).

Direct Effects to Individuals

Effects of Corps-led Actions

As described for California clapper rail above, disturbance such as loud noise or the presence and movement of people, and heavy equipment near western snowy plover habitat may alter bird behavior in ways that result in injury, mortality, or reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to western snowy plover avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or flushing, or altered activity patterns, that reduce energy reserves and increase predation risk. Construction of the Alviso Segment of the FRM levee near western snowy plover habitat in Ponds A12 and A13, the Alviso impoundment, New Chicago Marsh, and A16 could result in disturbance of nesting and foraging plovers in those areas. However, moderate to fairly heavy human use already exists along the levees adjacent to western snowy plover habitat in the proposed

project area. Numerous pedestrians and cyclists use the levees around the Ponds A9-A15 complex, between Ponds A15 and A13/A14, and between A16 and New Chicago Marsh on a daily basis. As a result, the western snowy plovers that use habitat adjacent to these levees (a) tend to avoid areas close to the levees used by humans, and (b) are already habituated to the use of humans along those levees. This reduces the extent to which western snowy plovers will be disturbed by levee construction and use of the levees by humans following levee completion.

Nevertheless, to minimize such impacts, work in and adjacent to potential western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, surveys before and during construction would be conducted for nesting western snowy plovers, and appropriate buffers (*i.e.*, 600 feet during construction activities) would be implemented between proposed project activities and nesting western snowy plovers.

Because western snowy plovers are not known or expected to nest very close to the existing levees, no western snowy plover nests or eggs would be located within the footprint of FRM levee construction. If nesting has occurred in areas adjacent to the levees, such as the Alviso impoundment, it is possible that young western snowy plovers could move into the construction footprint. However, if nesting occurs in the construction zone, then a Service-approved biologist will need to clear the area before construction can continue.

If Pond A18 is drawn down prior to breaching, as described previously, then breeding western snowy plovers could be nesting in the pond when construction of ditch blocks and breaching occurs. While adult breeding western snowy plovers would not be injured or killed by restoration-related construction activities or breaching, as they would flee the vicinity of any such activities, their nests, eggs, or young could be crushed, trampled, buried, or lost to flooding as a result of displacement of sediment into nesting habitat during construction of ditch blocks, or levee breaching and flooding of occupied habitat. For example, in 2010, two western snowy plovers nests at Ravenswood Pond SF2 were depredated when construction crews for the SBSPRP were working within 600 feet of the nests (San Francisco Bay Bird Observatory and Service 2010). Therefore, there is the potential for construction activities within 600 feet of a western snowy plover nest to flush the western snowy plover from its nest exposing the nest to depredation. To minimize such impacts, work in and adjacent to potential breeding western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, surveys prior to and during construction would be conducted for nesting breeding western snowy plovers, and appropriate buffers (*i.e.*, 600 feet during construction activities) would be implemented between proposed project activities and nesting western snowy plovers.

Loss of individual western snowy plovers (including eggs and chicks) due to predation could be exacerbated by the proposed project, at least in localized areas. The restoration of tidal marsh habitat will increase habitat for northern harriers, which are known to prey on western snowy plovers. Compensatory mitigation involving an increase in predator management in the New Chicago Marsh/A16 vicinity will reduce any increase in predation resulting from increased northern harrier populations from Corps-led activities.

Maintenance activities along the FRM levee have the potential to disturb nesting and foraging western snowy plovers as well. Recreational use of the Bay Trail segment atop the levee will affect western snowy plovers in adjacent areas to the point that plovers present in areas such as Pond A16 or New Chicago Marsh during levee maintenance activities will already be habituated to some level

of human activity on the levee. As a result, routine inspections and minor maintenance activities are not expected to result in an increase in western snowy plover disturbance, relative to other types of levee use. Even mowing along the levee tops is unlikely to cause substantial disturbance of western snowy plovers given the very narrow swaths to be mowed, the brevity of mowing operations, and the distance (330 feet or more) between mowing and western snowy plover habitat. Other maintenance activities involving heavy equipment would be conducted outside of the nesting season to the extent practicable, and if seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting western snowy plovers, and appropriate buffers would be implemented between proposed project activities and nesting western snowy plovers as necessary.
Even with the implementation of conservation measures to minimize disturbance of nesting western snowy plovers, snowy plovers that disperse away from disturbance may not successfully establish new breeding territories and breed. Plovers forced to disperse would need to either maintain existing pair bonds or develop new pair bonds and establish new breeding territories in other suitable habitat areas. Disturbance that occurs during the non-breeding season could also result in injury, mortality, or the disturbance of western snowy plover foraging and sheltering activities. Displaced individuals could be subjected to injury or mortality from starvation, physiological stress, and increased predation.

Effects of Service-led Actions

Disturbance of western snowy plovers using Ponds A9-A15 may occur due to pilot channel excavation, ditch block construction, and equipment access for these restoration-related activities. The effects of such disturbance would be similar to that described above.

If drawdown of Ponds A9-A15 occurs to facilitate within-pond preparations, western snowy plovers are expected to nest in at least some of these ponds. While adult western snowy plovers would not be injured or killed by restoration-related construction activities, as they would flee the vicinity of any such activities, their nests, eggs, or young could be crushed, trampled, buried, or lost to flooding as a result of displacement of sediment into nesting habitat during berm lowering or construction of ditch blocks, or levee breaching and flooding of occupied habitat. To minimize such impacts, work in and adjacent to potential western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-and during construction surveys would be conducted for nesting western snowy plovers, and appropriate buffers would be implemented between proposed project activities and nesting western snowy plovers.

As described for California clapper rail above, loss of individual western snowy plovers, eggs, and young may increase as a result of predation. An increase in tidal marsh habitat will result in an increase in northern harrier populations, and displacement of the California gull colony on the interior berms separating Ponds A9, A10, and A14 may cause gulls to relocate to areas closer to high densities of nesting western snowy plovers. Both the northern harrier and California gull are important predators of western snowy plovers in the South Bay. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation on western snowy plovers.

Service-led activities include the provision of recreational trails. Human activity may increase in areas where trails and observation platforms are to be opened or improved. Studies of the effects of recreational trail use in the South Bay on western snowy plovers showed that trail users caused

western snowy plovers to flush from their nests when walkers approached on average within 538 feet when approached directly or 478 feet when passed tangentially (Robinson 2008). Use of the trail along the new FRM levee is likely to increase once this levee is connected to other Bay Trail segments at its northeast end, but the removal of a loop trail in the A9-A15 complex may tend to reduce trail use. Management of potential disturbances in adjacent habitat areas (such as Ponds A9-A15 that have not yet been converted to tidal habitats) from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails. Increased recreational trail use adjacent to western snowy plover habitat could have the same disturbance effects as described above.
Interpretive signage will be installed at the edges of sensitive habitat areas discouraging human entry into those areas. If monitoring indicates that disturbance of western snowy plovers by humans is adversely affecting plover populations, seasonal closures of portions of these trails would be considered as an adaptive management measure.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

Studies in San Diego County (Hothem and Powell 2000), at Point Reyes (Schwarzbach *et al.* 2005), and in the South Bay (Schwarzbach and Adelsbach 2003) have found elevated mercury levels in western snowy plover eggs. At Point Reyes, high levels of mercury in unhatched eggs were thought to be a possible reason for the inviability of these eggs. In the San Diego County and South Bay studies, however, concentrations of mercury in western snowy plover eggs were below known embyrotoxic thresholds established for other species.

Western snowy plovers are currently exposed to mercury in ponds containing mercury-contaminated water or sediment. Proposed tidal restoration activities that stir up contaminated sediments, such as pilot channel excavation, construction of ditch blocks, and scour due to increased tidal prism would all occur just prior to, or as a result of, tidal restoration. Although western snowy plovers foraging on intertidal mudflats may be affected by increased mercury mobilization resulting from these activities, activities that stir up mercury-laden sediments in tidal habitats are expected to have little effect on snowy plovers due to the infrequency with which snowy plovers forage in intertidal habitats in the proposed project area. Furthermore, western snowy plovers are not known to use the Pond A18 area under existing conditions, and proposed project activities are not expected to enhance conditions for western snowy plovers in A18 after proposed project completion.

Effects of Service-led Actions

Potential effects of mercury mobilization and exposure on western snowy plovers, resulting from Service-led activities, are expected to be similar to those described above for the Corps-led activities.

California Least Tern

California least terns do not nest in the action area, and thus the proposed project is not expected to result in in any effects to nesting California least terns. California least terns have been observed foraging in the action area's ponds (A9, A11, and A14) only rarely, and they have not been observed foraging in Pond A18. Although they could potentially forage in any of these ponds that contain fish, survey data collected for the SBSPRP and incidental observations by birders indicate that

California least terns visit the action area (as a post-breeding forager) only irregularly and in low numbers.

Habitat Modification

Effects of Corps-led Actions

Construction of the FRM levee and the tide gate and pedestrian bridge in Artesian Slough will not affect California least tern foraging or roosting habitat. Although California least terns have not been recorded foraging in Pond A18, they could potentially forage there (albeit irregularly and in low numbers, given the lack of records). Drawing down Pond A18 prior to breaching would eliminate California least tern foraging habitat in the pond in the short term, and restoration of Pond A18 to tidal habitats would reduce the extent of suitable foraging habitat available to California least terns in the longer term. However, tidal marsh restoration is expected to benefit fish populations considerably by providing nursery habitat in the extensive channel networks that will be restored and by exporting organic material to aquatic habitats outside the restored habitat. As a result, tidal restoration is expected to increase fish abundance (through improved water quality, food resources, and spawning and rearing habitat) in the open waters of the Bay where California least terns also forage (in addition to foraging in managed ponds), thus increasing prey availability in the South Bay for California least terns. Due to the low level of California least tern use of Pond A18 and the benefits of tidal restoration to prey fish populations, Corps-led actions will not have a substantive adverse effect on California least tern habitat and prey, and they may have a beneficial effect.

Effects of Service-led Actions

Service-led tidal restoration will result in the conversion of managed pond habitat in Ponds A9-A15 to tidal habitats. Drawing down these ponds prior to breaching would eliminate California least tern foraging habitat in the ponds in the short term, and in the longer term, there would be a net reduction in potential foraging habitat for the California least tern due to the conversion of aquatic habitat within these ponds to mostly vegetated habitats. However, California least terns have only been recorded foraging in Ponds A9-A15 infrequently and in low numbers. Also, as noted previously, tidal restoration is expected to have substantial beneficial effects on South Bay fish populations. Due to the low level of California least tern use of Ponds A9-A15 and the benefits of tidal restoration to prey fish populations, Service-led restoration activities will not have a substantive adverse effect on California least tern habitat and prey, and they may have a beneficial effect.

Disturbance of Foraging Individuals

Effects of Corps-led Actions

Because California least terns have not been recorded using Pond A18 or any of the other ponds near the FRM levee (*i.e.*, A12, A13, or A16), there is little potential for disturbance of foraging California least terns from Corps-led actions. If individuals were to forage in these ponds during FRM levee construction and they were disturbed by construction activities, they would simply move away to other, more traditionally used foraging areas.

Effects of Service-led Actions

Disturbance such as loud noise or the presence and movement of people and heavy equipment near California least tern foraging habitat may alter the tern's foraging behavior. Such disturbance could result in temporary or permanent habitat loss due to California least tern avoidance of areas that have suitable habitat but intolerable levels of disturbance; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or altered activity patterns that reduce energy reserves and increase predation risk.

Because California least terns have been recorded using Ponds A9-A15 for foraging infrequently and in low numbers, the number of individuals that could be disturbed by Service-led construction or recreational activities is very low. If individuals were to forage in these ponds during restoration-related construction or breaching activities, or during high levels of recreation-related activity, and they were disturbed by those activities, they would simply move away to other, more traditionally used foraging areas.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

Because fish bio-accumulate methylmercury, and California least terns eat almost exclusively small fish, there is some potential for mercury mobilized by Corps-led restoration activities (as described above for California clapper rail) to adversely affect California least terns. California least terns are currently exposed to mercury in the South Bay by foraging on fish in contaminated tidal habitats containing mercury-contaminated water or sediment during their post-breeding period. Restoration activities in Pond A18 will mobilize contaminated sediments, and therefore there is the potential to increase California least terns' exposure to mercury. Methylmercury may also be mobilized by the frequent wetting and drying of mercury-contaminated sediments during construction activities. Such exposure could potentially affect the development of juveniles that ingest mercury in food taken during the post-breeding period and may affect fecundity in adults that ingest contaminated fish.

Recent biosentinel sampling in South Bay managed ponds and marshes indicates that mercury concentrations in fish are above the Bay mercury total maximum daily load of 0.03 μg/g for small fish (San Francisco Bay Regional Water Quality Control Board 2006). Mean mercury levels of longjaw mudsuckers and threespine sticklebacks in Alviso Slough fringe marshes were 0.11 μg/g and 0.16 μg/g, respectively (Grenier *et al.* 2010). These levels were higher (but not significantly) than in other South Bay reference sites (mudsuckers: 0.08 μg/g, stickleback: 0.11 μg/g). Based on this information, California least terns foraging in the South Bay could be exposed to mercury levels that are detrimental to piscivorous birds even in the absence of the proposed project. This is evident in Forster's terns (*Sterna forsteri*), a better-studied tern species that breeds in the South Bay, and thus has higher exposure to mercury than California least terns. In a contaminants study of Forster's terns, approximately 50 percent of captured terns were considered at or above moderate risk (> 1.0 μg/g), 13 percent were at or above high risk (>3.0 μg/g), and 9 percent were at or above extra-high risk (>4.0 μg/g) for impaired reproduction based on their blood mercury concentrations (Ackerman *et al.* 2008a). Blood sampling over time (between pre-breeding and breeding stages), suggests that breeding terns were at higher risk due to mercury increasing in their blood, suggesting terns' mercury concentrations increased with the time they spent foraging while in the Bay (Ackerman *et al.* 2008a).

Blood mercury concentrations were highest in terns captured in the southernmost portions of the Bay, in the Alviso salt pond complex, including Pond A8 (Ackerman *et al.* 2008a). Unexpectedly, blood mercury concentrations in Forster's terns were substantially higher approximately two months after arriving in the Bay (*i.e.*, the period between pre-breeding and breeding) than observed in Caspian terns (*Hydroprogne caspia*) during the same time period (Eagles-Smith *et al.* 2009). Caspian terns had much higher mercury levels upon arriving, but Forster's terns mercury levels were soon elevated beyond those of Caspian terns, despite the fact that Caspian terns forage on larger prey (*i.e.*, at higher trophic levels). This was likely due to differences in foraging ecology, as Caspian terns tend to forage in the open bay waters or at inland reservoirs and Forster's terns forage mainly in ponds and tidal marsh channels (Ackerman *et al.* 2008b). As noted above, open waters in the Bay are less likely to methylate mercury than tidal marsh areas (Marvin-DiPasquale *et al.* 2003), and ponds have the potential to methylate mercury due to high levels of degradable organic matter (Grenier *et al.* 2010). Therefore, terns that forage in ponds are much more likely to be exposed to mercury than those foraging in open bay waters.

Although mercury concentrations in post-breeding California least terns in the South Bay are largely unknown, it would be expected that California least terns' exposure to mercury in the South Bay is substantially less than both Caspian and Forster's terns. Because California least terns occur only in the South Bay during post-breeding periods, they would be exposed to mercury for a relatively brief period of time. Further, because they tend to forage in open bay waters or in managed ponds in the Mountain View area (where legacy contamination by mercury should be lower than in areas that receive drainage from the mercury mines in the Guadalupe River watershed or in Artesian Slough), their exposure to mercury should be less than those of Forster's terns. Also, because they eat smaller fish than Caspian terns, California least terns likely accumulate mercury slower than Caspian terns.

California least terns do appear to have some exposure to mercury from central San Francisco Bay (Central Bay) foraging areas near their colonies. Hothem and Zador (1995) analyzed contaminant levels in California least tern eggs collected at the Oakland airport and Alameda Point colonies, and from five colonies along San Diego Bay. Mercury was detected in all eggs, but concentrations were higher in eggs from the Central Bay, with an average of 1.88 μg/g in Central Bay colonies and 1.07 μg/g in San Diego colonies. In comparison, concentrations of mercury in collected Forster's tern eggs averaged 1.35 μg/g (Ackerman and Eagles-Smith 2009). Egg mercury concentrations above 1.0 μg/g is considered high enough for impaired hatchability and embryonic mortality in birds (Scheuhammer *et al.* 2007), and although eggs with concentrations above 1.0 μg/g can hatch, there may be residual effects of mercury on chick mortality after hatching (Ackerman and Eagles-Smith 2009). This suggests that Forster's terns' exposure to mercury during the pre-breeding and breeding periods in the South Bay is higher than California least terns foraging in the Central Bay during the same periods, due in part to overall higher mercury concentrations in the South Bay and their use of pond and tidal marsh foraging sites (as opposed to open bay waters). Because maternally-deposited mercury in eggs is a result of recent dietary exposure (Heinz and Hoffman 2003), mercury in California least tern eggs likely is associated with foraging sites near colonies and not associated with mercury from the South Bay that they are exposed to during post-breeding periods.

Although the potential effects of increased mercury exposure on California least terns resulting from the proposed project are difficult to determine, California least terns are unlikely to be affected substantially by an increase in mercury exposure from the proposed project. This is because California least terns tend to forage in open water habitats in the Bay or managed ponds in the

Mountain View area, where their exposure to mercury is lower than if they foraged more frequently in ponds in the Alviso area and/or in marshes like Forster's terns. Also, mercury that may impair California least tern reproduction is more likely to be derived from pre-breeding and breeding foraging sites than post-breeding staging areas in the South Bay. Finally, the increase in mercury mobilization resulting from Corps-led activities is expected to be relatively brief in duration.

Effects of Service-led Actions

Potential effects of mercury mobilization and exposure on California least terns, resulting from Service-led activities in Ponds A9-A15, are expected to be similar to those described above for Corps-led activities.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions unrelated to the proposed project are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

Climate Change

The global average temperature has risen by approximately 0.6 degree Centigrade during the 20th Century (International Panel on Climate Change [IPCC] 2001, 2007a, 2007b; Adger *et al.* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IPCC 2001, 2007a, 2007b; Adger *et al.* 2007), and that it is "very likely" that it is largely due to man-made emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Inkley *et al.* 2004, Adger *et al.* 2007, Kanter 2007) likely imperils the California clapper rail, salt marsh harvest mouse, Pacific Coast population of the western snowy plover, and California least tern and the resources necessary for their survival, since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, diseases, and non-native competitors. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat. Rising sea levels are likely to inundate much of the remaining salt marsh habitat available for the California clapper rail and salt marsh harvest mouse. Without upland habitat buffers available for the landward transgression of the marsh, the amount of suitable salt marsh habitat is likely to decrease with rising sea levels. The proposed project will reduce the cumulative effects of the loss of suitable salt marsh habitat within the action area from sea level rise by construction of the 345-foot-wide ecotone berms along Ponds A12 and A18 which will create an upland habitat buffer that will allow for the landward transgression of the marsh.

Conclusion

After reviewing the current status of the California clapper rail and salt marsh harvest mouse, the environmental baseline for these species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of these species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual California clapper rails and salt marsh

harvest mice; (2) the avoidance of disturbing any breeding California clapper rails; (3) the restoration of at least 517 acres of tidal salt marsh/brackish marsh habitat and creation of 67 acres of ecotone habitat for the California clapper rail and salt marsh harvest mouse within Pond A18; (4) the restoration of at least 300 acres of tidal salt marsh habitat and creation of 30 acres of ecotone for the California clapper rail and salt marsh harvest mouse within Pond A12; (5) the restoration of additional tidal marsh habitat for the California clapper rail and salt marsh harvest mouse within some of the Ponds A9-A15 under an adaptive management plan; (6) the enhancement of tidal marsh habitat for the California clapper rail and salt marsh harvest mouse along Artestian, Coyote, and Alviso sloughs through salinization of freshwater and brackish marsh habitat from increased tidal prism; and (7) the implementation of a long-term predator management plan and invasive plant species control plan.

After reviewing the current status of the Pacific coast population of the western snowy plover, the environmental baseline for this species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of this species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual western snowy plovers; (2) the avoidance of disturbing any breeding western snowy plovers during construction of the proposed project; (3) the implementation of a long-term predator management plan; (4) the enhancement of nesting habitat for western snowy plovers within Pond A16; and (5) the proposed project will enable the SBSPRP to fulfill their commitment to maintaining at least 250 breeding individual western snowy plovers within the SBSPRP area through adaptive management of suitable nesting habitat.

After reviewing the current status of the California least tern, the environmental baseline for this species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of this species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual California least terns; (2) the avoidance of disturbing any breeding California least terns; and (3) the increase in the abundance of prey fish populations for the California least tern in the South Bay through tidal marsh restoration.

INCIDENTAL TAKE STATEMENT

Section 9 of the Endangered Species Act and Federal regulations pursuant to section 4(d) of the Act, prohibit take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. The Service defines harassment as an intentional or negligent act or omission that creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. The Service defines harm to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited, provided such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below for the California clapper rail, salt marsh harvest mouse, Pacific coast population of the western snowy plover, and California least tern are nondiscretionary, and must be implemented by the Corps and the Refuge so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption under section 7(o)(2) to apply. The Corps and the Refuge have a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps or the Refuge: (1) fail to require the applicant or any of its contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms, and/or (2) fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or the Refuge must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take

California Clapper Rail

The Service anticipates incidental take of individual California clapper rails will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, their elusive and cryptic behavior, and the difficulty of finding killed or injured animals. Due to the difficulty in quantifying the number of California clapper rails that will be taken as a result of the proposed project, the Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all California clapper rails within the 1.04 acres of tidal freshwater marsh foraging/dispersal habitat disturbed along Artesian Slough during tide gate and pedestrian bridge construction.

2. The harassment of all California clapper rails within the 0.11 acre of tidal/brackish marsh foraging/dispersal habitat disturbed along the outboard Pond A18 levee during breaching and excavating the pilot channels.

3. The harassment and non-lethal harm of all California clapper rails within 17 acres of tidal marsh habitat lost due to scour along Artesian and Coyote sloughs.

4. The annual harassment of all California clapper rails within perennial pepperweed treatment areas in Pond A18.

5. The ongoing harassment by trail users of all California clapper rails within 50 feet of the pedestrian bridge constructed over Artesian Slough.

Service-led Actions

1. The harassment of all California clapper rails within the 0.06 acre of tidal/brackish marsh foraging/dispersal habitat disturbed along the outboard levees of Ponds A9-A15 during breaching and excavating the pilot channels.

2. The harassment and non-lethal harm of all California clapper rails within 40 acres of tidal marsh habitat lost due to scour along Alviso and Coyote sloughs.

3. The ongoing harassment by trail users of all California clapper rails within 50 feet of the segments of the trails constructed without a wide ecotone berm along the southern Pond A12 levee, the Pond A12/A13 levee, and the northern Pond A15 levee once tidal marsh is restored to these ponds.

4. The ongoing harassment of all California clapper rails within 50 feet of the Ponds A9-A15 levees during levee operation and maintenance activities.

5. The annual harassment of all California clapper rails within perennial pepperweed treatment areas in Ponds A9-A15.

Salt Marsh Harvest Mouse

The Service anticipates incidental take of individual salt marsh harvest mice will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, their elusive and cryptic behavior, and the difficulty of finding killed or injured animals. Due to the difficulty in quantifying the number of salt marsh harvest mice that will be taken as a result of the proposed project, the Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment and harm of all salt marsh harvest mice within the 13.65 acres of low quality salt marsh habitat disturbed along the edges of the Alviso impoundment, the northern edge of New Chicago Marsh, adjacent to the southern levee of Pond A16, and along both northern and southern sides of the existing Pond A18 levee during construction of the FRM levee and the Artesian Slough tide gate and pedestrian bridge.

2. The harassment and harm of all salt marsh harvest mice within the 0.11 acre of salt/brackish marsh habitat disturbed on the outboard Pond A18 levee along Artesian and South Coyote sloughs during breaching and excavation of the pilot channels.

3. The harassment and non-lethal harm of all salt marsh harvest mice within 17 acres of tidal marsh habitat lost due to scour along Artesian and Coyote sloughs.

4. The ongoing harassment and harm of all salt marsh harvest mice within 25 feet of the FRM levee top during levee operation and maintenance activities (*e.g.*, mowing a 15-foot wide strip of ruderal grassland habitat adjacent to the levee crown once per year).

5. The ongoing harassment by trail users of all salt marsh harvest mice within 25 feet of the pedestrian bridge constructed over Artesian Slough.

6. The annual harassment of all salt marsh harvest mice within perennial pepperweed treatment areas in Pond A18.

Service-led Actions

1. The harassment and harm of all salt marsh harvest mice within the 0.06 acre of tidal/brackish marsh habitat disturbed along the outboard levees of Ponds A9-A15 during breaching and excavating the pilot channels.

2. The harassment and non-lethal harm of all salt marsh harvest mice within 40 acres of tidal marsh habitat lost due to scour along Alviso and Coyote sloughs.

3. The capture of all salt marsh harvest mice on Refuge lands within the construction footprint in the action area during construction of the proposed project.

4. The ongoing harassment by trail users of all salt marsh harvest mice within 25 feet of the trails constructed along New Chicago Marsh and Ponds A12, A13, A15, and A18 once tidal marsh is restored to these ponds and ecotone habitat is created along Ponds A12 and A18.

5. The ongoing harassment of all salt marsh harvest mice within 25 feet of the Ponds A9-A15 levees during levee operation and maintenance activities.

6. The annual harassment of all salt marsh harvest mice within perennial pepperweed treatment areas in Ponds A9-A15.

Pacific Coast Population of the Western Snowy Plover

The Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all western snowy plovers within 600 feet of the Alviso Segment of the FRM levee in Ponds A12 and A13, the Alviso impoundment, New Chicago Marsh, and Pond A16 during construction of the proposed project.

2. The harassment and harm of two (2) breeding pairs of western snowy plovers due to the loss of breeding habitat in the Alviso impoundment and northern New Chicago Marsh due to the raising and widening of the FRM levee.

3. The annual harassment of all of western snowy plovers within 600 feet of the FRM levee during levee operation and maintenance activities adjacent to Pond A16, New Chicago Marsh, and the Alviso impoundment.

Service-led Actions

1. The harassment and harm of five (5) breeding pairs of western snowy plovers after the permanent loss of 2,010 acres of potential salt pond nesting habitat within Ponds A9-A15.

2. The ongoing harassment by trail users of all western snowy plovers within 600 feet of the Bay Trail along the FRM levee adjacent to Pond A16, New Chicago Marsh, and the Alviso impoundment.

California Least Tern

The Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all foraging and roosting California least terns within 300 feet of construction activities at Pond A18 and the FRM levee.

2. The harassment and harm of two (2) individual California least terns after the permanent loss of 736 acres of salt pond foraging habitat within Pond A18.

Service-led Actions

1. The harassment of all foraging and roosting California least terns within 300 feet of construction activities at Ponds A9-A15.

2. The harassment and harm of four (4) individual California least terns after the permanent loss of 2,010 acres of salt pond foraging habitat within Ponds A9-A15.

3. The ongoing harassment of all foraging and roosting California least terns by trail users within 300 feet of the trails along Ponds A18, A12, A13, and A15 until these ponds are restored to tidal marsh.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, and California least tern.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measures are necessary and appropriate to minimize the effects of the proposed project on the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, and California least tern:

1. The Corps through the CSCC, City of San Jose, and SCVWD will minimize adverse effects to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, and California least tern in the action area for the Corps-led actions by following the project description as modified by the terms and conditions.

2. The Refuge through the CSCC, City of San Jose, and SCVWD will minimize adverse effects to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, and California least tern in the action area for the Service-led actions by following the project description as modified by the terms and conditions.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and the Refuge shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These Terms and Conditions are nondiscretionary.

The following Term and Condition implements Reasonable and Prudent Measure Number One (1):

1. The Corps shall ensure that the CSCC, City of San Jose, and SCVWD minimize proposed project related effects of mobilization of methylmercury by minimizing the frequency and duration of methylization by minimizing the number of times mercury-contaminated soils are wetted and dried during construction of the proposed project (this measure does not apply to imported soils that meet contaminants screening criteria for mercury).

The following Term and Condition implements Reasonable and Prudent Measure Number Two (2):

1. The Refuge shall ensure that the CSCC, City of San Jose, and SCVWD minimize proposed project related effects of mobilization of methylmercury by minimizing the frequency and duration of methylization by minimizing the number of times mercury-contaminated soils are wetted and dried during construction of the proposed project (this measure does not apply to imported soils that meet contaminants screening criteria for mercury).

Reporting Requirements

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, the Corps and the Refuge shall adhere to the following reporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the Corps or the Refuge must reinitiate formal consultation as per 50 CFR 402.16.

1. The Service must be notified within one (1) working day of the finding of any injured or dead listed species or any unanticipated damage to its habitat associated with the proposed project. Notification will be made to the Coast/Bay Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600, and must include the date, time, and precise location of the individual/incident clearly indicated on a U.S. Geological Survey 7.5 minute quadrangle or other maps at a finer scale, as requested by the Service, and any other pertinent information. When an injured or dead individual of the listed species is found, the Corps or the Refuge shall follow the steps outlined in the Disposition of Individuals Taken section below.

2. The Corps and/or the Refuge shall provide annual updates and interim progress reports to the Service on the status of the implementation of the proposed project, avoidance and minimization measures, predator management, monitoring of the tidal marsh restoration areas, monitoring of the Pond A16 western snowy plover nesting habitat enhancements, and adaptive management.

Disposition of Individuals Taken

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, avoidance and minimization measures implemented, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact person is the Coast/Bay Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should develop, fund, and annually implement an avian and mammalian predator monitoring and management program within suitable habitat for the salt marsh harvest mouse, California clapper rail, western snowy plover, and California least tern around the Bay.

2. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should remove raptor nest and perch sites or install raptor perching deterrents within suitable habitat for the salt marsh harvest mouse, California clapper rail, western snowy plover, and California least tern around the Bay.

3. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should control invasive plant species (*e.g.*, perennial pepperweed) within suitable habitat for the salt marsh harvest mouse and California clapper rail.

4. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should import clean fill to raise the elevations of subsided salt ponds to accelerate the timeline of tidal marsh restoration.

5. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should install high-tide refugia islands planted with marsh gumplant for salt marsh harvest mice and California clapper rails within tidal marshes that lack sufficient high-tide refugia.

6. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should minimize the effects of atmospheric nitrogen deposition from nitrogen oxides emissions in construction vehicle traffic exhaust in facilitating the spread of invasive plant species into naturally nutrient-poor serpentine grassland habitat for the threatened Bay checkerspot butterfly and listed serpentine plants in the Santa Clara Valley by contributing funding to the management of invasive plant species in serpentine grassland habitat that supports these listed species.

7. The Corps and the Refuge should report sightings of any listed or sensitive animal species to the CNDDB of the CDFW. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed South Bay Shoreline Phase 1 Study in Santa Clara County, California. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any additional take will not be exempt from the prohibitions of section 9 of the Act, pending reinitiation.

If you have any questions regarding this biological opinion on the effects of the proposed South Bay Shoreline Phase 1 Study, please contact Joseph Terry, Senior Biologist, or Ryan Olah, Coast/Bay Division Chief, at the Sacramento Fish Wildlife Office at the letterhead address, telephone at (916) 414-6600, or via email (Joseph_Terry@fws.gov or Ryan_Olah@fws.gov). The Service contacts at the San Francisco Bay-Delta Fish and Wildlife Office are Armin Halston, Fish and Wildlife Biologist, or Kim Squires, Section 7 Coordinator, by telephone at (916) 930-5670 or via email (Armin_Halston@fws.gov or Kim_Squires@fws.gov).

Sincerely,

Jennifer M. Norris
Field Supervisor

cc:
Kim Squires, San Francisco Bay/Delta Fish and Wildlife Office, Sacramento, California
Brenda Blinn, California Department of Fish and Wildlife, Napa, California
Melisa Amato, Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California
Johnathon Bishop, National Oceanic and Atmospheric Administration/National Marine Fisheries Service, Santa Rosa, California

LITERATURE CITED

Ackerman, J. T. and C.A. Eagles-Smith. 2009. Integrating toxicity risk in bird eggs and chicks: using chick down feathers to estimate mercury concentrations in eggs. Environmental Science Technology 43:2166-2172.

Ackerman, J.T., C.A. Eagles-Smith, J.Y. Takekawa, J.D. Bluso, T.L Adelsbach. 2008a. Mercury concentrations in blood and feathers of pre-breeding Foster's terns in relation to space use of San Francisco Bay habitats. Environmental Toxicology and Chemistry 27:897-908.

Ackerman, J.T., C.A. Eagles-Smith, J.Y. Takekawa, S.A. Iverson. 2008b. Survival of postfledging Forster's terns in relation to mercury exposure in San Francisco Bay. Ecotoxicology 17:789-801.

Ackerman, J.T., M. Marvin-DiPasquale, D. Slotton, M. Herzog, and C. Eagles-Smith. 2011. The Effects of Wetland Restoration on Mercury Bioaccumulation in the South Bay Salt Pond Restoration Project: Using the Biosentinel Toolbox to Monitor Changes Across Multiple Habitats and Spatial Scales. http://www.southbayrestoration.org/documents/technical/Biosentinel%20Hg%20Annual%20Report%202010_Jan28_2011.pdf. Accessed on December 9, 2014.

Adger, P., P. Aggarwal, S. Agrawala, J. Alcamo, A. Allali, O. Anisimov, N. Arnell, M. Boko, O. Canziani, T. Carter, G. Cassa, U. Confalonieri, R. Cruz, E. de Alba Alcaraz, W. Eastreling, C. Field, A. Fischlin, B. Fitzharris, C.G. Garcia, C. Hanson, H. Harasawa, K. Hennessy, S. Huq, R. Jones, L.K. Bogataj, D. Karoly, R. Kliein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrin, L.J. Mata, R. McLean, B. Menne, G. Midgley, N. Mimura, M.Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nichols, B. Novaky, L. Nurse, A. Nyon, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P.R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J. van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P. Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Brussels, Belgium. 987 pp.

Albertson, J.D. 1995. Ecology of the California Clapper Rail in South San Francisco Bay. Unpublished Master's Thesis. San Francisco State University. San Francisco, California. 199 pp.

Bouton, S.N., P.C. Frederick, M.G. Spalding, H. McGill. 1999. Effects of chronic, low concentrations of dietary methymmercury on the behavior of juvenile great egrets. Environmental Toxicology and Chemistry 18:1934-1939.

Burger, J. and M. Gochfeld. 1997. Risk, mercury levels, and birds: relating adverse laboratory effects to field biomonitoring. Environmental Research 75:160-172.

California Department of Fish and Game. 2009. A status review of the Longfin Smelt (*Spirinchus thaleichthys*) in California. Report to the Fish and Game Commission. California Department of Fish and Game.

California Department of Fish and Wildlife (CDFW). 2014. California Natural Diversity Database. RareFind version 5. Natural Heritage Division. Sacramento, California.

California State Coastal Conservancy and U.S. Fish and Wildlife Service (Service). 2003. Final Programmatic Environmental Impact Statement/Environmental Impact Report for the San Francisco Estuary Invasive Spartina Control Program - Volumes I and II, September 2003. California State Coastal Conservancy, Oakland, California, and San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

California State Coastal Conservancy. 2005. Addendum to the Final Programmatic Environmental Impact Report for the San Francisco Estuary Invasive Spartina Project: Spartina Control Program. California State Coastal Conservancy, Oakland, California.

City of San Jose. 2013. Pond A18 2013 annual self-monitoring report. Prepared for the San Francisco Bay Regional Water Quality Control Board, Oakland, California.

Chesser, R.T, R.C. Banks, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, A.G. Navarro-Sigüenza, P.C. Rasmussen, J.V. Remsen, Jr., J.D. Rising, D.F. Stotz, and K. Winker. 2014. Fifty-Fifth Supplement to the American Ornithologists' Union *Check-list of North American Birds*. The Auk: October 2014, Vol. 131, No. 4, pp. CSi-CSxv. http://aoucospubs.org/doi/full/10.1642/AUK-14-124.1. Accessed on August 7, 2014.

Davidson, M. 2004. Transmission loss. Pages lecture structure obtained from website in IOM. Studies, editor. University of Plymouth, Drake Circus, Plymouth, Devon, United Kingdom. http://freespace.virgin.net/mark.davidson3/TL/TL.html

Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). 2012. Don Edwards San Francisco Bay National Wildlife Refuge Avian Predator Management Plan. Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California.

Donehower, C., K. Tokatlian, C. Robinson-Nilsen, and C. Strong. 2012. Western Snowy Plover Monitoring in the San Francisco Bay, Annual Report 2012. San Francisco Bay Bird Observatory, Milipitas, California and U.S. Fish and Wildlife Service, Newark, California.

Eagles-Smith, C.A., J.T. Ackerman, S.E.W. De La Cruz, and J.Y. Takekawa. 2009. Mercury bioaccumulation and risk to three waterbird foraging guilds is influenced by foraging ecology and breeding stage. Environmental Pollution 157:1993-2002.

EDAW, Inc. 2007. Draft Alviso Slough Restoration Project Fisheries and Aquatic Resources Technical Report.

EDAW, Philip Williams and Associates, Ltd., H.T. Harvey & Associates, Brown and Caldwell, and Geomatrix. 2007. South Bay Salt Pond Restoration Project Final Environmental Impact Statement/Report. December. http://www.southbayrestoration.org/EIR/. Accessed on December 3, 2014.

ESA and Philip Williams & Associates, Ltd. 2012. Shoreline Study Preliminary Alternatives and Landscape Evolution. Memorandum to the California State Coastal Conservancy.

Evers, D.C., O.P. Lane, L. Savoy, and W. Goodale. 2004. Assessing the Impacts of Methylmercury on Piscivorous Wildlife Using a Wildlife Criterion Value Based on the Common Loon, 1998–2003. Gorman (ME): BioDiversity Research Institute. Report no. BRI 2004-05.

Fisheries Hydroacoustic Working Group. 2008. Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities. Memorandum to Applicable Agency Staff. National Marine Fisheries Service, Northwest and Southwest Regions, U.S. Fish and Wildlife Service Regions 1 and 8, California/Washington/Oregon Departments of Transportation, California Department of Fish and Game, and U.S. Federal Highway Administration.

Foerster, K.S and J.E. Takekawa. 1991. San Francisco Bay National Wildlife Refuge Predator Management Plan and Final Environmental Assessment. U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

Foin, T. C, E. J. Garcia, R. E. Gill, S. D. Culberson, and J. N. Collins. 1997. Recovery strategies for the California clapper rail (*Rallus longirostris obsoletus*) in the heavily-urbanized San Francisco estuarine ecosystem. Landscape and Urban Planning 38(3):229-243.

Geissel, W., H. Shellhammer, and H. T. Harvey & Associates. 1988. The ecology of the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in a diked salt marsh. Journal of Mammalogy 69:696-703.

Greenfield, B.K., A.R. Melwani, R. M. Allen, D.G. Slotton, S.M. Ayers, K.H. Harold, K. Ridolfi, A. Jahn, J.L. Grenier, and M.B. Sandheinrich. 2013. Seasonal and annual trends in forage fish concentrations, San Francisco Bay. Science of the Total Environment 222:591-601.

Grenier, L., M. Marvin-DiPasquale, D. Drury, J. Hunt, A. Robinson, S. Bezalel, A. Melwani, J. Agee, E. Kakouros, L. Kieu, L. Windham-Myers, J. Collins. 2010. South Baylands Mercury Project Final Report.

HDR. 2014. Administrative Draft Integrated Document. U.S. Army Corps of Engineers-San Francisco District South San Francisco Bay Shoreline Phase I Study.

H.T. Harvey & Associates (HTH). 2007. Marsh Studies in South San Francisco Bay: 2005-2008. California Clapper Rail and Salt Marsh Harvest Mouse Survey Report, 2006. Prepared for the City of San Jose, San Jose, California.

_____. 2012. Marsh Plant Associations of South San Francisco Bay: 2012 Comparative Study. Draft Report. Prepared for City of San Jose. Report No. 477-30.

_____. 2013. Santa Clara Valley Water District Alviso Slough Project Biological Assessment for the California Clapper Rail, Salt Marsh Harvest Mouse, California Least Tern, West Snowy Plover, California Central Coast Steelhead, and Green Sturgeon, and Essential Fish Habitat Assessment. Project # 3270-11. June. Prepared for the Santa Clara Valley Water District, San Jose, California. 91 pp. plus figures.

_____. 2014. Draft South San Francisco Bay Shoreline Phase 1 Biological Assessment for the Salt Marsh Harvest Mouse, California Ridgway's Rail, Western Snowy Plover, California Least

Tern, Central California Coast Steelhead, Green Sturgeon, and Longfin Smelt and Essential Fish Habitat Assessment. November. Prepared by H.T. Harvey & Associates, Los Gatos, California, for the U.S. Army Corps of Engineers, San Francisco District, San Francisco, California.

Heinz, G.H. and D.J. Hoffman. 2003. Embryotoxic thresholds of mercury: Estimates from individual mallard eggs. Archives of Environmental Contamination and Toxicology 44:257-264.

Hobbs, J.A., P. Moyle, and N. Buckmaster. 2012. Monitoring the response of fish communities to salt pond restoration: Final report. Prepared for the South Bay Salt Pond Restoration Program and Resource Legacy Fund. University of California, Davis, California.

Hogle, I., R. Spenst, S. Leininger, and G. Block. 2007. San Pablo Bay National Wildlife Refuge *Lepidium latifolium* Control Plan. Prepared for the San Pablo Bay National Wildlife Refuge, Petaluma, California.

Hothem, R.L. and A.N. Powell. 2000. Contaminants in eggs of western snowy plovers and California least terns: is there a link to population decline? Environmental Contamination and Toxicology 65:42-50.

Hothem, R.L., and S.G. Zador. 1995. Environmental Contaminants in Eggs of California Least Terns (*Sterna antillarum browni*). Bulletin of Environmental Contamination and Toxicology 55:658-665.

Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffin, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Review 04-2. 26 pp.

International Panel on Climate Change (IPPC). 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson, editors). Cambridge University Press, New York, New York. 881 pp. http://www.ipcc.ch/. Accessed on March 22, 2013.

_____. 2007a. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, editors. Cambridge University Press, New York, New York. 996 pp. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm. Accessed on September 25, 2009.

_____. 2007b. Climate Change 2007: The Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R.K. Pachauri and A. Reisinger, editors. IPCC, Geneva, Switzerland. 104 pp. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm. Accessed on September 25, 2009.

Kanter, J. 2007. Scientists detail climate changes, Poles to Tropics. New York Times. April 10, 2007.

Maley, J. M., and R.T. Brumfield. 2013. Mitochondrial and next-generation sequence data used to infer phylogenetic relationships and species limits in the Clapper/King rail complex. Condor 115:316–329. http://aoucospubs.org/doi/abs/10.1525/cond.2013.110138. Accessed on August 7, 2014.

Marschalek, D.A. 2006. California Least Tern Breeding Survey, 2005 Season. California Department of Fish and Game, South Coast Region, San Diego, CA. Species Conservation and Recovery Program Report, 2006-01.

Marvin-DiPasquale, M.C., J.L. Agee, R.M. Bouse, B.E. Jaffe. 2003. Microbial cycling of mercury in contaminated pelagic and wetland sediments of San Pablo Bay, California. Environmental Geology 43:260-267.

National Marine Fisheries Service (NMFS). 2013. Reinitiation of the Endangered Species Act Section 7 Formal Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Aquatic Restoration Activities in the States of Oregon and Washington (ARBO II). 25 April 2013.

Olofson Environmental, Inc. 2012. 2012 Clapper rail surveys for the San Francisco Estuary Invasive Spartina Project. December. Prepared for the State Coastal Conservancy, San Francisco Estuary Invasive Spartina Project, Oakland, California. http://spartina.org/project_documents/revegetation_program/CLRA%20Report%202012.pdf. Accessed on December 4, 2014.

_____. 2014. 2014 Clapper Ridgway's rail surveys for the San Francisco Estuary Invasive Spartina Project. October. Prepared for the State Coastal Conservancy, San Francisco Estuary Invasive Spartina Project, Oakland, California. http://spartina.org/documents/RIRAReport2014_sm_000.pdf. Accessed on December 16, 2014.

Overton, C.T., M.L. Casazza, J.Y. Takekawa, D.R. Strong, and M. Holyoak. 2014. Tidal and seasonal effects on survival of the endangered California clapper rail: does invasive Spartina facilitate greater survival in a dynamic environment? Biological Invasions. doi: 10.1007/s10530-013-0634-5. http://www.werc.usgs.gov/ProductDetails.aspx?ID=5003. Accessed on June 17, 2014.

Paton, P.W.C. and V.C. Bachman. 1996. Impoundment drawdown and artificial nest structures as management strategies for snowy plovers. International Wader Studies 9:64-70.

Philip Williams & Associates, Ltd. and P.M. Faber. 2004. Design guidelines for tidal wetland restoration in San Francisco Bay.

Robinson, C. 2008. Western Snowy Plover Use of Managed Salt Ponds at Eden Landing, Hayward, CA. Masters of Science thesis. San José State University, San Jose, California.

Robinson, A. and B.K. Greenfield. 2011. LTMS Longfin Smelt Literature Review and Study Plan. San Francisco Estuary Institute. Prepared for the Long-term Management Strategy for Dredged Materials in San Francisco Bay.

Robinson-Nilsen, C., K. Tokatlian, J. Scullen, C. Burns, and C. Strong. 2013. Western Snowy Plover Monitoring in the San Francisco Bay, Annual Report 2013. San Francisco Bay Bird Observatory, Milipitas, California and U.S. Fish and Wildlife Service, Newark, California.

Rosenfield, J.A. 2009. Distribution and abundance trends of Longfin smelt in the San Francisco Estuary. Green Sturgeon, Longfin Smelt, and Dredging Operations Symposium. San Francisco Estuary Institute, Oakland, California.

San Francisco Bay Bird Observatory and U.S. Fish and Wildlife Service (Service). 2010. Western snowy plover numbers, nesting success, fledging success and avian predator surveys in the San Francisco Bay, 2010. Prepared by Caitlin Robinson-Nilsen, San Francisco Bay Bird Observatory, Milpitas, California, and Cheryl Strong, Don Edwards San Francisco Bay National Wildlife Refuge, Newark, California. http://www.fws.gov/arcata/es/birds/WSP/documents/siteReports/California/RU3_SNPL_Report_2010.pdf. Accessed on August 11, 2011.

San Francisco Bay Regional Water Quality Control Board. 2006. Mercury in San Francisco Bay Total Maximum Daily Load (TMDL) Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. Final Report. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

San Francisco Estuary Institute. Undated. Salt Marsh Harvest Mouse, *Reithrodontomys raviventris*, Database and Maps. Developed by Howard Shellhammer, H.T. Harvey & Associates. http://www.sfei.org/content/salt-marsh-harvest-mouse-database-and-maps. Accessed on June 16, 2014.

Scheuhammer, A.M., M.W. Meyer, M.B. Sandheinrich, and M.W. Murray. 2007. Effects of environmental health of wild birds, mammals, and fish. Ambio 36:12-18.

Schwarzbach, S. and T. Adelsbach. 2003. Field assessment of avian mercury exposure in the Bay-Delta ecosystem. Final Report to the California Bay Delta Authority. Sacramento, California. pp. 30.

Schwarzbach, S.E., J.D. Albertson, and C.M. Thomas. 2006. Effects of predation, flooding, and contamination on the reproductive success of California clapper rails (*Rallus longirostris obsoletus*) in San Francisco Bay. Auk 123:45-60.

Schwarzbach, S.E., M. Stephenson, T. Ruhlen, S. Abbott, G.W. Page, and D. Adams. 2005. Elevated mercury concentrations in failed eggs of the Snowy Plovers at Point Reyes National Seashore. Baseline 50:1444-1447.

Sexson, M.G. and G.H. Farley. 2012. Snowy plover nest survival in Kansas and effective management to counter negative effects of precipitation. Journal of Wildlife Management 76:1587-1596.

Shellhammer, H. 1978. Studies on *Reithrodontomys raviventris raviventris* in the Alviso Marshes, California. San Francisco Bay National Wildlife Refuge, Newark, California.

South Bay Salt Pond Restoration Project (SBSPRP). 2013. Summary of Recent Mercury and Alviso Slough/Pond A8 Results. Meeting notes taken by Laura Valoppi, Lead Scientist of the South Bay Salt Pond Restoration Project, April 2013.

Spalding, M.G., P.C. Frederick, H.C. McGill, S.N. Bouton, L.J. Richey, I.M. Schumacker, C.G.M. Blackmore, and J. Harrison. 2000. Histologic, neurologic, and immunologic effects of methylmercury in captive great egrets. Journal of Wildlife Diseases 36:423-435.

Thomsen, F.K, Ludemann, R. Kafemann, and W. Piper. 2006. Effects of offshore wind farm noise on marine mammals and fish. Cowrie, Ltd., Hamburg, Germany.

U.S. Fish and Wildlife Service (Service). 1998. Consultation Handbook. Procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. U.S. Fish and Wildlife Service and National Marine Fisheries Service. March 1998 Final.

_____. 2006. California Least Tern (*Sternula antillarum browni*) 5-Year Review Summary and Evaluation. Carlsbad Fish and Wildlife Office, Carlsbad, California. 33 pp. http://ecos.fws.gov/docs/five_year_review/ doc775.pdf. Accessed on November 25, 2014.

_____. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In 2 volumes. California/Nevada Operations Office, Sacramento, California. xiv + 751 pages. http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf. Accessed on November 25, 2014.

_____. 2008. Formal Endangered Species Consultation on the South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California. August 12. U.S. Fish and Wildlife Service file number 81420-F-08-0621-1. Sacramento Fish and Wildlife Office, Sacramento, California. 189 pp.

_____. 2010. Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*) 5-Year Review Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. 49 pp. http://www.fws.gov/ecos/ajax/docs/five_year_review/doc3221.pdf. Accessed on February 24, 2014.

_____. 2012a. Don Edwards San Francisco Bay National Wildlife Refuge Comprehensive Conservation Plan. San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

_____. 2012b. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the San Francisco Bay-Delta Population of the Longfin Smelt as Endangered or Threatened; Proposed Rule. Federal Register 77:19755-19797. http://www.fws.gov/sfbaydelta/species/longfin_smelt.cfm. Accessed on November 25, 2014.

_____. 2013. Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. Sacramento Fish and Wildlife Office, Sacramento, California. xviii + 605 pp. http://www.fws.gov/sacramento/es/Recovery-Planning/Tidal-Marsh/es_recovery_tidal-marsh-recovery.htm. Accessed on December 16, 2014.

_____. 2014a. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register 79:72449-72497.

_____. 2014b. 2014 Summer Window Survey for Snowy Plovers on U.S. Pacific Coast with 2005-2013. Arcata Fish and Wildlife Office, Arcata, California. http://www.fws.gov/arcata/es/birds/WSP/plover.html. Accessed on December 16, 2014.

Webber, H.M. and T.A. Haines. 2003. Mercury effects on predator avoidance behavior of a forage fish, golden shiner (*Notemigonus crysoleucas*). Environmental Toxicology and Chemistry (22)7:1556-1561.

Personal Communications

Liu, Leonard. 2012. Biologist, Wetlands Ecology Division, PRBO Conservation Science, Petaluma, California.

Strong, Cheryl. 2012. Wildlife Biologist, Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California.

Appendix A: Walking In the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife & Plants

December 15, 2004

I. Safety

A. *Before heading out into the marsh check the tides*: tides can affect your ability to move through the marsh. Be aware of how long you plan to be in the marsh, what channels you may have to cross, and how the tides will change while you are in the field.

B. *Plan your route through the marsh*: use existing aerial imagery and maps to identify channels and sloughs that may impede access. When available, use high points such as boardwalks or levees to scope out a route. Scoping a route can be especially important in scenarios where visibility across the marsh is low (*e.g.*, South Bay, Suisun). It may be necessary to flag stations and/or access corridors through the marsh prior to surveys. If more than one person is accessing the marsh, travel together along major access routes to avoid the development of multiple paths. At the end of the sampling period, persons furthest out should walk out first, meeting up with others along the major access route…this minimizes the potential of people getting lost and ensures that anyone who is injured will be found in a timely manner (before everyone else has left the marsh). The goal should be to plan a safe route into and out of the marsh while minimizing travel and pathways.

C. *Channels and sloughs*: Avoid jumping channels in locations where you cannot see through vegetation on the opposite bank. Thick vegetation (*e.g.*, pickleweed, gumplant) can obscure the edge of the bank. Considerations before jumping: depth of water/channel, steepness of the channel edges, tide levels. If you are not confident that you can make the jump and the edges have high dense vegetation that you cannot see through…..DO NOT JUMP.

D. *Getting stuck in the mud*: If you are sinking into mud, try to keep moving to avoid getting stuck further. If a leg gets stuck, try to twist your leg to break the suction while leaning your weight on your other leg or knee. Use whatever material you have available (e.g., clipboard, backpack) for leverage (*e.g.*, lean on those items).

E. *Other*: Besides general items such as water and food, it's a good idea to bring a flashlight and a phone (+GPS) in cases of an emergency. Let someone know what marsh area you will be in and when you plan to complete work for the day. Designate an end time and final meeting place when more than one person is out in the marsh at the same time.

II. Avoiding Impacts to Wildlife and Plants

A. *Movement through the Marsh*. While walking through the marsh, keep noise to a minimum. Avoid using multiple pathways through the marsh. Use trails if they exist. Plan and map your route to minimize environmental impacts and decrease running into hazards/barriers such as large channels. When looking for a suitable place to jump a channel, do not walk along the edge of the channel/slough because these areas provide nesting habitat for many species including the endangered California clapper rail. To find an alternate jump site, walk parallel to the channel at a distance where vegetation is lower in height and where visibility

of the ground surface is greater. At all times, observe the environment you are walking through to avoid disturbance. Choose channel jump sites where vegetation is lower or you can clearly discern what you are jumping onto. In general, avoid walking adjacent and parallel to channels/sloughs.

B. *Avoiding nests and nest substrates.* Tidal marsh species have nests that are well concealed and therefore easy to disturb when walking through the marsh. To avoid stepping on a nest, do not walk through thick vegetation or areas where you cannot see through to the ground. Avoid walking on vegetation whenever possible since plants serve as nesting substrate for many species in the marsh. In general, be aware of the area you are walking through.

C. *Bird Behavior.* If a bird vocalizes or flushes within close range of where you are standing or walking (*e.g.*, < 10-m), it is possible that a nest or young are nearby. When these circumstances arise, stop whatever you are doing and leave the immediate area (be sure to watch where and what you are walking on). Choose an alternate route through the marsh, identify the new route and location of the sighting/occurrence on a map, and record coordinates of the location if possible. Be sure to pass this information on to others that may use the same route or are conducting surveys in the same area. Be very observant of where you walk as you leave the area. There exists the possibility that you could step on a nest or young, both of which can be concealed by vegetation and are cryptic. When alarmed, individuals may freeze in place (especially juveniles).

D. *Tidal lagoons/ponds.* Avoid walking along tidal lagoons and ponds in marsh interiors that support foraging, roosting, or nesting shorebirds and waterfowl. Be observant of the distance at which birds flush or become alarmed.

E. *Tides.* Avoid conducting surveys during high tides as much as possible. These are periods when many wildlife species are at greatest risk (*e.g.*, predation). If your surveys require a high tide, be aware of the increased risk you may cause for wildlife and take all precautions to reduce that risk (*e.g.*, avoiding areas where sensitive species are known to occur).

United States Department of the Interior

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

In Reply Refer to:
08ESMF00-
2012-F-0450-3

APR 27 2015

Memorandum

To: Refuge Complex Manager, San Francisco Bay National Wildlife Refuge Complex, Fremont, California

From: Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Biological Opinion and Conference Opinion on the South San Francisco Bay (South Bay) Shoreline Phase 1 Study in Santa Clara County, California

This memorandum is in response to your December 11, 2014, request for intra-U.S. Fish and Wildlife Service (Service) consultation for the proposed South Bay Shoreline Phase 1 Study (proposed project) in Santa Clara County, California. Your request for intra-Service consultation was received in our office on December 22, 2014. The proposed project involves flood risk management, levee construction, upland transitional habitat (ecotone) berm construction along Ponds A12 and A18, tidal marsh restoration in Ponds A9-A15 and Pond A18, trail construction, and operation and maintenance activities on lands owned and managed by the City of San Jose and the Service's Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) in the South Bay. The U.S. Army Corps of Engineers (Corps) and the Service are each requesting the initiation of consultation for the Corps-led actions and Service-led actions of the proposed project, respectively. Your letter requested consultation on the endangered California clapper rail (*Rallus longirostris obsoletus*), endangered salt marsh harvest mouse (*Reithrodontomys raviventris*), threatened Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*), endangered California least tern (*Sternula antillarum browni*), and Federal candidate San Francisco Bay-Delta Distinct Population Segment (DPS) of the longfin smelt (*Spirinchus thaleichthys*). Critical habitat has been designated for the Pacific coast population of the western snowy plover but does not occur within the action area for the proposed project. This document is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act), and in accordance with the policies governing intra-Service consultations (Service 1998), which call for candidate species like the San Francisco Bay-Delta DPS of the longfin smelt to be considered as if proposed for listing.

This document represents the Service's biological opinion on the effects of the proposed project on the California clapper rail, salt marsh harvest mouse, Pacific Coast population of the western snowy plover, and California least tern. The same biological opinion is being submitted to the Corps. Currently the biological opinion is to both the Corps and the Service because the Corps is not authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency, but it can expend funds on flood control on such lands. However, it is a possibility that the Corps

may implement the entire action and, therefore, all aspects of the proposed project will be implemented by the Corps except those that were addressed in the South Bay Salt Pond Restoration Project (SBSPRP) Phase 1 Actions (Service file number 81420-F-08-0621-1, Service 2008). This document also represents the Service's conference opinion on the effects of the proposed project on the San Francisco Bay-Delta DPS of the longfin smelt.

The following sources of information were used to develop this biological opinion and conference opinion: (1) your letter requesting consultation on the proposed project dated December 11, 2014; (2) the November 2014 *Draft South San Francisco Bay Shoreline Phase 1 Biological Assessment for the Salt Marsh Harvest Mouse, California Ridgway's Rail, Western Snowy Plover, California Least Tern, Central California Coast Steelhead, Green Sturgeon, and Longfin Smelt and Essential Fish Habitat Assessment* (Biological Assessment) (H.T. Harvey & Associates (HTH) 2014); (3) the August 2008 *Formal Endangered Species Consultation on the South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California* (Programmatic Biological Opinion) (Service file number 81420-F-08-0621-1, Service 2008); (4) electronic mail and conversations among the Corps, the Refuge, HTH, California State Coastal Conservancy (CSCC), San Francisco Bay Conservation and Development Commission (BCDC), Santa Clara Valley Water District (SCVWD), the City of San Jose, California Department of Fish and Wildlife (CDFW), the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NMFS), and the Service; and (5) other information available to the Service.

CONSULTATION HISTORY

August 12, 2008	The Service issued the Programmatic Biological Opinion for the SBSPRP Phase 1 Actions (Service file number 81420-F-08-0621-1, Service 2008).
2008 – 2014	The Service continued coordination with the Corps, the Refuge, HTH, CSCC, BCDC, SCVWD, the City of San Jose, and CDFW on the SBSPRP and the proposed project.
October 15, 2014	The Service received via electronic mail from the Corps, the Refuge, and CSCC the October 2014 Draft Biological Assessment for the proposed project.
October 17, 2014	The Service provided via electronic mail comments on the October 2014 Draft Biological Assessment for the proposed project to the Corps, the Refuge, HTH, CSCC, SCVWD, and the City of San Jose.
October 28, 2014	The Service participated in a conference call among the Corps, the Refuge, HTH, CSCC, SCVWD, and the City of San Jose discussing the Service's comments on the Draft Biological Assessment for the proposed project.
November 17, 2014	The Service received via electronic mail from the Refuge and the Corps the revised Biological Assessment for the proposed project (HTH 2014).
December 22, 2014	The Service received from the Corps and the Refuge the letter requesting the initiation of formal consultation on the proposed project.

April 9, 2015	The Service submitted the draft biological opinion for the proposed project at the request of the Corps.
April 17, 2015	The Service received via electronic mail from the Corps comments on the draft biological opinion for the proposed project.

BIOLOGICAL OPINION AND CONFERENCE OPINION

Description of the Proposed Project

Background

The Corps is conducting a flood risk management and ecosystem restoration study for the South Bay shoreline. Phase I of the study, known as the South Bay Shoreline Phase I Study (proposed project), involves increasing the height and width of certain levees in the Alviso area in northern Santa Clara County, California, and breaching of other levees to restore tidal habitats in existing managed ponds. The proposed project's "Study Area" (Figure 1) is bounded on the southwest by Alviso Slough; on the north by Coyote Slough, Ponds A16 and A17, the "Island Ponds" (Ponds A19, A20, and A21), and the Newby Island Landfill; on the east by the Coyote Creek levee; and on the south by State Route (SR) 237.

The proposed project consists of two main sets of actions:

1. Corps-led actions: these include flood risk management levee improvements and public access improvements funded by the Corps and SCVWD, which will occur on Refuge lands and lands of the City of San Jose, as well as tidal restoration actions on City of San Jose lands;

2. Service-led actions: these include tidal restoration and public access improvements proposed by the Service and SCVWD on Refuge lands.

Proposed project activities on Refuge lands were included in the intra-Service Programmatic Biological Opinion for the SBSPRP, which addressed flood control, public access, and habitat restoration and management (Service file number 81420-F-08-0621-1, Service 2008). As a result, the intra-Service consultation for the South Bay Shoreline Phase I Study Project will tier off the programmatic consultation for the SBSPRP. However, portions of the South Bay Shoreline Phase I Study Project on City of San Jose lands were not included in the action area for the Programmatic Biological Opinion. Also, the Programmatic Biological Opinion did not cover effects to the longfin smelt which is currently a candidate for Federal listing but was not in 2008.

Flood Risk Management (FRM)

The Study Area is at risk of tidal flooding due to having large areas of low-lying terrain that are bordered by pond levees originally designed and constructed for commercial salt pond purposes rather than for FRM. The proposed project will address this flooding risk by raising the heights of levees in key areas.

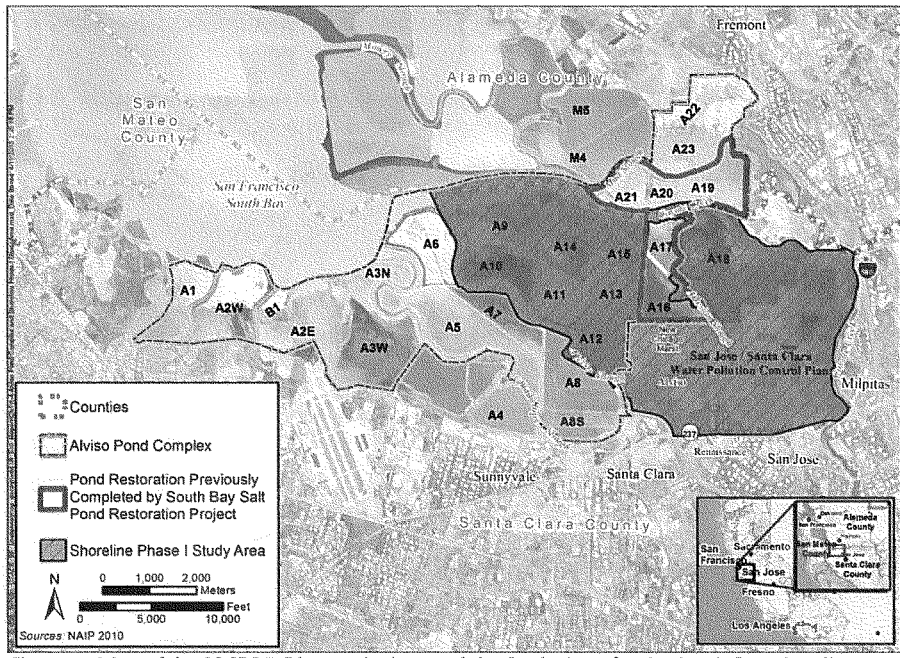


Figure 1. Map of the SBSPRP Phase 1 Actions and the Study Area for the South Bay Shoreline Phase I Study Project.

Ecosystem Restoration

Ecosystem restoration and FRM issues are inseparable in the Study Area because opening up ponds to tidal action changes the hydraulic behavior of the ponds under both normal and high-water conditions. Tidal restoration will alter both ecosystem conditions and potential flood risk to the surrounding areas. Engineered levees are necessary to replace the existing non-engineered pond levees, which were not intended to provide any FRM in order to address the potential change in flood risk.

Tidal salt marshes are in dynamic equilibrium with water levels in San Francisco Bay (Bay) and can keep pace with rising sea levels through accretion of sediment if restoration activities begin soon, based on current and projected sediment availability. In addition, a vegetated marsh plain can slow down tidal surge velocity and reduce wave heights as they traverse the marsh surface. Therefore, having an established marsh in front of FRM infrastructure would increase the resiliency of the shoreline relative to the projected impacts of sea level rise (HDR 2014).

Project Components

Overview

Figures 2 and 3 below depict the portions of the Study Area where long-term physical changes are expected to occur as a result of proposed project activities led by the Corps and the Service, respectively. As noted previously, the proposed project consists of two main sets of actions: tidal restoration and public access improvements proposed by the Service and SCVWD on the Refuge (Figure 3), and flood control levee improvements, public access improvements, and tidal restoration funded by the Corps and SCVWD, both on Refuge lands and lands of the City of San Jose (Figure 2). For the purposes of this biological opinion and conference opinion, the Corps-led actions and the Service-led actions are described separately because the Corps is not authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency, but it can expend funds on flood control on such lands. As a result, the Corps-led actions include flood improvements and public access improvements on Refuge lands, but the Corps cannot fund ecosystem restoration activities on the Refuge. The Corps can, however, fund ecosystem restoration on City of San Jose-owned portions of the Study Area, and thus the tidal restoration and ecotone (upland transitional zone) activities in Pond A18 are part of the Corps-led actions.

Regardless of the source of funding for various proposed project actions or the ownership of the lands on which these actions occur, all the actions described in this biological opinion and conference opinion are interrelated and interdependent. Tidal restoration in the proposed project area necessitates improved tidal FRM, the nature of tidal FRM along levees depends on whether adjacent ponds are tidal or not (e.g., with higher and more robust levees needed if adjacent areas are tidal than if they are managed ponds), and public access and recreation opportunities differ depending on whether and where levee improvements and tidal restoration occur.

Project Schedule and Phasing

The construction-phasing schedule is illustrated in Figure 4 below. This schedule includes both Corps-led and Service-led activities and indicates the lead agency for each task. The South Bay Shoreline Phase I Study timeline includes a 50-year span (2017–2067).

Figure 4 and subsequent discussion regarding the sequence of proposed project activities reflect a scenario in which the first pond to be breached would be Pond A12; this is likely to be the case if the Corps is able to expend funds on restoration on Refuge lands. However, as noted above, the Corps is not currently authorized to expend funds on ecosystem restoration on lands controlled by another Federal agency. As a result, Pond A18 (which is not on Refuge lands) may be breached first, in which case the sequencing and timing of activities associated with A12 and A18 may be reversed. Resolution of the sequence will occur when the proposed project obtains interpretation of the Water Resources Reform and Development Act from Corps Headquarters.

Construction will commence in 2017 beginning with FRM levee construction; the ecotones at Ponds A12 and A18 will be constructed during the same period. Subsequently, Pond A12 will be prepared for breaching. The first breach is scheduled for 2020, followed by monitoring and adaptive management to inform the next potential phases of restoration. This period of monitoring and adaptive management will also be used to inform potential adjustments to Pond A12 and may extend beyond this four-year period. The second phase of ponds (Ponds A9-A11 and Pond A18)

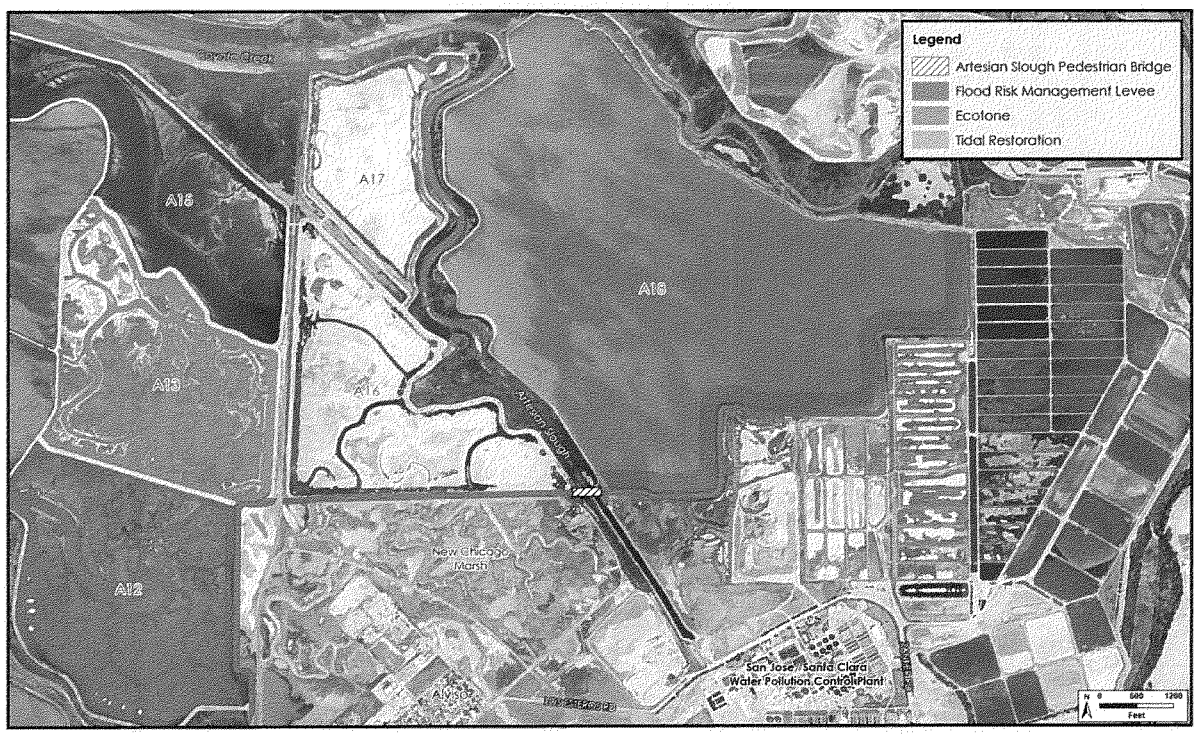


Figure 2. Corps-led Actions in the South Bay Shoreline Phase 1 Study Project (copied from HTH 2014).

Figure 3. Service-led Actions in the South Bay Shoreline Phase 1 Study Project (copied from HTH 2014).

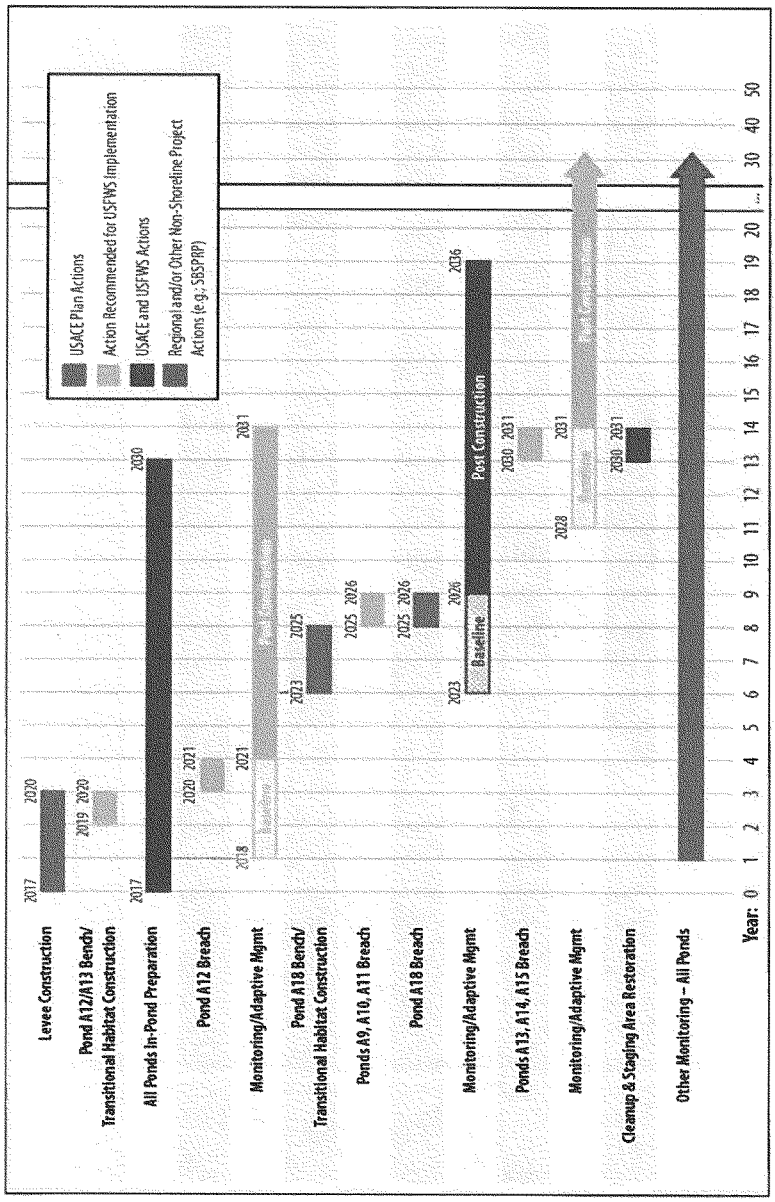


Figure 4. Construction Schedule for the South Bay Shoreline Phase 1 Study (copied from HTH 2014).

will be breached in 2025, assuming that monitoring results from the previous phase indicate that tidal marsh restoration should proceed, and will also be followed by a similar period of monitoring and adaptive management. The last phase of ponds will be breached in 2030 and will be followed by continued monitoring and adaptive management for all areas. Maintenance (e.g., of levees and trails) and management according to a long-term management plan (described in the "Conservation Measures" section below) will continue throughout the life of the proposed project.

For the ecotone at Ponds A12 and A18, separate time frames are identified to construct each of these features. Material for construction of the ecotone at both ponds is assumed to be available on site and free of charge. This material is provided through agreements that the Refuge makes with local construction companies to acquire materials excavated from other regional construction sites, and with the SCVWD to acquire sediment dredged for stream maintenance purposes. After the new FRM levees are constructed, the Refuge and/or SCVWD will use these materials to construct transitional habitat. The construction phasing strategy allows for the accumulation of material needed to build the 345-foot-wide ecotones with 30:1 side slopes at Ponds A12 and A18.

Monitoring will continue throughout the life of the proposed project.

Corps-led Actions

Flood Protection Actions

The Corps conducted an analysis of potential FRM actions in order to identify the proposed project activities. Details of the analysis, including potential actions that were considered but that are not proposed and potential alternatives to the proposed project, are discussed in the Integrated Document (HDR 2014).

Construction

The Corps will construct 3.1 miles of new levee from the Alviso Marina northeastward to the northwestern corner of the San Jose/Santa Clara Water Pollution Control Plant (WPCP) (Figure 2). The levee, which would provide FRM assuming a one percent Annual Chance of Exceedance, consists of the following three components:

1. The 1.7-mile Alviso Segment, which is located entirely on Refuge lands, will provide FRM for the community of Alviso. This segment follows the eastern border of Pond A12 and the southern border of Pond A16.

2. The Artesian Slough crossing will entail construction of a new tide gate across the slough to protect the WPCP from storm waters flooding the slough and backing up into the facility during extreme storm events. The proposed location of the tide gate will be at least 300 feet bayward of the existing WPCP outfall for treated water at Artesian Slough (the location shown in the Biological Assessment is approximate, and the actual location may be farther upstream along Artesian Slough). The gates will only be closed during extreme storm events. When the gates are closed, the WPCP will need to pump water outputs over the gate, or provide for internal excess water storage during a storm event. With or without the proposed project, the WPCP will develop a plan to pump or store waters during such events given increases in Bay water levels that correspond with future sea level rise scenarios. To

best meet the general operations requirements for the WPCP and allow for discharge during storm events, the tide gate will be designed in coordination with WPCP engineers.

3. The 2.1-mile WPCP Segment, which is located on City of San Jose lands, will provide FRM to the WPCP. It runs west to east in a stair-step pattern along the southern border of Pond A18, from the southwest corner of the pond to its northeast corner.

The engineered levee will be earthen. The proposed change in levee size from the existing levee (*e.g.*, along the southern edge of Pond A16) will be an increase of up to approximately 10 feet in height (after settlement) and about double in existing width. For example, the Alviso Segment levee along the southern edge of Pond A16 will increase in height from approximately 6 feet to 16 feet and increase in width at the toe from approximately 55 feet to 115 feet. The average width at the crown of the levee will be 16 feet, with 3:1 (horizontal: vertical) slopes except where ecotones having a 30:1 slope will be constructed (Figure 5). Along the east edge of Pond A12, the Alviso Segment levee will have an additional 345-foot-wide ecotone along its west side.

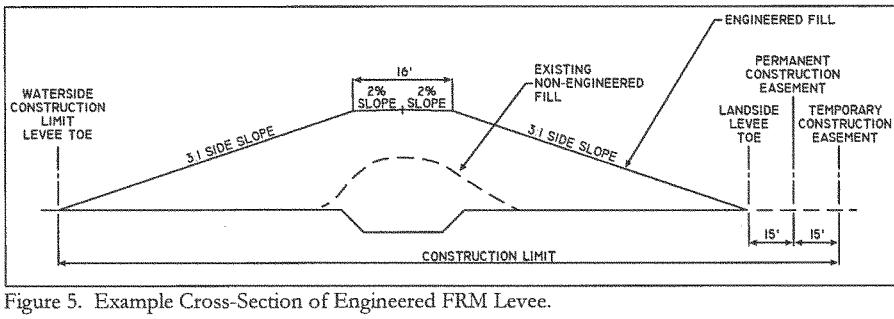


Figure 5. Example Cross-Section of Engineered FRM Levee.

Dredge material originating from areas outside the proposed project area that is used for ditch blocks, or for portions of the ecotone and FRM levee that will be in contact with tidal waters, will need to meet the contaminants screening criteria as described in the Biological Assessment (HTH 2014).

The levee design will include vegetation as erosion protection on the bayward and landward side slopes. Vegetation is anticipated to be continuous and able to provide erosion protection from overtopping of the levee. The vegetation that will be seeded or planted on the levee following construction will consist of marsh vegetation and peripheral halophytes at the toes of the levee and upland grasses at higher elevations. The combination of vegetation, buried stone, and/or transitional habitat fills (*i.e.*, planting berms) is proposed to balance requirements for levee safety with the need to limit disturbance from traditional maintenance activity (described below) such as regular mowing in/near habitat for sensitive species such as the salt marsh harvest mouse.

Proposed vegetation will include marsh species and peripheral halophytes, such as 12 to 18-inch tall pickleweed, from elevation 0 feet to 3 feet above the typical high water elevation. The high water elevation corresponds to approximately elevation 6 feet and 10 feet on the landward and bayward

side slope, respectively. Upland grasses will occupy the side slopes between the levee crest and the pickleweed. Combinations of buried stone protection and buried gravel may be necessary to stunt the growth of native vegetation in lieu of regular mowing (i.e., to reduce the frequency of mowing) in an environmentally sensitive area, or to provide erosion protection where vegetation cannot be supported.

Where the FRM levee will cross the active railroad line just east of Pond A12, railroad floodgates will be installed. Concrete barriers will be installed on either side of the railroad right-of-way and will tie into the earthen levees. The metal floodgates will be connected to the barrier and will remain open during normal conditions and closed during flood conditions.

Certain locations may require special structures or treatment as follows:

1. Where the levee crosses an existing water feature such as a slough, structures will be installed to allow drainage during normal conditions and closure during flood conditions.

2. Where the levee crosses below-ground infrastructure (utilities, etc.), load-bearing structures may be needed to support the weight of levee materials.

Other materials such as geotextile fabric, stone column, foundation over-excavation, or replacement with stronger soil may also need to be included in the final FRM levee design.

Fill for the FRM levee will be imported from local sources and delivered by truck. Proposed staging areas and ingress/egress routes are shown on Figure 6 below. Potential staging areas #1 and #2 are both on WPCP land. Ingress and egress truck routes for these two areas are proposed on existing levee roads used currently by WPCP for materials hauling. Potential staging area #3 is on Zanker Landfill land and will be restricted in use for dirt stockpiling only.

The timing and duration of construction will be governed by both weather conditions and the need to avoid construction in sensitive areas during certain times of the year to avoid and minimize impacts to listed species. Types of construction equipment may include excavators, belly scrapers, front-end loaders, bulldozers, forklifts, vibratory rollers, dump trucks, and water trucks. Ancillary types of equipment that may be used include diesel generators, water pumps, and pile drivers. It is anticipated that dewatering and temporary installation of sheet piling will be necessary during the construction of water control structures such as tide gates. Dredge-locks or coffer dams may be constructed using earth levees or sheet piling to allow access for water-based equipment within a site. When possible, amphibious excavators, vibratory pile drivers, and other less-impacting equipment will be used.

Maintenance

Once construction of the Corps-led components is complete, the non-Federal sponsors (the CSCC, SCVWD, and City of San Jose) will be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of these components (*i.e.*, the Pond A18 tidal restoration and ecotone, as well as the entire levee both adjacent to Pond A18 and on Refuge property). An OMRR&R Manual will be prepared to describe these activities. It is anticipated that the following OMRR&R activities will be performed on the FRM levees:

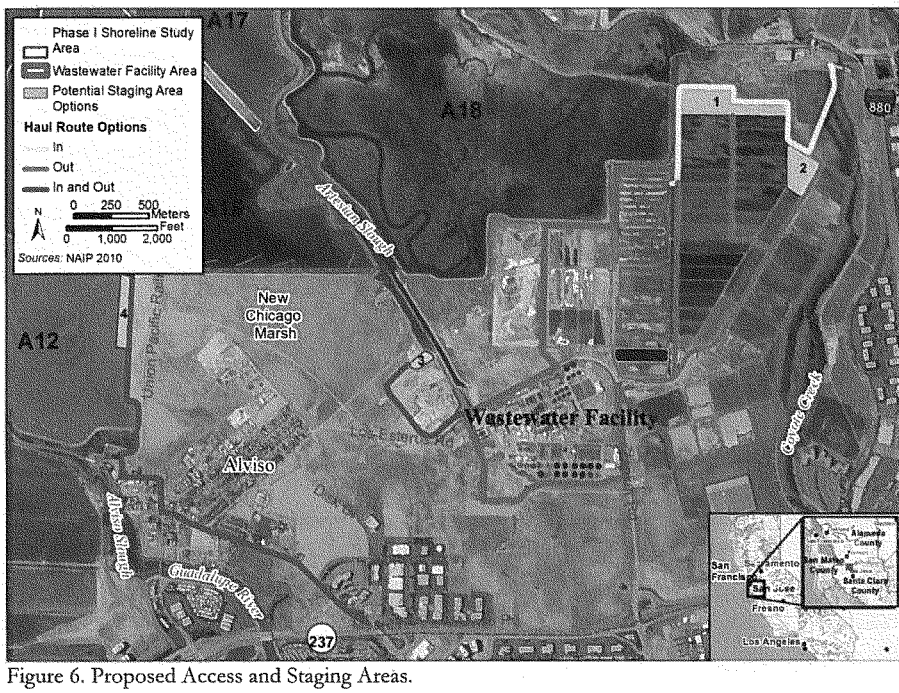


Figure 6. Proposed Access and Staging Areas.

1. Trash and anthropogenic debris removal along levee slopes and where it is causing obstruction in culverts or other problems.

2. Repairs on levee due to damage by small burrowing mammals, runoff/erosion, storm activities, or other factors.

3. Repairs along concrete flood wall structures (if included in plan) and other features, such as bridges and culverts.

4. Levee inspections conducted by SCVWD and the Corps.

5. Graffiti removal.

6. Access improvements and upkeep.

7. Vector monitoring (presence of mosquitoes and their larvae).

8. Vegetation management – As mentioned previously, the levee design will include vegetation as erosion protection on the bayward and landward side slopes.

a. Combinations of buried stone protection and buried gravel may be used to stunt the growth of native vegetation to reduce the frequency of mowing in this environmentally sensitive area, or to provide erosion protection where vegetation cannot be supported.

b. It is anticipated that a reduced need for regular mowing will still include annual mowing of the levee side slopes within 12 to 15 feet of the levee crown. Such a narrow swath of vegetation management will likely require only two or three passes of a mower, once per year, which would minimize the disturbance of sensitive species in adjacent areas. Mowing will proceed from the top (closest to the crown, where habitat is of lowest quality) downward toward higher-quality habitat so that if any wildlife is using the area to be mown, the noise and movement of the mower may encourage wildlife to move downslope into the higher-quality habitat and out of the impact area. This area of mowing will correspond to the area above elevation 9 feet on the levee side slopes and higher elevations in reaches with ecotone fills.

c. No woody plant species greater than two inches in diameter will be allowed to become established on the levees to prevent roots from damaging the structural integrity of the levee. Due to salinity levels in lower-elevation areas, there is a low likelihood of woody vegetation establishment in many areas. Any woody vegetation that germinates in the higher-elevation mowing zone will be managed by mowing. Below the mowing zone, any woody plant removal that becomes necessary will be performed by hand; such hand-removal is expected to be necessary very infrequently (*e.g.*, once every few years, at most).

9. Burrowing mammal management – California ground squirrels may burrow into levees deep enough to affect the structural integrity of the levees, and thus squirrel management may be necessary. Ground squirrels are uncommon along the existing levees in the proposed project area and are thus not expected to require frequent or intensive management efforts. If ground squirrel management becomes necessary, it will be implemented using live traps with screens that have holes large enough to allow small mammals such as salt marsh harvest mice to easily exit the traps. Any mammals caught during such trapping that are potential predators of the salt marsh harvest mouse or California clapper rail, such as rats, striped skunks, red foxes, feral cats, raccoons, or opossums will be lethally removed.

Ecosystem Restoration Actions

The ecosystem restoration strategy to be implemented by the Corps is the conversion of Pond A18, which is currently managed for migratory waterbirds, into vegetated tidal wetlands with goals of maximizing long-term habitat benefits, particularly in consideration of potential sea level rise. Ecosystem restoration also includes creation of a broad, gently sloping ecotone.

Tidal Habitat Restoration

The following ground preparation actions will be involved in converting Pond A18 to tidal marsh:

1. Drain the pond to the extent feasible. The pond will be drained passively, so it may take several months to dry out; pumping would expedite the process and may be considered.

Due to historic pond subsidence, some pond areas are not able to be completely dried. This step is also dependent on temporal proximity to the western snowy plover nesting season and/or if access to the area can be obtained without impacts to western snowy plovers, as dried pond areas may invite western snowy plover nesting.

2. Remove vegetation where needed (*i.e.*, around the breach locations) to discourage salt marsh harvest mice from using the impact areas.

3. Construct upland transitional habitat (described below).

4. Construct ditch blocks to inhibit flow through existing borrow ditches, promote scour and flow through the remnant historical channels, and provide some initial pickleweed habitat where located at the correct elevations. Without the construction of ditch blocks, the borrow ditches around the perimeter of the restored pond would capture the bulk of the flow, reducing the formation of complex dendritic channels in the restored marsh habitat.

5. Construct pilot channels on the outboard side of the A18 levee to facilitate flow between tidal sloughs and the restored tidal habitat in Pond A18. Three pilot channels will be constructed along Artesian Slough, and one will be constructed along South Coyote Slough. These pilot channels will be constructed at the locations of major historical tidal channels.

6. Breach the outboard levee in four locations along Artesian Slough and one location along South Coyote Slough. Breach size will be determined based on the hydrologic relationship between the tidal channel and marsh drainage area and on data from tidal channels in mature marshes throughout the Bay (ESA and Philip Williams & Associates, Ltd. 2012). Breaches are sized to long-term equilibrium dimensions to balance between excavation costs, scour potential, and tidal drainage consistent with *Design Guidelines for Tidal Wetland Restoration in San Francisco Bay* (Philip Williams & Associates, Ltd. and Faber 2004). Dimensions are adjusted to provide a cross-section with side slopes of 4:1 to 5:1 and a bottom width of approximately 10 feet. On the inboard side of the levee, the breach excavation will extend to the levee toe.

Pond A18 will be breached in five locations to facilitate flow of water into and through the pond, allow the tides to carry sediment into the pond, and allow for the retention of remnant channels in the pond bottom. Breaching of Pond A18 will restore approximately 736 acres of new tidal habitat (in addition to the upland transitional habitat discussed below). When Pond A18 is breached, its bottom elevation will be too low for vegetated marshes to form immediately. Several feet of sediment will need to be deposited by natural processes before the pond bottom reaches a sufficient elevation for marsh vegetation to grow. This sedimentation process is expected to proceed at rates determined in part by suspended solids concentrations as well as by factors causing re-suspension of sediment, such as wave action and tidal currents, in the breached pond (ESA and Philip Williams & Associates, Ltd. 2012). Because these factors cannot currently be predicted, it is not known how quickly vegetated marsh will form in Pond A18. Monitoring of the restoration process, and adaptive management if necessary to achieve vegetated tidal marsh, will occur per the *Shoreline Study Monitoring and Adaptive Management Plan* (MAMP) described previously. Once tidal marshes have begun to form in the former ponds, the rate of sedimentation will increase as the vegetation slows the water, catches sediment, and retains it. Eventually, with sufficient sediment, it is expected that Pond A18 will be largely vegetated, aside from tidal channels.

Because of the tidal flood protection functions currently provided by the outboard levees around Ponds A9-A15, tidal restoration within those ponds would not be feasible without enhancement of flood protection inboard from those ponds. As a result, the Service-led tidal restoration on Refuge lands described below could not occur but for the Corps-led construction of the levee and tide gate. Thus, tidal restoration on Refuge lands is dependent on Corps-led levee construction.

Upland Transitional Habitat Creation

Transitional habitat can attenuate waves and reduce wave run-up, increase habitat resiliency by providing space for marshes to retreat inland in the face of sea level rise, and provide refugia for animals such as the California clapper rail and salt marsh harvest mouse during very high tides, when the marsh plain is inundated. The upland transitional habitat adjacent to Pond A18 will be constructed along the interface between the new levee (along the southern and eastern edges of Pond A18) and the newly restored tidal habitat in the pond.

The non-Federal sponsors (the CSCC and SCVWD) recognize the enhanced value of having a gently sloped upland transitional habitat. As a result, the transitional habitat along Pond A18 will be constructed to incorporate a 30:1 slope, which will add up to 345 feet to the width of the bay side of the levee footprint. This ecotone will be constructed along approximately 14,000 linear feet of levee along Pond A18, for a total extent of 67 acres of new upland transitional habitat. Following construction of the ecotone area, it will be seeded and/or planted with native grasses, forbs, and low shrubs. Such an ecotone will provide substantial benefits for wildlife in the Study Area, as this sort of upland transitional habitat is not well represented in the South Bay. Vegetation allowed to establish in the upland transitional areas would be limited to non-woody and semi-woody plants (and possibly shallow-rooted shrubs) and would be otherwise unmanaged, except to control invasive plants from establishing. Figures 13 and 14 in the Biological Assessment (HTH 2014) depict cross-sectional views of how the upland transitional habitat will relate to restored tidal habitats (using Pond A12 as an example) at construction completion (2020) and as anticipated to evolve by 2067, respectively. Within a narrow (15 feet or less) strip of ecotone fill along the edge of the exposed levee surface, vegetation will be managed the same as on the levee (see "Maintenance" section above) to ensure compliance with the Corps' levee vegetation policy.

As indicated in Figure 4, the Pond A12 ecotone will be constructed concurrently with construction of the FRM levee, using the same staging areas and access routes as for levee construction. The Pond A18 ecotone will similarly be constructed simultaneously with levee construction.

Maintenance

Following the breaching of levees around Pond A18, the only management activities that might occur within the restored tidal habitats are predator management and, if necessary, invasive plant management, both of which would be performed on an as-needed basis. If monitoring determines that predator management is necessary to protect special-status and sensitive species, such as California clapper rails and salt marsh harvest mice, from predators such as California gulls, northern harriers, American crows, common ravens, red foxes, striped skunks, feral cats, and raccoons, then adaptive predator management would be implemented. Predator management would be focused on specific areas where predation problems are occurring (or areas, such as poles or towers, used as nesting sites or hunting perches by raptors), and culling would be limited to certain individuals; target mammalian predators that are captured would be lethally removed, while target avian

predators would be either lethally removed (*e.g.*, crows and ravens) or relocated (*e.g.*, raptors). Because it is not currently known whether, and to what extent, predator management at Pond A18 will be needed, and habitat for the California clapper rail and salt marsh harvest mouse will take years to develop after A18 is breached, the local sponsor (*e.g.*, the SCVWD), rather than the Corps, will fund any necessary predator management. Invasive plant management will be needed for the first few years following construction of the ecotone to ensure that perennial pepperweed and other invasives do not become dominant. Otherwise, invasive plant management would be performed if monitoring indicates that particularly invasive species colonize Pond A18 in a way that would jeopardize the habitat enhancements achieved through tidal restoration.

Monitoring and Adaptive Management Actions

The Corps and/or local sponsors (*i.e.*, the SCVWD, CSCC, or the City of San Jose) will provide initial funding for monitoring and adaptive management (MAM) at Pond A18, whereas MAM at the other proposed project ponds will be funded by the Service, SCVWD, City of San Jose, or CSCC. Funding for maintenance and MAM provided by the SCVWD will take the form of an allocation in the SCVWD's annual budget. Given the stability of, and the public need for, the SCVWD, the commitment of long-term funding through the SCVWD's annual budget process will ensure the availability of adequate funding to meet its responsibilities to the proposed project. The entity that will manage Pond A18 in the long-term is not currently known. The City of San Jose and the Corps will identify an appropriate manager for Pond A18 after breaching occurs, and that manager will then be subject to Service approval. Funding for maintenance and MAM at Pond A18 will be provided by the SCVWD, CSCC, and/or City of San Jose. If in the future, Pond A18 is conveyed to the Refuge, an agreement between the City of San Jose, SCVWD, and the Refuge to provide funding for maintenance and MAM at Pond A18 would need to be reached.

MAM for the proposed project falls into three categories: (1) MAM associated with meeting ecosystem restoration objectives, (2) MAM associated with "adaptive implementation" (*i.e.*, decisions about whether to continue or halt the restoration of tidal marsh habitat depending on the monitoring of the effects of pond-to-marsh conversion), and (3) MAM associated with permit compliance. The Corps will cost-share activities associated with meeting ecosystem restoration objectives at Pond A18, for a period of 10 years; the non-Federal sponsors will provide funding for other required MAM. The MAMP includes a discussion of MAM's scientific basis and institutional structure, specific MAM activities, and cost estimates. Because the South Bay Shoreline Phase I Study Project includes a subset of ponds within the SBSPRP, the MAMP for the South Bay Shoreline Phase I Study Project draws heavily from the monitoring and applied studies being conducted by the larger SBSPRP. Monitoring activities to be funded by the Corps at Pond A18 include the following:

1. Water levels, sediment accretion rates, and suspended sediment concentrations;

2. Tidal marsh habitat acreage;

3. Presence and abundance of California clapper rails and salt marsh harvest mice in newly established tidal habitat; given the length of time that may be required for suitable habitat for these species to become established in Pond A18, it is possible that this monitoring may not occur within the 10-year period of Corps cost-shared monitoring, although salt marsh harvest mice may occupy the ecotone within 10 years;

4. Abundance and health of estuarine fish;

5. Count of migrating salmonids;

6. Abundance of non-native plants;

7. Plant species composition in upland transition zones; and

8. Mammalian and avian predators of California clapper rails and salt marsh harvest mice.

Recreation Actions

The only specific recreation-related action that will be funded by the Corps is the construction of a pedestrian bridge over Artesian Slough. This bridge will be constructed to link the multi-use trails on top of the new FRM levee (construction of the trails will not be Corps-funded). The bridge would span the slough atop sets of four parallel piles spaced every 50 feet. This would result in the installation of a total of forty 12-inch-thick steel piles that would form the pedestrian bridge piers. A barge-mounted pile driver/crane or an in-water excavator with a vibratory hammer would be used to drive the 12-inch-thick steel piles.

Service-led Actions

Ecosystem Restoration Actions

The activities involved in tidal restoration in Ponds A9-A15, and ecotone construction along the eastern edge of Pond A12, are similar to those described in above for Pond A18. However, there is an additional activity that will occur in Ponds A9-A15 that will not be necessary in Pond A18 because A18 has no internal berms. For restoration of Ponds A9-A15, breaches in the internal berms will be necessary to reconnect historical channels and restore the hydrologic connections to the innermost ponds in the proposed project footprint. Breach excavations will be sized in a similar manner to those applied to the outboard levees and will extend beyond the levee into the remnant historical channels. Existing internal berms may be lowered in some areas during the breach excavation to create wave breaks to limit wave action, enhance sedimentation, and create vegetated marsh habitat on the berm crests in the short term while the ponds develop from mudflat to vegetated marsh. As Ponds A9-A15 are breached in a phased manner, berms in adjacent ponds not yet being breached will be temporarily raised to provide increased FRM inboard of the current pond breaching actions.

Pond A12 has experienced the greatest degree of subsidence and is proposed for the first phase of restoration (though see above for a discussion of the possibility that Pond A18 may be breached first). By limiting new tidal exchange to this pond (rather than breaching multiple ponds in the first phase), Pond A12 can undergo maximum tidal interaction and sediment deposition, thus helping to raise its bottom elevation to a point where colonization by marsh vegetation will occur. During the first three years (2017–2019), Pond A12 will be prepared for breaching and inundation through excavation of pilot channels in two locations along Alviso Slough and construction of borrow ditch blocks. Berms between Pond A12 and Ponds A11 and A13 will be temporarily (*i.e.*, until tidal restoration in A11 and A13) raised to provide flood protection for A11 and A13. Surplus material excavated from pond preparation will be used to contribute to other in-pond construction activities

requiring material, such as raising of internal levees, if determined suitable by Refuge staff. Subsequently, levee breaches will be implemented in Pond A12 to introduce tidal flow.

Following restoration of tidal flow to Pond A12, monitoring will be conducted to measure the effectiveness of tidal function equilibrium and restorative values. If necessary, corrective measures will be implemented. A period of approximately four years has been established for MAM associated with Pond A12.

Pond preparation for Ponds A9, A10, A11, and A18 would potentially be implemented based on the lessons learned as a result of MAM conducted for Pond A18, including whether to breach these ponds and restore them to tidal marsh. As described previously, this decision will be made according to the MAMP, which includes a series of decisions (based on those in the SBSPRP MAMP) regarding whether to continue breaching that involve monitoring of populations of pond-associated birds, monitoring of sediment accretion in the South Bay, and other factors. If the decision is made to breach these ponds, borrow ditch blocks and pilot channels will be constructed. Pond A11 will be connected to Ponds A10 and A12 with inboard berm breaches, but it will not be breached directly to Alviso Slough. Two breaches to Alviso Slough are planned in Pond A10, and one breach each to Alviso Slough and Coyote Slough are planned for Pond A9. Internal berms between Ponds A9-A11 and Ponds A13-A14 will be temporarily (*i.e.*, until tidal restoration in A13 and A14) raised to provide flood protection for A13 and A14. Levee breaches for Ponds A9-A11 will be implemented in Year 8 (2025) of the proposed project.

Pond preparation for Ponds A13, A14, and A15 will potentially be implemented based on the lessons learned as a result of MAM conducted for previous ponds, including whether to breach these ponds and restore them to tidal marsh. If the decision is made to breach these ponds, borrow ditch blocks and a pilot channel will be constructed. Only one outboard breach will occur for tidal restoration in these three ponds; this breach will connect Pond A15 to Coyote Slough along a major historical channel. Inboard berm breaches at the locations of historical sloughs will connect Ponds A13 and A14 to surrounding ponds (A9, A11, A15, and A12) to provide tidal flows to A13 and A14. Levee breaches will be implemented in Year 13 (2030) of the proposed project.

Ecotone habitat will be created along approximately 4,000 linear feet of levee on the east side of Pond A12. Approximately 30 acres of new upland transitional habitat will be created in this area. Following construction of the ecotone area, it will be seeded with native grasses, forbs, and low shrubs.

Breaching of Ponds A9-A15 would restore up to 2,010 acres of new tidal habitat (including the upland transitional habitat discussed below). As discussed for Pond A18 above, sediment accretion will need to occur within these ponds in order to raise pond bottoms to elevations that will support marsh vegetation. Once tidal marshes have begun to form in the former ponds, the rate of sedimentation will increase as the vegetation slows the water, catches sediment, and retains it. Eventually, with sufficient sediment, it is expected that, if breached, Ponds A9-A15 will be largely vegetated, aside from tidal sloughs. The considerable increase in tidal prism that will occur once these ponds are breached is expected to draw saline water from the Bay into these ponds, resulting in dominance of restored marsh by salt marsh species. An analysis performed by HTH (2012) predicted that the majority of the Pond A9-A15 system will be dominated by salt marsh vegetation. In addition, this increase in tidal prism will draw more saline water into and around the marshes

downstream, thus converting some existing brackish marsh along Alviso and Coyote Sloughs to salt marsh habitat.

Maintenance

Following the breaching of levees around Ponds A9-A15, the only management activities that might occur within the restored tidal habitats are predator management and invasive plant management, as discussed previously. Predator management currently performed according to the Refuge's predator management plan (Foerster and Takekawa 1991, as updated in Service 2012a; Refuge 2012) will continue to be implemented on Refuge lands.

Recreation Actions

Recreation activities were incorporated into the proposed project to replace the loss of public access as the ponds in the Service-managed Refuge are breached and restored to tidal marsh. The proposed recreation measures associated with Service-led actions are multi-use trails on top of the new FRM levee, with connections to the Bay Trail network, along with viewing platforms, and trail upgrades to be made to an existing segment of the Bay Trail system along SR 237 (Figure 3).

Under existing conditions, a loop trail extends around Ponds A9 through A15, with an interior trail also existing between A15 and A13/14. These trails can be accessed from the Alviso Marina or via a spur that crosses the railroad tracks between Ponds A16 and A15. Restoration of tidal action to Ponds A9 through A15 will involve breaches in the outboard levees, thus interrupting the perimeter trail. Around Ponds A9-A15, the only trails that would remain following the completion of tidal restoration would consist of short segments in the eastern part of this group of ponds, as shown on Figure 3 (see also Figure 18 in the Biological Assessment (HTH 2014)).

The proposed project includes a new section of maintenance trail along the crest of the new WPCP Segment, which will be available for pedestrian traffic. Consistent with the WPCP Master Plan, the eastern extent of the levee maintenance trail will connect to a designated route at the existing bridge at McCarthy Boulevard. The existing pedestrian walkway on the bridge will take recreationists to the Coyote Creek Trail that runs along the east bank of the creek. This proposed trail connection will be refined in final design with consideration of both public safety and the addition of features (*e.g.*, fencing) to limit public access to sensitive wildlife areas. In addition, because the westernmost extent of the proposed levee's maintenance trail will end (with the levee itself) at existing high ground adjacent to the Alviso Marina, this will facilitate another connection to the Bay Trail if the City of San Jose's proposed plans to connect the Alviso Marina to the larger trail network are realized. In addition, the proposed project will construct a trail segment along the north side of SR 237 between the Guadalupe River and Zanker Road (see Figure 18 in the Biological Assessment (HTH 2014)).

Construction Equipment/Activities for Recreation Components

Construction of the recreation and public access components may consist of the following activities:

1. Grading and, for all-weather trails, gravel application. Equipment required for trail construction may include small, Bobcat-sized equipment, backhoes or front-end loaders, graders, bulldozers, asphalt placement equipment, and dump trucks.

2. Constructing trails, including some trails designed to accommodate vehicular use, trails to provide access to a staging area, and trails for disabled access.

3. Constructing interpretive stations of varying size and scope, which will include interactive features that can operate independently or can be enhanced with the assistance of docents.

4. Constructing viewing platforms at vista points where important information about the landscape can be described. Viewing platforms will be made of wood, metal, or plastic material and assembled in-place using a backhoe or excavator and hand tools. Interpretive stations will be built on-site, or will be prefabricated structures. Assembly and installation will require a backhoe or excavator and hand tools.

Maintenance of Recreation Components

Once construction of the recreation components is complete, the SCVWD, likely in a cooperative agreement with the City of San Jose, will be responsible for their operation, maintenance, repair, replacement, and rehabilitation. It is anticipated that the following operations and maintenance activities will be performed on the trails and the Artesian Slough pedestrian bridge:

1. Trash and anthropogenic debris removal;

2. Repairs due to damage by people, small mammals, storm activities, or other factors;

3. Trail and bridge inspections;

4. Graffiti removal;

5. Access improvements and upkeep;

6. Predator and invasive species management;

7. Enforcement of conservation measures; and

8. A long-term management plan will be prepared to describe the implementation of these activities.

Monitoring and Adaptive Management Actions

MAM will be implemented in Ponds A9-A15 as described previously for Pond A18. The MAMP includes a discussion of the scientific basis and institutional structure for implementation, specific MAM activities, and cost estimates. Monitoring activities to be performed for the restoration activities at Ponds A9-A15 include those listed previously. Other monitoring of more regional issues, such as regional changes in mudflat and tidal marsh acreages, changes in bird populations (including sensitive species and predators such as gulls), and mercury bioavailability, will continue to occur through the SBSPRP as it currently does.

Conservation Measures

The operational implementation of proposed project activities incorporates a number of measures, including general and species-specific measures, to avoid and minimize impacts during construction. All of these measures apply both to Corps-led and Service-led activities. Residual impacts remaining after implementation of the general and species-specific avoidance and minimization measures are addressed through compensatory conservation measures. These conservation measures are further described below.

General Avoidance and Minimization Measures

Below, the general conservation measures that will be implemented during proposed project activities to avoid and minimize adverse effects on sensitive species and habitats are described, followed by conservation measures specific to individual special-status species. Additional details and measures are provided in the proposed project's *Integrated Document* (HDR 2014). All permit conditions, legal requirements, and appropriate excavation and engineering practices shall be followed to avoid and minimize environmental impacts associated with the proposed project. The term "project site" below refers to any of the potential work locations related to FRM and restoration activities that will occur throughout the proposed project's action area.

1. Earthen materials (*e.g.*, existing levees) will be reused to the extent feasible to reduce the amount of imported material and stockpile and landfill material.

2. Staging, access, and parking areas will be located outside of sensitive habitats to the extent feasible.

3. Areas of disturbance will be limited to the smallest footprint necessary.

4. All equipment will be maintained free of petroleum leaks. All vehicles operated within 150 feet of any water body will be inspected daily for leaks and, if necessary, repaired before leaving the staging area. Inspections will be documented in a record that is available for review on request.

5. Spill prevention kits will always be in close proximity to construction activities (*e.g.*, crew trucks and other logical locations) when using hazardous materials. Feasible measures will be implemented to ensure that hazardous materials are properly handled and the quality of aquatic resources is protected.

6. No fueling will be performed in wetland or aquatic habitats unless equipment stationed in these locations is not readily relocated (*e.g.*, Aquamog, pumps, generators, dredge barges). For stationary equipment that must be fueled on site, containment will be provided in such a manner that any accidental spill of fuel will not be able to enter the water or contaminate sediments that may come in contact with water.

7. A hazardous materials management/fuel spill containment plan will be developed and implemented by the construction contractor and given to all contractors and biological monitors working on the proposed project, with at least one copy of the plan located onsite at all times. The purpose of the plan is to provide onsite construction managers,

environmental compliance monitors, and regulatory agencies with a detailed description of hazardous materials management, spill prevention, and spill response/cleanup measures associated with the construction of the proposed project elements. The primary objective of the plan is to prevent a spill of hazardous materials. Elements of the plan include, but are not limited to the following:

a. A discussion of hazardous materials management, including delineation of hazardous material and hazardous waste storage area, access and egress routes, waterways, emergency assembly areas, and temporary hazardous waste storage areas;

b. Materials Safety Data Sheets for all chemicals used and stored on site;

c. An inventory list of emergency equipment;

d. Spill control and countermeasures including employee spill prevention/response training;

e. Notification and documentation procedures; and

f. Monthly reporting plan.

8. Vehicles will be washed only at an approved area. No washing of vehicles will occur at job sites.

9. A berm or other sediment-control devise will be installed around stockpiled soil material to prevent runoff from transporting sediment into sensitive habitats.

10. Any large wood or weed-free topsoil displaced by construction will be stockpiled for use during site restoration. Native vegetation displaced by construction will be stockpiled if it would be useful during site restoration.

11. The work site, areas adjacent to the work site, and access roads will be maintained in an orderly condition, free and clear from debris and discarded materials. Personnel will not sweep, grade, or flush surplus materials, rubbish, debris, or dust into storm drains, water bodies, or waterways. Upon completion of work, all building materials, debris, unused materials, concrete forms, and other construction-related materials will be removed from the work site.

12. A stormwater management plan will be developed to ensure that, during rain events, construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion-control materials (*e.g.*, baffles, fiber rolls, or hay bales; temporary containment berms) and erosion-control measures such as straw application or hydroseeding with native grasses on disturbed slopes; and floating sediment booms and/or curtains to minimize any impacts that may occur due to increased mobilization of sediments. Suitable erosion control, sediment control, source control, treatment control, material management, and non-stormwater management best management practices will be implemented consistent with the latest edition of the California Stormwater Quality Association

"Stormwater Best Management Practices Handbook," available at www.capmphandbooks.com.

13. All disturbed areas will be stabilized within 12 hours of any break in work unless construction will resume work within seven days. Earthwork will be completed as quickly as possible, and site restoration will occur immediately following use.

14. For each activity, the supervising construction personnel will participate in a Service-approved worker environmental awareness program. Under this program, construction personnel will be informed about the presence of listed species and habitats associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the Act. Prior to construction activities, a qualified biologist approved by the Service will instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts on these species during proposed project construction and implementation. The awareness program will apply to construction occurring within or adjacent to tidal marsh or slough habitat and within or adjacent to managed pond habitat. A fact sheet conveying this information will be prepared for distribution to the construction crew and anyone else who enters the proposed project site. A Service representative will be appointed who will be the contact source for any employee or contractor who might encounter a listed species. The representative(s) will be identified during the environmental awareness program. The representative's name and telephone number will be provided to the Service prior to the initiation of any activities.

15. No firearms (except for Federal, State, or local law enforcement officers and security personnel) will be permitted at the proposed project site to avoid harassment, killing, or injuring of wildlife, with the exception of hunters who are authorized by the Service to pass through an area to access hunting areas.

16. No animals (*e.g.*, dogs or cats) will be brought to the proposed project site to avoid harassment, killing, or injuring of wildlife.

17. Ingress and egress points will be clearly identified in the field using orange construction fence. Work will not be conducted outside the designated work area.

18. In order to minimize the spread of invasive plants, all equipment (including personal gear) will be cleaned of soil, seeds, and plant material prior to arriving on the proposed project site to prevent introduction of undesirable plant species.

19. The proposed project site will be maintained trash-free, and food refuse will be contained in secure bins and removed daily during construction.

20. Nighttime work near tidal marsh habitat will be avoided to the extent feasible. If nighttime work cannot be avoided, lighting will be directed to the work area and away from habitat for the salt marsh harvest mouse, California clapper rail, and western snowy plover.

21. Interpretive signage prohibiting access to areas that are closed to the public, and indicating the importance of protection of sensitive biological resources, will be placed in key locations, such as along trails near sensitive habitats.

22. Prior to construction, all high-quality habitat for listed species will be mapped and provided to the Service. Vehicles driving on levees adjacent to such habitat for construction or monitoring activities will then travel at speeds no greater than 10 miles per hour to minimize noise and dust disturbance.

23. All clean fill material proposed for upland and wetland placement will meet the qualifications set forth in the Regional Water Quality Control Board's (RWQCB's) waste discharge requirements (Tentative Order), and will meet the screening criteria listed in the Biological Assessment (HTH 2014). If the above-mentioned thresholds are not attained but the material is approved for use by the RWQCB, consultation will be reinitiated to analyze the potential effects of the contaminated material to listed species.

24. The restored tidal marsh wetlands will be monitored for possible infestation by non-native cordgrass, perennial pepperweed, and other invasive, non-native plant species that could result in a substantial reduction in the ecological value of the tidal restoration and ecotone construction. It is expected that some non-natives that are not particularly invasive will colonize the ecotones, but if any particularly invasive plant species are found, a qualified botanist will recommend specific measures to control the spread of non-native plant species. All infestations of non-native cordgrass within the restored tidal marsh wetlands will be controlled and removed in coordination with the San Francisco Estuary Invasive *Spartina* Project without substantially hindering or harming the establishment of native vegetation in the restored wetlands. If perennial pepperweed control is necessary, spraying with glyphosate or imazapyr formulated for aquatic use may be necessary, as described by Hogle *et al.* (2007) for the San Pablo Bay National Wildlife Refuge. Otherwise, preferred vegetation management will involve non-mechanized methods of removal including hand-pulling, saline spray, pond flooding (during non-breeding seasons), and substrate-based controls. Aside from glyphosate and imazapyr for pepperweed control, the use of any herbicides will be subject to Service and NMFS approval.

25. If spraying for perennial pepperweed is necessary, the following general conservation measures will be implemented (measures specific to the California clapper rail are described below):

    a. Herbicides will be applied by a certified applicator and in accordance with application guidelines and the manufacturer label.

    b. Herbicide applications would be timed to coincide with ebbing tides to protect non-target vegetation, to allow a minimum of six hours dry time for glyphosate/imazapyr mixture applications, and at least one-hour dry time for imazapyr applications.

    c. Herbicides will be applied directly to perennial pepperweed plants and at low or receding tide to minimize the potential application of herbicide directly on the water surface.

d. All certified applicators will be trained to correctly identify perennial pepperweed, to distinguish this species from native species in the action area, and to adhere to the conservation measures in this biological opinion and conference opinion.

26. Long-term maintenance and monitoring will be performed outside of peak migration periods of, and breeding seasons of, sensitive wildlife species to the maximum extent feasible.

27. A Service-approved biological monitor will be present during all work activities in or immediately adjacent to habitat that could be occupied by federally listed species to look for individuals that may be impacted by construction; activities are considered "immediately adjacent" to sensitive habitat if those activities could result in the physical disturbance of the habitat (*e.g.*, as a result of mobilization of sediment into the habitat) or if individual listed species could move from that habitat into the proposed project area (*e.g.*, seeking refuge under construction equipment). The biologist will have stop-work authority if any individual of a federally listed species is detected in an area where it may be injured or killed by construction activities.

28. Any fencing near habitat for the salt marsh harvest mouse, California clapper rail, or western snowy plover will incorporate raptor perch deterrents to minimize raptor predation on listed species.

29. To avoid the loss of individual California clapper rails and salt marsh harvest mice, construction, maintenance, and management activities (including mowing) within or adjacent to habitat for these species will not occur within two hours before or after extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge and adjusted to the timing of local high tides), when the marsh plain is inundated, because protective cover for these species is limited and activities could prevent them from reaching available cover.

30. No dogs will be allowed on trails (or elsewhere) on Refuge lands. On City of San Jose lands, all dogs must be on leashes and must remain on established trails.

31. Long-term Predator Management and Invasive Plant Species Control Plans: A long-term management plan will be prepared to describe predator management, invasive plant species control, litter cleanup, and patrols/enforcement along the trails in the proposed project area. This plan will be implemented under a cooperative agreement between the SCVWD, the Refuge, and the City of San Jose, and it will be funded by the SCVWD.

Avoidance and Minimization Measures for the California Clapper Rail

The following measures will be implemented to avoid and minimize effects on California clapper rails:

1. To avoid causing the abandonment of an active California clapper rail nest, activities (including construction and maintenance activities) within 700 feet of vegetated tidal marsh providing suitable breeding habitat for California clapper rails will be avoided during the rail's breeding season from February 1 through August 31 unless protocol-level surveys are conducted by a Service-approved biologist to determine California clapper rail locations and territories. If breeding California clapper rails are determined to be present, activities will

not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel (*e.g.*, Alviso, Coyote, or Artesian Sloughs) or across a substantial barrier between the California clapper rail calling center and any activity area is greater than 200 feet, then work may proceed at that location within the breeding season. Aside from continued use of recreational trails established prior to the start of the breeding season (which may continue), only inspection, maintenance, research, or monitoring activities that have little potential for effects on California clapper rails due to their short durations, distance from rail habitat, or low-magnitude effects may be performed during the California clapper rail's breeding season in areas within or adjacent to California clapper rail breeding habitat, with approval of the Service under the supervision of a qualified biologist. Otherwise, with Service approval on a case-by-case basis, construction activities may take place after July 15 in a given area if the activity is thought to be minimally disturbing to breeding California clapper rails.

2. To be effective, perennial pepperweed control has to occur when the plant is in bud (May-July), during the California clapper rail breeding season. If perennial pepperweed control must be performed in California clapper rail habitat, the following measures will be implemented to minimize impacts on rails:

    a. Vehicle and foot access pathways to perennial pepperweed through tidal marsh will be minimized and use of existing roads and trails for control work will be maximized. Shortest possible access paths through the marsh to treatment patches will be identified prior to marsh access. Control methods to be used in each area will be selected to minimize potential impacts to marsh habitat and listed species from control operations.

    b. If breeding California clapper rails are determined to be present in a marsh, marsh access using aquatic-tracked vehicles (ARGOs) will not be allowed in contiguous marsh areas within 700 feet of an identified California clapper rail calling center (also referred to as the "700-ft Buffer Area") to avoid nest destruction, nest abandonment, and harassment of breeding California clapper rails. If the intervening distance across a major slough channel or across a substantial physical barrier between the California clapper rail calling center and the proposed access area is greater than 200 feet, then access may proceed within the breeding season.

    c. ARGOs will not travel within 50 feet of slough channels to avoid crushing high vegetation, such as gumplant, that grows along channels.

    d. Boats will be used to access marsh areas (where feasible) to treat large areas of perennial pepperweed along slough edges (*e.g.*, use of intelli-sprayer with 300 feet of hoseline) to further reduce the necessity of walking long distances through the marsh.

    e. Crews will be instructed to walk carefully through the marsh, avoiding high pickleweed cover (*e.g.*, greater than one foot) and wrack where salt marsh harvest mice are likely to nest or find cover.

f. All personnel entering the marsh will be trained to identify and avoid direct and indirect disturbance to listed species and associated habitats. Training material will include taped recordings of California clapper rail calls and the "Walking in the Marsh" protocol (see Appendix A of this biological opinion) which addresses potential disturbance effects to California clapper rails and salt marsh harvest mice.

g. Before spray operations commence each year, a qualified California clapper rail biologist familiar with the project area will familiarize the spray crew with the area and ensure that all crew members know the location of each "700-ft Buffer Area" for protection of nesting California clapper rails. Crews will be instructed to avoid these areas unless accompanied by a qualified California clapper rail biologist.

h. During the California clapper rail breeding season, before crews are allowed to enter a California clapper rail "700-ft Buffer Area" to conduct control work, the Refuge Biologist, or designee, will work with other qualified California clapper rail biologists and the spray crew to develop a strategy for control that will minimize the amount of time the crew spends in each "700-ft Buffer Area" while conducting control. This planning session will include use of detailed maps showing perennial pepperweed locations within each "700-ft Buffer Area".

i. During the California clapper rail breeding season, a qualified California clapper rail biologist such as a Refuge Biologist, will accompany spray crews into "700-ft Buffer Areas" and will supervise and guide control operations within these areas.

j. Crews will limit time within a California clapper rail nesting area (call center + 700-ft Buffer Area) to 30 minutes or less to minimize disturbance to adult rails and to avoid potential nest destruction or nest abandonment.

k. If California clapper rail nests are encountered during control work, observers will immediately leave the vicinity of the nest and report findings to the Service.

l. If California clapper rail adults are encountered during control work, observers will move away from the birds if they are giving alarm calls or otherwise appear agitated.

Avoidance and Minimization Measures for the Salt Marsh Harvest Mouse

To minimize potential effects on the salt marsh harvest mouse, the following measures (in addition to those described above for the California clapper rail during perennial pepperweed control) will be implemented:

1. To avoid the loss of individual salt marsh harvest mice from any excavation, fill, or construction activities in suitable habitat, vegetation removal will be limited to the minimum amount necessary to permit the activity to occur. Wherever feasible, sufficient pickleweed habitat, as determined by a Service-approved biologist, will remain adjacent to the activity area to provide refugia for displaced individuals.

2. Within areas where vegetation potentially supporting salt marsh harvest mice will be impacted, vegetation and debris that could provide cover for salt marsh harvest mice will be

removed using only hand tools at least three weeks prior to the commencement of construction activities. Vegetation removal will occur under the supervision of a Service-approved biologist. This vegetation will be removed on a progressive basis, such that the advancing front of vegetation removal moves toward vegetation that would not be disturbed. In some cases, temporary berms may need to be constructed over borrow ditches to enable suitable escape routes, or temporary shelter consisting of dead vegetation may be positioned to provide escape routes to suitable habitat. A Service-approved biologist will monitor the vegetation removal and make specific recommendations with respect to the rate of vegetation removal (to ensure that any salt marsh harvest mice present are able to escape to cover that will not be impacted), whether vegetation needs to remain in a certain area temporarily to facilitate dispersal of salt marsh harvest mice into habitat outside the impact area, and whether any berms are necessary to allow salt marsh harvest mice to disperse across channels.

3. Following the hand-removal of vegetation, exclusion fencing will be erected as needed between construction areas and salt marsh harvest mouse habitat that is to remain unimpacted to define and isolate protected salt marsh harvest mouse habitat. This fencing will consist of heavy plastic sheeting or metal material that cannot be climbed by salt marsh harvest mice, buried at least four inches below the ground's surface, and with at least one foot (but no more than four feet) above the ground. All supports for the fencing will be placed on the inside of the work area. A four-foot buffer will be maintained free of vegetation around the outside of the exclusion fencing. The fencing will be inspected daily during construction, and any necessary repairs will be made within 24 hours of when they are found. If any breaks in the fencing are found, the Service-approved biologist will inspect the work area for salt marsh harvest mice.

4. Although individual salt marsh harvest mice cannot be handled on non-Federal land, because the species is fully protected according to the California Fish and Game Code, individuals can be handled on Federal land (*i.e.*, the Refuge). If any individual salt marsh harvest mice are found within the impact footprint on Refuge land, and they do not move on their own to vegetated areas outside the impact footprint, they will be relocated by hand to suitable habitat outside the impact zone by a qualified biologist.

5. During construction, a Service-approved biologist will check underneath vehicles and equipment for salt marsh harvest mice before such equipment is moved, unless the equipment is surrounded by salt marsh harvest mouse-proof exclusion fencing.

6. During mowing of vegetation along the FRM levee, mowing will start from the top (the area of least suitable habitat) and proceed downslope toward more suitable habitat so any salt marsh harvest mice present in the narrow swath to be mown can move away from the disturbance of the mower and out of the mowing area.

7. Below the zone at the top of the levee that will be mown, any woody plant removal that becomes necessary will be performed by hand; such hand-removal is expected to be necessary very infrequently (*e.g.*, once every few years, at most).

Avoidance and Minimization Measures for the Western Snowy Plover

The following measures will be implemented to avoid and minimize effects on western snowy plovers:

1. No activities will be performed within 600 feet of an active western snowy plover nest during the western snowy plover's breeding season, March 1 through September 14 (or as determined through surveys). Vehicles driving on levees and pedestrians walking on recreational trails established prior to the start of the breeding season (which may continue) will remain at least 300 feet away from western snowy plover nests and broods to the extent feasible, although because these trails are already accessible to the public, nesting western plovers are expected to continue to adjust the location of nesting based on their tolerance of distance from these trails. If necessary, signage, temporary fencing such as roped-off areas, or other markers will indicate areas that vehicles and pedestrians should avoid to protect nesting western snowy plovers, and Refuge staff will enforce these closures. In addition, personnel that must stop at a specific site for brief inspections, maintenance, or monitoring activities will remain 600 feet away from western snowy plover nests and broods. *Exception*: Only inspection, minor maintenance (such as water level management within a pond), research, or monitoring activities may be performed during the western snowy plover breeding season in areas within or adjacent to western snowy plover breeding habitat with approval of the Service under the supervision of a qualified biologist. If western snowy plover chicks are present and are foraging along any levee that will be accessed by vehicles (*e.g.*, for construction, inspection, or access), vehicle use will be under the supervision of a qualified biologist (to ensure that no chicks are present within the path of the vehicle).

2. Breaching of ponds that contain suitable western snowy plover habitat will not be performed during the breeding season (March 1 through September 14) unless surveys have documented that no active nests or unfledged chicks are present within the ponds to be flooded by breaching.

3. Viewing platforms, kiosks, benches, interpretive displays, and other focal areas for public use will be located a minimum of 600 feet from suitable western snowy plover nesting habitat.

Avoidance and Minimization Measures for the California Least Tern

Although California least terns are not known or expected to nest in or very near the action area, the following measures required by the Service's biological opinion for the SBSPRP are incorporated into the proposed project:

1. No activities will be performed within 300 feet of an active California least tern nest during the California least tern's breeding season, which is April 15 to August 15 (or as determined through surveys). *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the California least tern's breeding season in areas within or adjacent to California least tern breeding habitat with approval of the Service under the supervision of a qualified biologist.

2. Breaching of ponds that contain suitable California least tern nesting habitat will not be performed during the breeding season unless surveys have documented that no active nests or unfledged chicks are present within the ponds to be flooded by breaching.

3. To avoid or minimize potential adverse effects from public access and recreation features constructed near tidal marsh, trails adjacent to some nesting areas for sensitive bird species will be closed during the breeding season. Public trails within 300 feet of suitable California least tern nesting habitat will be closed during the breeding season. In addition, if trails are to be open during the breeding season of this species, viewing platforms, kiosks, benches, interpretive displays, and other focal areas for public use will be located a minimum of 600 feet from suitable nesting habitat. The locations of trail segments to be closed, and the periods of closure will depend on whether sensitive bird species, such as California least terns, are nesting in certain areas in a given year and whether nesting areas are located in close proximity to the trails. Decisions about whether to close a particular trail segment will be made early in the breeding season (and possibly later in the season as conditions change) following surveys for nesting birds within a given pond adjacent to a trail.

Avoidance and Minimization Measures for the Longfin Smelt and Other Special-Status Fish Species

To minimize potential effects on the longfin smelt and other special-status fish species managed according to the Fishery Management Plans, the following measures will be implemented:

1. Construction activities in, or directly adjacent to, waters where Central California Coast steelhead and longfin smelt are likely to be present will be performed between June 1 and November 30.

2. Levee breaching will not occur between February 1 and May 31 for the protection of out-migrating juvenile steelhead in, or directly adjacent to, waters where steelhead are likely to be present.

3. Activities that extend into the waters where listed fish and fish species managed according to Fishery Management Plans may be present, such as pilot channel excavation, will be performed at low tide and/or under de-watered conditions, to the extent practicable.

4. Cofferdams will be used to the extent feasible during construction and maintenance activities, as well as during implementation of any adaptive management actions, that could potentially result in substantial siltation of protected fish habitat.

5. All pumps used for dewatering where salmonids may be present will be screened according to NMFS and CDFW criteria for juvenile salmonids.

6. During tide gate construction on Artesian Slough, all pile driving will be performed using a vibratory hammer to minimize the potential effects of noise and pressure-waves on fish.

7. NMFS personnel will be immediately notified of any observed fish mortality events.

8. Tidally restored ponds will contain channels that are adequate for the ingress and egress of fish with tidal circulation. Inspections will be documented in a record that is available for review on request.

9. Treated wood will not be used in structures that may come into contact with water.

Western Snowy Plover Compensatory Conservation Measures

The Corps will implement the following compensatory mitigation for effects to western snowy plovers from levee construction:

1. Breeding habitat for the western snowy plover will be enhanced on an island in Pond A16. Islands were constructed in Pond A16 in 2012 and 2013 as part of Phase I activities of the SBSPRP, for the purpose of providing nesting, roosting, and foraging habitat for a variety of pond-associated bird species, including western snowy plovers. Western snowy plovers nested on one of these islands in 2013. However, the dark substrate of the islands, and their relatively homogeneous surfaces, could make western snowy plovers on the islands relatively conspicuous to predators. The South Bay Shoreline Phase I Study Project will provide small gravel (or other appropriate substrate) that will be distributed in patches on one of the islands in A16 (with the island to be selected by the Refuge), and the proposed project will fund the maintenance of this gravel. Pea gravel has been intentionally provided in some areas as a substrate for use by nesting western snowy plovers (Paton and Bachman 1996, Sexson and Farley 2012), and in the Bay, some western snowy plovers at the Eden Landing Ecological Reserve nest in fine gravel along roads.

2. Predator management is currently performed on Refuge lands, but as partial compensation for adverse proposed project effects on western snowy plovers, the intensity of this management will be increased in Pond A16 and New Chicago Marsh during the western snowy plover breeding season. This enhanced predator management will include more frequent monitoring for predators nesting (*e.g.*, gulls and corvids), roosting, or foraging in these areas islands; more frequent trapping of mammalian predators in New Chicago Marsh and along Artesian Slough; and ongoing identification and implementation of deterrence or removal measures for those predators. This measure will consist of funding a predator management technician for an additional 10 hours per week during the period March 1 through September 14 (approximately 28 weeks).

The Corps will fund the initial enhancement of nesting islands in Pond A16 with gravel. The SCVWD will fund the long-term maintenance of the gravel substrate on those islands and the incremental increase in predator management in Pond A16 and New Chicago Marsh. This funding will take the form of annual allocations in the SCVWD's budget specifically for these purposes.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The "effects of the action" to be analyzed in this biological opinion and conference opinion are defined as the direct and indirect effects of the action, together with the effects of other activities that are interrelated or interdependent with that action (such as activities implemented or funded by the local sponsors, the

CSCC and SCVWD, in conjunction with the Corps' and Service's activities). The action area includes the construction footprints for FRM and recreational access activities; the entirety of Ponds A9 through A15 and A18; portions of Pond A16 adjacent to the proposed project footprint and on the island where western snowy plover habitat enhancement will occur; the northern and western boundaries of New Chicago Marsh; areas on the outboard (bayward) sides of those ponds where pilot channel excavation will occur; all staging, stockpiling, and access areas; the portions of Alviso Slough, Coyote Slough, South Coyote Slough, and Artesian Slough downstream from proposed levee breaches that may be subject to additional scour from increased tidal prism or temporarily increased sedimentation during construction; and areas surrounding the construction footprint and trails where indirect effects such as disturbance (*e.g.*, areas within 600 feet for nesting western snowy plovers and 700 feet for nesting California clapper rails) may occur.

Analytical Framework for the Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analyses in this biological opinion and conference opinion relies on four components: (1) the *Status of the Species*, which evaluates the California clapper rail's, salt marsh harvest mouse's, western snowy plover's, California least tern's, and longfin smelt's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of these species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the California clapper rail, salt marsh harvest mouse, western snowy plover, California least tern, and longfin smelt; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on these species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the California clapper rail's, salt marsh harvest mouse's, western snowy plover's, California least tern's, and longfin smelt's current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these species in the wild.

The jeopardy analysis in this biological opinion and conference opinion places an emphasis on consideration of the range-wide survival and recovery needs of the California clapper rail, salt marsh harvest mouse, western snowy plover, California least tern, and longfin smelt and the role of the action area in the survival and recovery of the California clapper rail, salt marsh harvest mouse, western snowy plover, California least tern, and longfin smelt as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Status of the Species

California Clapper Rail

The status of the California clapper rail and information about its biology, ecology, distribution, and current threats is available in the *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan; http://www.fws.gov/sacramento/es/Recovery-Planning/Tidal-

Marsh/es_recovery_tidal-marsh-recovery.htm; Service 2013). Critical habitat has not been designated for this species. Recent genetic analyses of rail species resulted in a change in the common name and taxonomy of the large, "clapper-type" rails (*Rallus longirostris*) of the west coast of North America to Ridgway's rail (*Rallus obsoletus*) (Maley and Brumfield 2013, Chesser *et al.* 2014). Thus the California clapper rail is now referred to in the scientific community as the California Ridgway's rail (*Rallus obsoletus obsoletus*). The change in the common name and taxonomy of the California clapper rail, however, does not change the listing status of the species.

Salt Marsh Harvest Mouse

There are two subspecies of the salt marsh harvest mouse: the northern subspecies (R. *r. halicoetes*) and the southern subspecies (R. *r. raviventris*). Both subspecies are listed as endangered. The status of the salt marsh harvest mouse and information about its biology, ecology, distribution, and current threats is available in the Recovery Plan (http://www.fws.gov/sacramento/es/Recovery-Planning/Tidal-Marsh/es_recovery_tidal-marsh-recovery.htm; Service 2013). Critical habitat has not been designated for this species.

Pacific Coast Population of the Western Snowy Plover

The status of the Pacific coast population of the western snowy plover and information about its biology, ecology, distribution, and current threats is available in the *Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (Charadrius alexandrinus nivosus)* (http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf, Service 2007).

California Least Tern

The status of the California least tern and information about its biology, ecology, distribution, and current threats is available in the five-year review (http://ecos.fws.gov/docs/five_year_review/doc775.pdf, Service 2006).

San Francisco Bay-Delta DPS of the Longfin Smelt

The status of the San Francisco Bay-Delta DPS of the longfin smelt and information about its biology, ecology, distribution, and current threats is available in the 12-month finding (http://www.fws.gov/sfbaydelta/species/longfin_smelt.cfm, 77 FR 19756, Service 2012b) and the 2014 annual Candidate Notice of Review (79 FR 72449, Service 2014a).

Environmental Baseline

Proposed Project Location and Existing Conditions

The proposed project is located in the community of Alviso, part of the City of San Jose, Santa Clara County, California. The Study Area is bounded on the southwest by Alviso Slough; on the north by Coyote Slough, Ponds A16 and A17, the "Island Ponds" (Ponds A19, A20, and A21), and the Newby Island Landfill; on the east by the Coyote Creek levee; and on the south by SR 237 (Figure 1).

Figure 1 depicts the Study Area in relation to the Alviso complex of the SBSPRP (on Refuge lands). The Alviso pond complex of the SBSPRP area bisects the Study Area, with managed ponds A9 through A17, Alviso Slough, and portions of Coyote Slough within the SBSPRP's Alviso complex, and Pond A18, New Chicago Marsh, and the WPCP being outside the SBSPRP's Alviso complex. However, the entire Study Area is within the action area for the SBSPRP's section 7 consultation (Service 2008).

Tidal marshes along both Alviso Slough and Coyote Slough are fresh/brackish in their upper reaches, where they are dominated by California bulrush, alkali bulrush, cattails, and invasive perennial pepperweed, but this vegetation transitions into salt marsh species such as Pacific cordgrass, pickleweed, and marsh gumplant toward the downstream portions of these sloughs. Artesian Slough, into which the WPCP discharges treated wastewater, is dominated primarily by freshwater marsh, which transitions to brackish marsh toward its confluence with Coyote Slough. Marshes along all three of these sloughs are relatively narrow and thus, in most places, lack the extensive channel networks that characterize larger marshes. Pond A17 has only recently been opened to tidal action, and thus rather than being vegetated, is inundated during the higher portion of the tidal cycle and consists mostly of mudflat at low tide; eventually, it is expected and intended that A17 will be dominated by tidal marsh. New Chicago Marsh is a diked, muted tidal salt marsh dominated by pickleweed, saltgrass, jaumea, and other halophytes in some areas, but with extensive open water and salt panne habitat as well.

Ponds A9, A10, A11, A14, A16, and A18 are managed ponds, with varying water depths and salinities similar to or slightly higher than Bay salinities. Ponds A9, A10, A11, and A14 are joined by breaches in their levees; water control structures along Alviso Slough at Pond A9 and Coyote Slough at Pond A14 allow water to enter these ponds. Ponds A12, A13, and A15 are also managed ponds, but are referred to as "batch ponds", because they are managed for higher salinities. Pond A16, which will be a managed pond under the SBSPRP, receives water from Pond A17 through a control structure, and water flows out of A16 through another structure in its southeastern corner; a structure along the southern edge of Pond A16 allows water to discharge into New Chicago Marsh as well. Pond A18 is not managed in concert with the other ponds; water in this pond is managed via two control structures, one in the northwest and one in the southwest portion of the pond. Currently, all managed and batch ponds on Refuge lands (A9-A15) are managed primarily as habitat for pond-associated waterbirds; Pond A18 is managed to maintain ambient conditions, with ancillary benefits to waterbirds. The Study Area also includes developed areas associated with the community of Alviso and an electrical generation plant, landfills, the WPCP water/sewage treatment areas, and upland grassland/ruderal habitat in the WPCP buffer lands.

The South Bay Shoreline Study is closely interrelated, and in some cases overlaps, with the ongoing implementation of the SBSPRP. The planning process for the South Bay Shoreline Phase I Study is being coordinated with the SBSPRP actions, as both efforts have similar FRM, ecosystem restoration, and recreation objectives. A final SPSPRP Environmental Impact Statement/ Environmental Impact Report, including both programmatic and project-specific actions, was released in December 2007 (EDAW *et al.* 2007). The total SBSPRP area consists of 15,100 acres of former salt ponds and adjacent habitats in the South Bay that the Service and CDFW acquired from Cargill, Inc. in 2003. The SBSPRP area includes the Eden Landing pond complex in the cities of Hayward and Fremont, Alameda County; the Ravenswood pond complex in the City of Menlo Park, San Mateo County; and the Alviso pond complex, which extends from the City of Mountain View

southeastward to the Alviso area in Santa Clara County. The SBSPRP also includes ponds A22 and A23 in the City of Fremont, Alameda County, and the aforementioned Island Ponds (Figure 1).

The Refuge owns and manages the 8,000-acre Alviso pond complex, within which are located New Chicago Marsh and 2,100 acres of ponds included in the current South Bay Shoreline Phase I Study Area. Pond A18 (about 856 acres), owned by the City of San Jose, is also included in the South Bay Shoreline Phase I Study Area, although it is not included in the SBSPRP Study Area and was not covered by the SBSPRP's section 7 consultations. Although Pond A18 was not considered in the SBSPRP, primarily due to not being a Service-managed property, the actions being proposed for the pond are similar to those proposed for the rest of the Alviso complex ponds, and the addition of Pond A18 to the South Bay Shoreline Phase I Study Area is consistent with the goals for the greater South Bay tidal restoration.

SBSPRP Phase I construction started in 2008; the final SBSPRP Phase I restoration actions were initiated in 2011 at Alviso Complex Ponds A16 and A17. Because both Ponds A16 and A17 were restored or reconfigured as part of SBSPRP Phase I implementation, no focused South Bay Shoreline Phase I restoration actions are proposed for these two ponds (although one of the islands in A16 will be enhanced for use by western snowy plovers).

California Clapper Rail

Central/South San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the Recovery Plan's Central/South San Francisco Bay Recovery Unit for the California clapper rail (Service 2013). The Central/South San Francisco Bay Recovery Unit supports the majority of California clapper rail populations. Populations in this unit are widely separated from northern ones, but there may be occasional dispersal between these areas. Predation by mammalian and avian predators is one of the primary threats to California clapper rails in the Central/South San Francisco Bay Recovery Unit (Albertson 1995, Service 2013, Overton *et al.* 2014). Overton *et al.* (2014) tracked 108 radio-marked California clapper rails at four marshes within the Central/South San Francisco Bay Recovery Unit (*i.e.*, Colma Marsh, Arrowhead Marsh, Laumeister Marsh, and Cogswell Marsh) and estimated survival rates over 166 weeks between 2007 and 2009. Overton *et al.* (2014) found that most of the California clapper rails (53 percent) died due to predation with raptors depredating 30 individual California clapper rails (28 percent) and mammals depredating 27 individual California clapper rails (25 percent). The annual survival rate for California clapper rails at Laumeister Marsh, a native tidal marsh managed by the Refuge near the City of East Palo Alto, San Mateo County, was 0.227 (Overton *et al.* 2014). The Refuge intermittently conducts mammal predator management on some Refuge lands within the Central/South San Francisco Bay Recovery Unit; however, the extent of mammal predator management implemented at the Refuge is limited by the lack of funding. The Refuge recently finalized an avian predator management plan to control avian predators of the California clapper rail on Refuge lands within the Central/South San Francisco Bay Recovery Unit; however, the Refuge lacks the resources to adequately monitor and control avian predators at the Refuge.

Breeding-season surveys of South Bay marshes for California clapper rails through the early 1990s, summarized by Foin *et al.* (1997), indicated that the most substantial populations of California clapper rails in the South Bay were, predictably, in the largest sections of tidal salt marsh at: Mowry Marsh and Dumbarton Marsh (in the eastern Bay between the Dumbarton Bridge and Mowry

Slough in Alameda County), the Faber/Laumeister Tracts and other marshes in the Palo Alto/East Palo Alto area in San Mateo and Santa Clara counties, and Greco Island in the City of Redwood City, San Mateo County. California clapper rails occurred in many other marshes as well, including Ideal Marsh, La Riviera Marsh, and Calaveras Marsh in the City of Fremont, Alameda County, and Triangle Marsh in the community of Alviso, Santa Clara County. Surveys by HTH and others since the early 1990s, as well as observation by birders (including HTH staff), have documented California clapper rails in a number of areas in the far South Bay, including lower San Francisquito Creek; the Palo Alto Baylands; Hook's Isle; the mouth of Charleston Slough; lower Permanente and Stevens creeks; Guadalupe Slough (primarily from its confluence with Moffett Channel downstream); Alviso Slough; a number of locations along Coyote Slough, extending upstream through the reach of the slough between Newby Island Landfill and the WPCP (known as South Coyote Slough or the lower Coyote Creek Bypass); and in the Warm Springs marshes. Although site-specific surveys have not been conducted in all suitable habitat for California clapper rails in the South Bay, this species is likely to occur in tidal salt marsh habitats in a number of additional areas as well.

Habitats and Occurrences within the Action Area

Within the action area, California clapper rails are most likely to occur in tidal salt marsh and brackish marsh along the lower and middle reaches of Alviso Slough (*e.g.*, from the northwest corner of Pond A12 downstream) and Coyote Slough (*e.g.*, from the vicinity of the Artesian Slough confluence downstream), and near the mouth of Artesian Slough. Although California clapper rails are known to be present in the downstream reaches of these sloughs, where the tidal marsh is dominated by salt-marsh plant species, they are less likely to occur in areas dominated by freshwater vegetation (*e.g.*, California bulrush and cattail) along the upper portions of Coyote, Artesian, and Alviso sloughs. In recent years, few surveys for California clapper rails have been conducted along the upper reaches of Alviso Slough, or anywhere in Artesian Slough or along upper Coyote Slough (upstream from its confluence with Artesian Slough).

In 2007, PRBO Conservation Science conducted surveys for California clapper rails along the middle and lower reaches of Guadalupe and Alviso sloughs (L. Liu, PRBO Conservation Science, pers. comm. cited in HTH 2013). Single California clapper rails were detected near the mouths of these sloughs (*i.e.*, along Guadalupe Slough near the Pond A5/A6 levee and along Alviso Slough east of Pond A6), but none were heard farther upstream.

More recently, surveys for the Invasive *Spartina* Project have been conducted along Alviso Slough from Pond A11 downstream to its confluence with Coyote Slough, and along Coyote Slough from the vicinity of the railroad tracks downstream along Ponds A12, A14, and A9 (data provided by Olofson Environmental, Inc.). From 2010 through 2014, all California clapper rail detections along Alviso Slough were at its mouth, near the northwest corner of Pond A9: between nine and 10 California clapper rails were detected in 2010, between four and six were detected in 2011, between one and two were detected in 2012, and between two and four California clapper rails were detected in 2014 near the mouth of Alviso Slough (Olofson Environmental, Inc. 2012, 2014).

On one occasion, a California clapper rail was recorded in brackish/freshwater transition marsh along upper Alviso Slough between the Alviso Marina and the Gold Street Bridge (February 14, 1997; Scott B. Terrill, pers. obs.). Earlier (approximately 1989) an individual California clapper rails was detected in the Alviso Marina (Ron Duke, pers. obs. cited in HTH 2013). However, no California clapper rails have been observed along upper Alviso Slough within recent years. For

example, surveys conducted by the San Francisco Bay Bird Observatory at the Alviso Marina found no California clapper rails during early spring 2003 and 2004 (C. Strong, Refuge, pers. comm. 2012). Also, pre-construction California clapper rail surveys conducted by the Refuge prior to Pond A8 notch construction in 2010 did not find any California clapper rails in this reach of upper Alviso Slough (C. Strong, Refuge, pers. comm. 2012). Therefore, any occurrence of California clapper rails in upper Alviso Slough would likely be by occasional non-breeding birds.

California clapper rails have also been detected along Guadalupe Slough as far as the nontidal freshwater ponds between Calabazas and San Tomas Aquino Creeks north of SR 237 (16 August 1998; Steve Rottenborn, HTH, pers. obs.). Between one and two California clapper rails were detected along upper Guadalupe Slough again in 2012 near the Moffett Channel (Olofson Environmental, Inc. 2012). However, such rails are likely wandering and foraging individuals, and their occurrence in these areas is expected to be sporadic.

Along Coyote Slough, all California clapper rails detections since 2010 have been from Triangle Marsh (north of Pond A15) downstream to Pond A9 except for a single detection near the northwest corner of Pond A18, at the Coyote Slough/Artesian Slough confluence. Call count surveys along South Coyote Slough detected between nine and 10 California clapper rails in 2011, between six and 10 rails in 2012, and between eight and 10 rails in 2014 between Pond A15 and Triangle Marsh (Olofson Environmental, Inc. 2012, 2014).

Therefore, based on the known occurrences of the California clapper rail within the action area, the Service believes the California clapper rail is likely to occur within the action area in all suitable tidal salt marsh and tidal brackish marsh habitat along Alviso Slough, Artesian Slough, Coyote Slough, and South Coyote Slough.

Salt Marsh Harvest Mouse

Central/South San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the Recovery Plan's Central/South San Francisco Bay Recovery Unit for the salt marsh harvest mouse (Service 2013). The Central/South San Francisco Bay Recovery Unit is within the range of the southern subspecies of the salt marsh harvest mouse (R. *r. raviventris*) (Service 2013). The population status of the southern subspecies is more precarious than that of the northern subspecies (R. *r. halicoetes*). Few major, resilient, or secure populations of the southern subspecies of the salt marsh harvest mouse persist within the Central/South San Francisco Bay Recovery Unit. The current populations within this recovery unit are very small and isolated compared with the historical pattern of distribution and abundance of the subspecies. All major population centers of the southern subspecies are remote from one another based on dispersal distances known for the species. Predation by mammalian and avian predators and spread of invasive plant species (*e.g.*, perennial pepperweed) are major threats to salt marsh harvest mice in the Central/South San Francisco Bay Recovery Unit (Albertson 1995, Service 2010, Service 2013).

Occurrences near the Action Area

The salt marsh harvest mouse has been detected during trapping studies in a number of locations within and near the action area, including Alviso Slough near the northwest corner of Pond A12,

Triangle Marsh, New Chicago Marsh, the mitigation wetlands on the south side of Pond A18, the Coyote Creek Bypass area, and Guadalupe Slough (San Francisco Estuary Institute, http://www.sfei.org/content/salt-marsh-harvest-mouse-database-and-maps, site numbers 21, 57, 249, and 306; California Natural Diversity Database (CNDDB) occurrence numbers 91, 92, 115, 116, 147, 132, and 133; CDFW 2014). The highest-quality habitat for this species within the action area occurs in tidal salt marsh along the lower reaches of Alviso and Coyote Sloughs, and at the mouth of Artesian Slough, as well as in diked salt marsh within New Chicago Marsh and within the mitigation wetlands on the south side of Pond A18. Brackish marshes farther upstream along Alviso, Coyote, and Artesian Sloughs represent lower-quality habitat, and salt marsh harvest mice have a lower probability of occurrence (and if present, likely occur in lower densities) in such brackish marshes. However, as a result of this species' detection in brackish marshes in the Warm Springs area in 2006 (HTH 2007), it could occur in at least small numbers in brackish marshes. The freshwater marshes in the upper reaches of Alviso Slough (*i.e.*, from the southwestern part of Pond A12 upstream to the Alviso Marina and above) and Artesian Slough (*i.e.*, from the vicinity of the southeastern corner of Pond A17 upstream), as well as those in the South Coyote Slough area north of the northeastern corner of Pond A18, are less suitable habitat for the species.

There is no recent survey data available for salt marsh harvest mice within or near the action area. However, based on known occurrences of the salt marsh harvest mouse within and near the action area and the occurrence of suitable habitat within the action area, the Service believes that the salt marsh harvest mouse is likely to occur within all suitable tidal salt and brackish marshes, diked salt and brackish marshes, and adjacent upland habitats (*e.g.*, contiguous grassland habitat within 328 feet of suitable marsh habitat (Service 2010, 2013)) throughout the action area.

Pacific Coast Population of the Western Snowy Plover

San Francisco Bay Recovery Unit

The action area for the proposed project occurs within the San Francisco Bay Recovery Unit for the Pacific coast population of the western snowy plover (http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf, Service 2007). One of the delisting criteria for the Pacific coast population of the western snowy plover is for the maintenance of 500 individual breeding western snowy plovers within the San Francisco Bay Recovery Unit (Service 2007). The SBSPRP has committed to the maintenance of at least 250 individual breeding western snowy plovers in the South Bay through adaptive management of salt pond breeding habitat and predator management within the SBSPRP area. The Refuge intermittently conducts avian and mammal predator management within some of the larger western snowy plover nesting populations in the South Bay.

In the South Bay, the highest numbers of nesting western snowy plovers occur in portions of Alameda and San Mateo counties outside the action area. Nearly all of the Bay nesting occurs south of State Route 92 (San Mateo Bridge) in the South Bay (Page and Stenzel 1981, Page *et al.* 1991, Service 2007). Abundance of western snowy plovers during surveys around the Bay may vary considerably from year to year. Summer window-survey data for the years 2009-2014 detected 147, 275, 249, 147, 202, and 178 individual western snowy plovers within the San Francisco Bay Recovery Unit during those six years (http://www.fws.gov/arcata/es/birds/WSP/plover.html, Service 2014b).

Habitats and Occurrences within the Action Area

Western snowy plover summer window-survey data for the years 2009-2014 detected eight, zero, 11, 20, 10, and zero individual western snowy plovers during those six years in the Alviso area of northern Santa Clara County (http://www.fws.gov/arcata/es/birds/WSP/plover.html, Service 2014b). In the action area itself, western snowy plovers have nested recently (*i.e.*, 2012-2014) in New Chicago Marsh, Ponds A9, A12, A13, and A16, and in the impoundment between Pond A12 and the railroad tracks (just north of the old Alviso Marina; hereafter "Alviso impoundment"). Of 13 western snowy plover nests in 2012, four each were in Ponds A16 and A17, which were being dried out for construction of islands in A16 and tidal restoration in A17 (Donehower *et al.* 2012). The other five western snowy plover nests were in Pond A13. Of the 10 western snowy plover nests in the vicinity of the action area in 2013, six were in Pond A16; one was on a recently constructed island and five were on the dried-out pond bottom when the pond was drawn down for island creation, but this area was eventually re-flooded (Robinson-Nilsen *et al.* 2013). The others included single western snowy plover nests in New Chicago Marsh and the Alviso impoundment, and two in Pond A9. In 2014, western snowy plovers have been documented nesting in Pond A9 (one nest that was flooded) and A13 (two nests that hatched young). Due to variability in water level management in Ponds A9-A15, the suitability of habitat for nesting in these ponds has varied from year to year, and Pond A12 has provided nesting habitat in some years. Western snowy plovers have never been known or suspected to breed in the action area east of Artesian Slough (*i.e.*, in the vicinity of Pond A18).

California Least Tern

In the Bay, the primary California least tern breeding colonies are at Alameda Point in the City of Alameda and Hayward Regional Shoreline in Alameda County, and at the Montezuma Wetlands near Suisun City, Solano County. California least terns also nested in 2000 and 2001 in the City of Albany (near Alameda), Alameda County, with up to 12 pairs in 2000. In the City of Pittsburg, Contra Costa County on Suisun Bay, 13 pairs nested in 2001 and eight pairs nested in 2003. Historically, small numbers of birds have nested at the Oakland International Airport (last reported in 1995), Bay Farm Island (last reported 1975), Bair Island (last reported 1984), Port Chicago (last reported in 1988), the Bay Bridge Sand Spit (one-time attempt in 1985), and Tern Island (one-time attempt in 1990, U.S. Geological Survey preliminary data, unpubl.)

California least terns have never been recorded nesting in the vicinity of the South Bay Shoreline Phase I Study Project's action area, or anywhere else in Santa Clara County or nearby areas of Alameda County. In recent years, the main post-breeding staging area for California least terns in the South Bay has been in the complex of ponds immediately north of Moffett Field (Ponds AB1, A2E, and AB2), which are located approximately two miles west of the action area. These areas are used for roosting and foraging by adults and juveniles in July and August every year, with typical counts of 20 to 100 California least terns, although 276 were observed there in July 2004 (S. Rottenborn, HTH, pers. obs.). California least terns have also been recorded foraging or roosting at other South Bay ponds, including A1, A2E, A3N, A3W, A4, A5, A7, A9, A10, A11, and A14 (Marschalek 2006; J. Krause, CDFW, pers. comm.; U.S. Geological Survey preliminary data, unpubl.). Ravenswood ponds in San Mateo County are also used occasionally for foraging and roosting, with counts of 96 California least terns in July 2002, 42 in July 2003, and 110 in July 2004 (U.S. Geological Survey preliminary data, unpubl.). Eden Landing ponds in Alameda County are used irregularly for foraging including E2, E4, E5, E8A, E9, E10, and E11. California least terns do

not generally forage in smaller sloughs or channels adjacent to managed ponds but rather prefer more open waters, including the Bay waters; 50 of 58 California least terns observed foraging at one South Bay location in July 2004 were doing so over the open waters of the Bay while the other eight were foraging in ponds (S. Rottenborn, HTH, pers. obs.).

California least terns are not known to nest in the action area. California least terns have been observed foraging in the action area's ponds (A9, A11, and A14) only rarely, and they have not been observed foraging in Pond A18, despite occasional visits by birders and biologists to A18 and birder coverage of A18 (using spotting scopes) from the Pond A16 levee. Although California least terns could potentially forage in any of these ponds that contain fish, survey data collected for the SBSPRP and incidental observations by birders indicate that California least terns visit the action area (as a post-breeding forager) irregularly and in low numbers.

San Francisco Bay-Delta DPS of the Longfin Smelt

Longfin smelt larvae and juveniles are found throughout the San Francisco Bay Estuary, including the South Bay during wet years (Rosenfield 2009 and California Department of Fish and Game 2009). Longfin smelt are known to be located in the action area from several different surveys. Surveys conducted in 1982 and 1983 found adults followed by larvae in Coyote Slough, mostly likely indicating that spawning had likely occurred there (Robinson and Greenfield 2011). Longfin smelt have also been collected inside the Island Ponds following breaching to restore tidal action (EDAW Inc. 2007, Robinson and Greenfield 2011, Hobbs *et al.* 2012). Fish surveys conducted during 2010 through 2012 for the SBSPRP by Hobbs *et al.* (2012), which included otter trawls in sloughs and bay waters, between the months of October through March detected longfin smelt in the Alviso pond complex. During these trawls longfin smelt was the seventh most abundant species and were captured in all major sloughs and tributaries. The species was not detected during other surveys conducted from 2010 to 2012, which were at least monthly, indicating absence between the months of May and September.

The action area is located downstream from the Bay's largest source of toxic mercury, the historical Almaden Quicksilver mine in the hills above San Jose. Recent biosentinel sampling in South Bay managed ponds and marshes indicates that mercury concentrations in fish are above the Bay mercury total maximum daily load of 0.03 microgram/gram for small fish (San Francisco Bay Regional Water Quality Control Board 2006).

Effects of the Proposed Project

The footprint of ground disturbance from the proposed project consists of a total of approximately 165 acres. Table 1 below lists the acreages of each of habitat type that will be disturbed by the proposed Corps-led actions (*e.g.*, construction of the levees, the Artesian Slough tide gate, the pedestrian bridge, and the Pond A18 ecotone and tidal restoration activities) and Service-led actions (e.g., construction of the Pond A12 ecotone and Ponds A9-A15 tidal restoration activities). Construction of trails and other recreational facilities, which is a Service-led activity, will occur entirely on existing levees and berms, or in ruderal grassland along SR 237, and thus the acreage of such habitat disturbance from trail construction is not included in Table 1.

In the following sections discussing effects on individual listed species, effects are separated for Corps-led and Service-led activities as appropriate. Because of the tidal flood protection functions

currently provided by the outboard levees around Ponds A9-A15, tidal restoration within those ponds would not be feasible without enhancement of flood protection inboard from those ponds. As a result, the effects of Service-led tidal restoration on Refuge lands could not occur but for the Corps-led construction of the levee and tide gate, and thus, the benefits that accrue from tidal restoration on Refuge lands are dependent on Corps-led levee construction.

Table 1. Habitat Disturbance from the Proposed Project.

Habitat Type	Impacts of Corps-Led Actions (acres)		Impacts of Service-Led Actions (acres)	Total Habitat Disturbance (acres)
	Levee/Tide Gate/ Bridge Construction	A18 Ecotone/ Tidal Restoration	A12 Ecotone/ Tidal Restoration	
Brackish marsh	0.20	0.07	0.03	0.3
Freshwater marsh	1.04	0.06	<0.01	1.1
Muted tidal/diked marsh	1.80	0.00	0.00	1.8
Tidal salt marsh	1.64	0.03	0.03	1.7
Non-tidal salt marsh	8.20	0.00	0.00	8.2
Seasonal wetland	3.65	0.00	0.05	3.7
Mudflat	0.59	0.01	0.00	0.6
Batch pond	3.60	0.00	29.00	32.6
Managed pond	12.07	66.13	0.00	78.2
Open water	9.40	0.00	0.00	9.4
Upland vegetation	1.00	0.00	0.00	1.0
Water/sewage treatment	0.10	0.00	0.00	0.1
Levee	18.49	0.33	0.88	19.7
Developed	6.15	0.24	0.01	6.4
TOTAL	67.93	66.87	30.00	164.8

California Clapper Rail and Salt Marsh Harvest Mouse

Habitat Restoration

Effects of Corps-led Actions

The highest-quality habitat for the California clapper rail and salt marsh harvest mouse consists of tidal salt marsh, although these species will also use tidal brackish marshes to some extent. Tidal restoration in Pond A18 is expected to result in the creation of approximately 119 acres of tidal salt marsh and 398 acres of brackish marsh habitat for the California clapper rail and salt marsh harvest mouse (HTH 2012). In addition, approximately 67 acres of ecotone habitat will be created along the southern and eastern edges of Pond A18. The ecotone created along the southern and eastern edges of Pond A18 will provide high quality extreme high tide refugia cover for California clapper rails and salt marsh harvest mice which will reduce the risk of predation. The grassland habitat along the ecotone will also provide foraging and dispersal habitat for salt marsh harvest mice. The ecotone

will also allow for the landward transgression of the tidal marsh in the face of sea level rise and provide a buffer between the marsh and developed areas. This ecotone habitat is expected to develop more quickly than the tidal marsh in A18, which will not become vegetated until sedimentation has elevated the former pond bottom to the point where vegetation can colonize it. Within a few years, it is expected that vegetation along the ecotone will provide habitat that is of higher quality for salt marsh harvest mice than the narrow strip of vegetation that is currently present along the southern and eastern edges of Pond A18.

Effects of Service-led Actions

Assuming that all of Ponds A9-A15 are eventually restored to tidal action, approximately 2,010 acres of new tidal marsh will be restored within these ponds. All of this restored tidal marsh is predicted to be salt marsh (HTH 2012). In addition, 30 acres of ecotone habitat will be created along the eastern edge of Pond A12; habitat along the ecotone is expected to become suitable for use by salt marsh harvest mice within a few years after seeding and planting occur. If only Ponds A12 and A18 are restored, then approximately 300 acres of suitable tidal marsh will be restored in A12 and 517 acres of suitable tidal/brackish marsh habitat will be restored in A18. The ecotone habitat created along the eastern edge of the restored tidal marsh in Pond A12 will benefit the California clapper rail and salt marsh harvest mouse by providing transitional habitat for the rail and the mouse to utilize as cover during extreme high tide and flooding events which will reduce the risk of predation. The ecotone will also provide foraging and dispersal habitat for the salt marsh harvest mouse. The ecotone will also allow for the landward transgression of the tidal marsh in the face of sea level rise and provide a buffer between the marsh and developed areas.

Habitat Restoration Effects Common to Corps-led and Service-led Actions

All of these marshes (in Pond A18 and A9-A15) will support complex channel networks. These channels will provide extensive foraging habitat for California clapper rails, and the larger channels will provide natural levees supporting taller cordgrass and gumplant, which serve as rail nesting habitat and high-tide refugia.

Because the rate of evolution of tidal habitats is dependent largely on sediment availability, which is difficult to predict, the precise rates of evolution of these marshes are unknown. However, the following general timeline of expected marsh evolution predicted for restored South Bay marshes by the SBSPRP indicates the likely habitat progression expected over the 50-year timeline of the South Bay Shoreline Phase I Study Project.

Habitat restoration in the action area described above for California clapper rail will result in similar benefits for the salt marsh harvest mouse. Because salt marsh harvest mice reach their highest densities in mature marshes with pickleweed, which form in the highest marshes, the evolution of suitable habitat for salt marsh harvest mice within restored marshes will be slower than for California clapper rails, as it will take longer for marsh elevations to reach elevations appropriate for pickleweed dominance. However, development of suitable habitat for salt marsh harvest mice in the ecotones will be relatively rapid. Once suitable habitat is restored, the high fecundity of salt marsh harvest mice will ensure that this species will rapidly colonize and spread throughout the restored pickleweed marshes from occupied habitat along Coyote or Alviso sloughs or other suitable habitat.

The amount of habitat for the California clapper rail and salt marsh harvest mouse that will be restored by both the Corps-led and Service-led actions is expected to substantially increase South Bay populations of these species, and contribute greatly to their survival and recovery. In addition, the restoration of ecotones in Ponds A18 and A12 will provide high-quality refugia during extreme high tides that inundate the rest of the marsh plain, thus helping to improve winter survival rates. The ecotones will also provide seasonal foraging and dispersal habitat for the salt marsh harvest mouse in addition to providing some residence habitat for this species.

Estimated Timeline for Tidal Marsh Establishment

In 2020, Pond A12 will be breached, restoring full tidal action to approximately 300 acres of salt pond (though see the previous discussion of the possibility that Pond A18 may be breached first). By Year 10 (2027), enough sediment is expected to have accumulated in other areas of this former pond that low tidal marsh vegetation dominated by Pacific cordgrass will start to become established. Use of the restored marshes by California clapper rails is expected to occur as soon as enough vegetation is present to provide cover for foraging California clapper rails. Even though this vegetation may not be dense and/or extensive enough to provide nesting habitat by Year 10, California clapper rails are expected to forage on intertidal mudflats near vegetative cover, which may occur near the breach locations.

In 2023, the Pond A18 ecotone will be constructed and seeded providing suitable habitat for colonization by salt marsh harvest mice from nearby areas. In 2025, additional breaching may restore tidal action to approximately 875 acres in Ponds A9, A10, A11, and 736 acres in Pond A18. By 2027, tidal marsh vegetation will begin to colonize the edges of levees and berms, but by the end of Year 10 (2027), the bottoms of Ponds A9, A10, A11, and A18 may still be too low for substantial vegetation establishment.

As sediment continues to accumulate in the restored ponds, bottom elevations will be raised, and the areas at elevations suitable for colonization by tidal marsh vegetation will increase. By Year 20 (2037), vegetation will be expanding outward from the ecotone area and the edges of other levees and berms, and it is expected that sufficient sediment will have accumulated in other portions of Ponds A9-A12 and A18 that low marsh suitable for use by California clapper rails for nesting and foraging will have developed.

In 2030, an additional 850 acres of tidal restoration may occur via breaching of Ponds A13, A14, and A15. Thus, by Year 13 (2030), approximately 2,010 acres of new tidal habitat in Ponds A9-A15 and 736 acres in Pond A18 will have been restored. Evolution of marshes within Ponds A13-A15 will occur gradually as described above for other ponds.

In Years 20-50 (2037-2067), vegetated marsh will continue to expand in area and increase in elevation as sediment accumulates. Although sea level rise will raise the elevation of water within the restored marshes, thus restricting the rate of marsh development to some extent, it is predicted that the rate of sediment accumulation will outpace sea level rise, so that vegetated marshes will colonize all but the lowest-elevation areas such as tidal sloughs and channels (ESA and Philip Williams & Associates, Ltd. 2012, HTH 2012). Suitable nesting habitat and cover for the California clapper rail and salt marsh harvest mouse will continue to expand, and higher-marsh areas that form on natural levees along the larger tidal sloughs will provide high-tide refugia. By Year 50, it is expected that approximately 2,130 acres of restored tidal salt marsh and 398 acres of restored

brackish marsh suitable for use by California clapper rails and salt marsh harvest mice will have been restored.

Increased Salinity and Beneficial Marsh-Type Conversion

Effects of Corps-led Actions

Breaching of Pond A18 will result in an increased tidal prism and salinization of brackish and fresh marshes throughout all of Artesian Slough and Coyote Slough, thus resulting in the expansion and enhancement of California clapper rail and salt marsh harvest mouse habitat over large areas of existing brackish and freshwater marsh along these sloughs. In addition, this change in the tidal gradient will result in the development of higher-quality habitat in already-breached Pond A17 and the Island Ponds than would develop in the absence of breaching of A18. The effects on salinities within existing marshes would be immediate, and within a period of just a few years, it is expected that considerable expanses of brackish marshes dominated by bulrush and pepperweed will have begun conversion to marshes dominated by Pacific cordgrass, pickleweed, and gumplant.

Effects of Service-led Actions

Restoration of tidal action to Ponds A9-A15 will result in an increased tidal prism and salinization of brackish and fresh marshes along Alviso Slough upstream to Pond A12 and along lower Coyote Slough, thus resulting in the expansion and enhancement of California clapper rail and salt marsh harvest mouse habitat in these areas. In addition, this change in the tidal gradient will result in the development of higher-quality habitat in already-breached Pond A6 and the Island Ponds than would develop in the absence of breaching of Ponds A9-A15. These effects are expected to occur rapidly.

Increased Salinization Effects Common to Corps-led and Service-led Actions

As levees are breached and ponds are subjected to tidal action, these ponds will draw considerable amounts of water through the breaches on rising tides. As a result, the rate of water flowing "upstream" along Alviso, Artesian, and Coyote sloughs, from the Bay into the breached ponds, on rising tides will be considerably higher than it currently is. This will result in the transportation of more saline Bay water upstream, and higher upstream, along these sloughs than currently occurs. The effect of this change in tidal prism and the upstream migration of the salinity gradient will be the salinization of marshes along these sloughs that are currently brackish and fresh marshes due to the inputs of freshwater from Coyote Creek, the Guadalupe River, and WPCP effluent. Because outboard levee breaches will be located high up these sloughs, such as at Pond A12 along Alviso Slough, in the southwest corner of Pond A18 along Artesian Slough, and in the northeast corner of Pond A18 along Coyote Slough, more saline water will be drawn far up these sloughs, and this salinization will affect the plant species composition of marshes on a very large scale. The result will be the conversion of extensive areas of brackish marsh to salt marsh and conversion of extensive areas of freshwater marsh to brackish marsh. As a result, habitat conditions within existing brackish and fresh marshes along Alviso Slough, Artesian Slough, and Coyote Slough will become much more suitable for California clapper rails and salt marsh harvest mice. Furthermore, the upstream migration of the salinity gradient will result in higher-salinity marshes in recently restored areas such as the Island Ponds, Pond A6, and Pond A17, thus helping to enhance habitat for California clapper

rails and salt marsh harvest mice beyond the conditions that would be created in the absence of the South Bay Shoreline Phase I Study Project.

In particular, given the vast extent of brackish and freshwater marsh along Coyote Slough, the breaching of Pond A18 will result in considerable expansion of California clapper rail and salt marsh harvest mouse habitat up Coyote Slough and much higher-quality rail and mouse habitat in Pond A17 and the Island Ponds. Marsh evolution predictions for the proposed project took the increased tidal prism along Coyote Slough, resulting from Pond A18 breaching into account when predicting that the entirety of restored tidal habitat in Ponds A9-A15 would be salt marsh instead of brackish marsh (HTH 2012). Thus, the increase in California clapper rail and salt marsh harvest mouse habitat and enhancement of rail and mouse habitat quality as a result of both the Corps-led and Service-led actions will be far greater than just the increase in tidal marsh within the ponds to be breached.

The salinization of tidal marsh that will result from the proposed project will also expedite project benefits to the California clapper rail and salt marsh harvest mouse. As described previously, there will be a lag between breaching of levees and development of California clapper rail and salt marsh harvest mouse habitat due to the need for sediment accumulation to elevate pond bottoms enough that vegetation can colonize the restored habitat. In the case of increased salinization, however, the effects on salinities within existing marshes would be immediate, and within a period of just a few years, it is expected that considerable expanses of brackish marshes dominated by bulrush and pepperweed will have begun the conversion to marshes dominated by Pacific cordgrass, pickleweed, and gumplant.

Loss of Habitat

Effects of Corps-led Actions

Artesian Slough Tide Gate and Pedestrian Bridge

Construction of the Artesian Slough tide gate and Artesian Slough pedestrian bridge will result in the loss of suitable habitat for the California clapper rail and salt marsh harvest mouse through the placement of fill in salt and brackish marsh habitat, but no suitable nesting habitat for California clapper rails will be directly affected. Construction of the tide gate and pedestrian bridge in Artesian Slough will result in the direct disturbance of about 1.04 acres of non-breeding tidal freshwater marsh habitat that may be occasionally utilized by a low number of foraging and dispersing California clapper rails and salt marsh harvest mice. As indicated in Table 1, 1.64 acres of tidal salt marsh will be disturbed; however, this marsh is located in a narrow strip along the Alviso impoundment and is not truly tidal, receiving tidal inflow only during the highest tides. As a result, the disturbance of muted tidal marsh along the Alviso impoundment will disturb potential habitat for the salt marsh harvest mouse but not the California clapper rail.

Excavation of Pilot Channels and Pond A18 Breaches

Excavation of pilot channels in the outboard marsh around Pond A18 will occur in five locations, four along Artesian Slough and one at South Coyote Slough. The marsh vegetation at these breach locations consists of brackish marsh at three locations and freshwater marsh at two locations. Excavation of pilot channels and breaching will result in the direct disturbance of about 0.07 acre of

brackish marsh and 0.04 acre of tidal salt marsh that could potentially support low densities of California clapper rails and salt marsh harvest mice. It is possible that the salt and brackish marsh provides suitable nesting and foraging habitat for California clapper rail. However, given the paucity of California clapper rail occurrences along Artesian Slough and the extreme eastern end of South Coyote Slough in recent years, it is likely that very few rails use this habitat, and then only occasionally (and likely only during the non-breeding season).

FRM Levee Construction

Construction of the FRM levee will result in the loss of non-tidal salt and brackish marsh habitat and adjacent upland habitat along the edges of Ponds A16 and A18 and New Chicago Marsh that are suitable habitat for the salt marsh harvest mouse but not the California clapper rail. Areas with vegetation that potentially supports the salt marsh harvest mouse, and that will be disturbed by fill placed for the levee, include non-tidal and muted tidal/diked salt marsh along the southern, western, and northern edges of the Alviso impoundment; the northern edge of New Chicago Marsh, adjacent to the southern levee of Pond A16; and both the northern and southern sides of the existing Pond A18 levee. The loss of suitable salt marsh harvest mouse habitat will result from the widening of the levee, relative to its existing footprint, and will affect a total of about 13.65 acres of vegetation dominated by pickleweed, alkali heath, grasses, and non-native weedy species that provide at least marginal-quality habitat for salt marsh harvest mice. No suitable California clapper rail habitat will be disturbed by the widening of the levee footprint because the marshes along the existing levee are non-tidal and thus not likely to support the rail.

No high-quality salt marsh harvest mouse habitat will be impacted by widening of the levee. The habitat that will be disturbed consists of narrow strips of vegetation located between the existing bare levee and either bare salt panne/mud (along the Alviso impoundment), the waters of Ponds A16 and A18, or a borrow ditch (on the south side of the levee at Ponds A16 and A18). The impacted habitat is very narrow, which increases the risk of predation on any salt marsh harvest mice that might be present in those strips of vegetation, and is separated by unsuitable habitat (*e.g.*, open ground without vegetation or open water) from more extensive, higher-quality expanses of habitat, such as that in New Chicago Marsh and in the wetlands south of Pond A18 and east of Artesian Slough. Even along the southern edge of the Pond A16 levee, the strip of pickleweed and other vegetation between the levee and New Chicago Marsh is narrow, includes much dead and sparse vegetation, and supports only a patchy distribution of dense, tall, high-quality pickleweed. As a result, the quality of habitat, and the expected density of salt marsh harvest mice within the habitat to be impacted, is low, and the effects on salt marsh harvest mouse populations from the loss of these narrow strips of vegetation will be low.

Furthermore, these narrow strips of vegetation do not provide high-quality dispersal habitat for the salt marsh harvest mouse. The strips on the outboard (northern) side of the Pond A18 levee are separated by the bare levee itself from potential source populations of salt marsh harvest mice in New Chicago Marsh, the wetlands east of Artesian Slough, or the Coyote Creek Bypass. Open, unvegetated areas may act as barriers to movement of salt marsh harvest mice (Shellhammer 1978, Geissel *et al.* 1988), and thus salt marsh harvest mice likely cross the levee to and from this habitat very infrequently. In order for this vegetation to serve an important dispersal function, salt marsh harvest mice would have to cross bare levees from one source population, move long distances through the narrow strip of vegetation (or survive over generations within that narrow strip so that progeny eventually disperse long distances over time), and cross the bare levee again to reach

another high-quality habitat area. Such occurrences are unlikely, or happen very infrequently. The narrow strip of vegetation along the western edge of the Alviso impoundment is even further removed from high-quality habitat, being separated from New Chicago Marsh by a broad salt panne and the railroad tracks.

Following levee construction, unimpacted pickleweed-vegetated areas between the Zanker Landfills/WPCP and the new levee will continue to provide suitable dispersal and residence habitat for salt marsh harvest mice. More importantly, a broad ecotone along the southern and eastern sides of A18 will be constructed. This ecotone will provide much higher-quality residence and dispersal habitat than what will be impacted. This 345-foot-wide ecotone will extend from the levee top downslope to Pond A18. The native plants that will be seeded or planted on this ecotone area will provide suitable dispersal habitat for salt marsh harvest mice, and wetland vegetation and peripheral halophytes near the lower edge of the ecotone area will provide residence habitat for the salt marsh harvest mouse that is at least as suitable (or of much higher quality) as what will be impacted. This ecotone will thus compensate (and more) for any loss of habitat along Pond A18, both in terms of the acreage of habitat impacted and linearly, replacing low-quality habitat with higher-quality habitat in the same areas linearly along the levee. Although no broad ecotone habitat is proposed at Pond A16 to replace the narrow strips of vegetation lost due to levee widening, the lower slopes of the levee will be allowed to be vegetated, and pickleweed of similar quality and extent to that currently present is expected to colonize these lower slopes. This pickleweed will not be mowed, as mowing would occur only on the higher portions of the levee. Along the eastern edge of Pond A12, the vegetation to be lost (*i.e.*, between the A12 levee and the Alviso impoundment) is so narrow that it likely serves little function, either as residence or dispersal habitat, for salt marsh harvest mice. As a result, the loss of this habitat to FRM levee construction does not warrant immediate compensation in situ by the Corps. Rather, the broad ecotone to be constructed by the Service and local sponsors on the west side of the FRM levee at Pond A12 will more than compensate for any lost salt marsh harvest mouse habitat in the A12 vicinity. Although the construction of the Pond A12 ecotone is a Service-led activity, it would not be feasible but for the construction of the FRM levee by the Corps, and thus the Corps' levee construction is enabling that important habitat restoration component.

Construction of the FRM levee on the existing Pond A18 levee footprint will modify the structures that convey water in and out of the non-tidal wetlands east of Artesian Slough and south of Pond A18. These wetlands contain extensive pickleweed and are thus expected to support resident salt marsh harvest mice. The proposed project will replace any modified or removed water control structures so that flow in and out of these wetlands can continue and existing conditions within the wetlands will be maintained.

Scour of Tidal Marsh Habitat

Following breaching of Pond A18, the increased tidal prism will result in the scour of sediment, and some vegetated marsh, from channels leading between the Bay and the breach locations. As a result, some loss of existing fringe marsh for the California clapper rail and salt marsh harvest mouse will occur along Artesian and Coyote sloughs. This marsh will consist primarily of brackish and freshwater marsh, but some salt marsh along lower Coyote Slough will be lost to scour as well. The acreage of marsh expected to be lost due to scour resulting from the breaching of Pond A18 is unknown. The SBSPRP predicted that 220-250 acres of marsh loss to scour would occur over a 50-year period resulting from restoration of tidal action to as much as 11,500 acres for the entire

SBSPRP (*i.e.*, scour of about 2 percent of the marsh restored). Given the 736 acres of tidal restoration proposed at Pond A18, the extent of marsh loss for the California clapper rail and salt marsh harvest mouse due to scour might be roughly estimated at 17 acres. Such marsh loss would be gradual, and this total represents the total loss due to scour over the 50-year proposed project period.

The fringe marshes of the South Bay, which will be the marshes adversely affected by this scour, often provide the only habitat connecting the larger patches of marsh habitat that contain the "core" populations of salt marsh harvest mice. The loss of these marshes in the short term, before the restored marshes have matured to vegetated high marsh, could temporarily reduce the connectivity between the salt marsh harvest mouse populations of the South Bay. However, the short-term loss of salt marsh harvest mouse habitat and connectivity from fringe marsh scour will be offset by an order of magnitude when the restored marsh matures to a point that it can support salt marsh harvest mice. In the meantime, the marsh loss due to scour will be far less than the expected extent of marsh-type conversion (*i.e.*, from fresh or brackish marsh to salt marsh) due to increased salinization related to increased tidal prism. As a result, the enhancement of California clapper rail and salt marsh harvest mouse habitat from increased salinization will outpace any adverse effects of marsh loss due to levee construction, breaching, and localized scour while new tidal salt marsh is developing within restored Pond A18. The short-term nature of any reduction in connectivity from construction and scour suggests that it will not adversely affect the metapopulation dynamics or genetic diversity of the salt marsh harvest mouse in the South Bay.

To put the loss of marsh from excavation of pilot channels and downstream scour of fringing marsh into perspective, this 17 acres of marsh loss is far less than the expected extent of marsh-type conversion (*i.e.*, fresh or brackish marsh to salt marsh) due to increased salinization related to increased tidal prism. As a result, the beneficial effects on California clapper rail and salt marsh harvest mouse populations due to enhancement of habitat resulting from increased salinization will outpace any adverse effects of marsh loss due to breaching and localized scour in the near term while the much more extensive tidal salt and brackish marsh is developing within restored Pond A18.

During any construction or excavation activities that may result in impacts to tidal marsh habitat, the limits of work will be clearly delineated to limit effects to existing California clapper rail and salt marsh harvest mouse habitat. Side-casting of dredged materials into tidal marsh habitat (*e.g.*, during excavation) will be limited so that a minimum amount of marsh is filled. Conservation measures incorporated into the proposed project will minimize effects of human activity within marshes on California clapper rail and salt marsh harvest mouse habitat.

Effects of Service-led Actions

The only Service-led activities that could result in the loss of existing California clapper rail and salt marsh harvest mouse habitat will occur as a result of tidal restoration at Ponds A9-A15. Excavation of pilot channels in the outboard tidal marsh around these ponds will disturb about 0.03 acre of salt marsh, 0.03 acre of brackish marsh, and <0.01 acre of freshwater marsh at five breach locations along Alviso Slough and one breach location along Coyote Slough. Because recent surveys for California clapper rails conducted for the Invasive *Spartina* Project along Alviso Slough have only detected California clapper rails at the mouth of the slough, pilot channel construction and breaching at the four breach locations on Ponds A10 and A12 are likely to have little effect on

habitat that is used by nesting California clapper rails; rather, this habitat is likely used only by occasional, foraging, non-breeding individuals. The breach in the northwest corner of Pond A9 is closer to areas where California clapper rails have been recently detected, but it is located at an existing tide gate where the marsh along Alviso Slough is extremely narrow, too narrow to provide suitable nesting habitat or high-quality foraging habitat for California clapper rails. The only location where pilot channel excavation could affect habitat that has any likelihood of being used by breeding California clapper rails is in the northeastern corner of Pond A9, where the pilot channel will be excavated out to Coyote Slough. It is likely that salt marsh harvest mouse abundance in most of the breach locations is low owing to the brackish and/or very narrow nature of the marshes at these locations. However, the breach in the northeast corner of Pond A9 is located in tidal salt marsh that is more suitable for this species. Vegetation is almost completely absent from the internal berms within the Ponds A9-A15 system, and thus within-pond preparation activities for tidal breaching will not disturb any suitable salt marsh harvest mouse habitat.

Prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If California clapper rail and salt marsh harvest mouse habitat has developed within Pond A12 by that time, there may be a temporary loss of habitat due to breaching. However, that habitat will be quickly offset by continued marsh development. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal action in Ponds A13-A15, potentially resulting in temporary losses of California clapper rail and salt marsh harvest mouse habitat. Again, any such losses will quickly self-restore.

As mentioned above, the increased tidal prism resulting from restoration of tidal action to Ponds A9-A15 will cause the scour of sediment, and some vegetated marsh, from channels leading between the Bay and the breach locations. As a result, some loss of fringe marsh along Alviso Slough and Coyote Slough will occur. Such scour will reduce habitat for the California clapper rail and salt marsh harvest mouse and may limit dispersal of salt marsh harvest mice along these sloughs to some extent in the short term. Assuming that the loss of marsh to scour might comprise approximately 2 percent of that restored, up to 40 acres of tidal marsh might be lost to scour over the 50-year proposed project period. This marsh would be limited to Alviso Slough downstream from Pond A12 and a small area of Coyote Slough from the northwest corner of Pond A9 downstream. Such marsh loss will occur gradually due to the phasing of breaching at these ponds (Pond A12 in 2020, A9-11 in 2025, and A13-15 in 2030). However, the beneficial effects on California clapper rail and salt marsh harvest mouse populations due to enhancement of habitat resulting from increased salinization are expected to outpace any adverse effects of marsh loss due to breaching and localized scour while new tidal salt and brackish marsh is developing within the restored marshes in Ponds A9-A15. Once cordgrass and pickleweed-dominated habitat colonizes the restored marsh within these former ponds, California clapper rail and salt marsh harvest mouse habitat will be expanded by orders of magnitude.

Small-scale, localized disturbance of habitat for the California clapper rail and salt marsh harvest mouse may also occur from walking through marshes or grounding boats in marshes during monitoring, research, or predator management efforts. Such disturbance would be very limited, particularly with implementation of proposed conservation measures (*e.g.*, for perennial pepperweed control). Effects to California clapper rails and salt marsh harvest mice resulting from monitoring, research, and predator management on the Refuge will be covered by the existing biological opinion for the SBSPRP and a future biological opinion for the Refuge's Comprehensive Conservation Plan.

Effects to California clapper rails and salt marsh harvest mice resulting from perennial pepperweed control are discussed below under the "Perennial Pepperweed Control" section."

Direct Effects to Individuals

Effects of Corps-led Actions

California Clapper Rail

Construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge has the potential to disturb areas where California clapper rails are occurring only at Artesian Slough. Due to the low quality of this freshwater marsh for use by California clapper rails, there is a very low probability that a rail would be anywhere in the vicinity of the tide gate/pedestrian bridge construction area when activities are occurring in the tidal marsh. Furthermore, because the freshwater habitat in that location is not suitable for use by breeding California clapper rails, no nests, eggs, or young would be affected by activities at that location, and any California clapper rail present in the vicinity would move away from construction activities long before it could be physically injured or killed. Therefore, no loss of individuals, nests, eggs, or young will occur from construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge.

Excavation of pilot channels in the outboard marsh around Pond A18 is also unlikely to result in the loss of any California clapper rails. The brackish marsh habitat at three of the pilot channel locations does not provide high-quality nesting habitat, due both to its brackish nature and the narrow nature of the marsh at those locations, and there is a low probability that California clapper rails would be breeding in those areas. Further, if pilot channel excavation in brackish or salt marsh habitat is conducted during the breeding season (February 1 – August 31), surveys for California clapper rails will be conducted prior to proposed project activities to determine whether nesting California clapper rails are present in the vicinity. If California clapper rails are detected, buffers between rail activity centers and construction will be followed. During any construction or excavation activities that may result in effects to California clapper rails, the limits of work will be clearly delineated to limit effects to this species. These conservation measures will minimize effects of human activity within marshes on California clapper rails.

Disturbance such as loud noise or the presence and movement of people and heavy equipment in or near California clapper rail habitat may alter bird behavior in ways that result in altered foraging or sheltering behavior and reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to California clapper rail avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or flushing from cover, or altered activity patterns, that reduce energy reserves and increase predation risk. The potential for disturbing breeding California clapper rails will be avoided by delaying construction activities within suitable California clapper rail breeding habitat until after the breeding season unless protocol-level surveys determine California clapper rails are absent from a 700-foot-buffer around the proposed work area. The level of disturbance of California clapper rails will also be minimized by having a Service-approved biological monitor supervise the work.

Loss of individual California clapper rails due to predation could be exacerbated by the proposed project. The restoration of tidal marsh habitat will increase habitat for northern harriers, which may

prey on California clapper rails (especially chicks). However, because habitat for northern harriers is suitable for California clapper rails as well, the increase in California clapper rail populations due to habitat restoration in a given area is expected to outpace any adverse effects of predation by northern harriers. Local increases in predation on California clapper rails may occur due to marsh restoration in close proximity to areas frequented by California gulls, such as the Newby Island Landfill, Pond A16, and New Chicago Marsh; electrical towers within Pond A18 that provide known nesting sites for common ravens and red-tailed hawks, and perches for peregrine falcons; and upland areas providing sources of predators such as cats, rats, foxes, raccoons, white-tailed kites, and American crows. Although terrestrial pathways used by mammalian predators to access marshes will be reduced through the breaching of levees in some areas, marshes that abut upland areas will be subject to predation by land-based predators. In addition, rock at the bridge abutments and surrounding electrical towers in Pond A18 may provide refugia for rats that may prey on California clapper rail eggs. The risk of predation on California clapper rails will be reduced by the implementation of a Service-approved long-term predator management and litter cleanup program under a cooperative agreement among the SCVWD, the Refuge, and the City of San Jose that will be funded by the SCVWD.

Maintenance activities along the FRM levee have the potential to disturb California clapper rails in Ponds A12, A13, and A18 after tidal restoration has occurred and rail habitat has developed within those former ponds. Recreational use of the Bay Trail segment atop the levee will affect California clapper rails in adjacent areas to the point that rails present in those restored marshes during levee maintenance activities will already be habituated to some level of human activity on the levee. In addition, the 345-foot wide ecotones will limit the potential for levee maintenance activities to adversely affect California clapper rails. As a result, routine inspections and minor maintenance activities are not expected to result in an increase in California clapper rail disturbance, relative to other types of levee use. Even mowing along the levee tops is unlikely to cause substantial disturbance of California clapper rails given the very narrow swaths to be mown, the brevity of mowing operations, and the distance (330 feet or more) between mowing and California clapper rail habitat. However, maintenance activities involving heavy equipment would be conducted outside of the California clapper rail's nesting season to the extent practicable, and if seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting California clapper rails, and appropriate buffers would be implemented between proposed project activities and nesting rails as necessary.

Salt Marsh Harvest Mouse

Construction of the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge will result in fill of vegetated areas that could potentially support small numbers of salt marsh harvest mice. Excavation of pilot channels in the outboard marsh around Pond A18 will also result in removal of brackish marsh that could potentially support low densities of salt marsh harvest mice. Although the number of individual salt marsh harvest mice that may be present in habitat to be impacted by levee construction and pilot channel excavation is low, individual salt marsh harvest mice could potentially be injured or killed by crushing or smothering during the placement of sediment or other materials in suitable habitat, or by excavation of habitat. Conservation measures such as hand-removal of vegetation in potential salt marsh harvest mouse habitat under the supervision of a Service-approved biologist, measures to ensure that salt marsh harvest mice leave

areas prior to impacts, and salt marsh harvest mouse exclusion fencing will be implemented to minimize the potential for injury and mortality of individual salt marsh harvest mice.

Disturbance such as loud noise or the presence and movement of people and heavy equipment in or near salt marsh harvest mouse habitat may alter mouse behavior in ways that result in alteration of foraging and sheltering activities or reduced breeding success. Disturbance may result in displacement of salt marsh harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of salt marsh harvest mice from their territory/home range in the areas where their habitat is destroyed. Displaced salt marsh harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance of female salt marsh harvest mice, particularly during the period of March through November, may cause abandonment or failure of the current litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Noise from construction activities associated with the FRM levee, Artesian Slough tide gate, and Artesian Slough pedestrian bridge close to suitable salt marsh harvest mouse habitat may alter mouse breeding, foraging, and sheltering behavior. Salt marsh harvest mice may be similarly disturbed during excavation of pilot channels, preparation of ponds for breaching (*e.g.*, construction of ditch blocks), and access of construction areas by heavy equipment along existing levee roads.

Loss of individual salt marsh harvest mice due to predation could be exacerbated by the proposed project, at least in localized areas, as described for California clapper rail. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation.

Vegetation management along the levees has some potential to result in the injury or mortality of individual salt marsh harvest mice and the disturbance of foraging, sheltering, and dispersal activities. However, the potential for take and number of individuals that could be taken is very low, for several reasons. First, the strip of vegetation that will be mowed along the levee top will be very narrow (expected to be 15 feet or less). Only ruderal grassland foraging/dispersal habitat and no suitable pickleweed breeding habitat will be mowed; therefore, the potential for disturbing breeding salt marsh harvest mice or a salt marsh harvest mouse nest will be avoided because breeding mice will not be present in these areas. Mowing from the levee top downslope will result in slight disturbance of downslope areas that might encourage salt marsh harvest mice to move downslope, away from the mowing activity. In addition, vegetation along the levee top is not expected to be particularly dense, especially in comparison to vegetation lower on the levee/ecotone slopes. As a result, it is possible that salt marsh harvest mice will make little use, if any, of the vegetation that needs to be mown. Maintenance such as mowing in or adjacent to salt marsh harvest mouse habitat will also be avoided during extreme high tides when salt marsh harvest mouse are most likely to approach the levee top to escape the flooding marsh. If trapping of California ground squirrels is necessary to control burrows within the levees, live traps with openings large enough to allow salt marsh harvest mice to exit the traps will be used.

Disturbance of salt marsh harvest mice from recreational trail use may occur, due to the expected occurrence of salt marsh harvest mice in ecotones and vegetated lower levee slopes and in the salt marsh harvest mouse habitat adjacent to lower Coyote Creek, where the levee trail connection to the

existing Bay Trail segment will be provided. However, such disturbance will be minimized by the physical separation of the bare-topped trail and the vegetated slopes where salt marsh harvest mice may occur. Trail use may also result in indirect effects, such as increased trash (which may attract predators) and increased invasive plants, which may adversely affect habitat quality. Predator management and invasive plant species control implemented along the trails will minimize these adverse effects.

Effects of Service-led Actions

California Clapper Rail

Excavation of pilot channels in the outboard marsh around Ponds A9-A15 has the potential to affect individual California clapper rails, including nests, eggs, and young, directly. Such effects are most likely along the pilot channel excavation area near the northeast corner of Pond A9, which provides suitable nesting habitat for California clapper rails. As noted above, the probability of nesting California clapper rails is low in the brackish marsh and narrow areas of salt marsh where breaches and pilot channels are proposed along Alviso Slough.

As mentioned previously, prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If California clapper rail habitat has developed within Pond A12 by that time, there is some potential for effects to individuals or nests due to breaching. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal action in Ponds A13-A15, potentially resulting in effects to individual California clapper rails.

If pilot channel excavation in brackish or salt marsh habitat, or breaching of berms for Phases 2 and 3 near suitable California clapper rail habitat, is conducted during the breeding season, protocol-level surveys for California clapper rails will be conducted prior to proposed project activities to determine whether nesting rails are present in the vicinity. If any California clapper rails are detected, 700-foot buffers between rail activity centers and construction will be followed. During any construction or excavation activities that may result in effects to California clapper rails, the limits of work will be clearly delineated to limit effects to this species. These conservation measures will minimize effects of human activity within marshes on California clapper rails.

As noted previously, tidal restoration will result in an increase in the abundance of marsh-associated predators such as northern harriers. However, mammalian predators will have less access to these restored marshes due to the breaching of levees and the presence of Alviso and Coyote sloughs on two sides of the A9-A15 complex. Further, because no high-tension powerlines run through these ponds, perch sites for most predatory raptors will be limited.

A large colony of California gulls nests on the interior berms separating Ponds A9, A10, and A14. Tidal restoration would result in the intentional lowering of these berms or eventual erosion of these berms through tidal action, thus causing these gulls to move elsewhere to nest. These displaced gulls may select nesting sites in close proximity to California clapper rail habitat elsewhere. The displacement of gulls from areas of lower quality California clapper rail habitat to areas of higher quality habitat could result in increased predation pressure by gulls on the rail. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation.

Monitoring, research, and predator management efforts involving people walking through tidal marshes or boats grounding on marshes could result in effects to individual California clapper rails. Adult California clapper rails are unlikely to be injured or killed during such activities, as they are expected to flee an area subject to such activities before injury or mortality occurs. However, these activities could destroy or damage California clapper rail nests or eggs, or result in the injury or mortality of less mobile young California clapper rails. Such activities are expected to be very localized, and implementation of conservation measures (such as minimizing such activities during the California clapper rail's breeding season) will minimize the potential for such effects.

Following complete restoration of Ponds A9-A15, the extent of trails at these ponds will be limited to a trail along the eastern edges of Ponds A12, A13, and A15, with shorter spurs in three areas. Observation platforms would be constructed at the ends of these spurs. Human activity use may increase in areas where trails and observation platforms are to be opened or improved. Use of the trail along the new FRM levee is likely to increase once this levee is connected to other Bay Trail segments at its northeast end, but the removal of a loop trail in the A9-A15 complex may tend to reduce trail use. Management of potential disturbances in adjacent habitat areas from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails.

Increased recreational trail use in areas where existing trails occur adjacent to California clapper rail habitat could result in the flushing of California clapper rails at high tides, increasing predation risk. No new trails are proposed to be opened adjacent to existing California clapper rail habitat, but rails that colonize the restored tidal marshes in Ponds A12, A13, A15, and A18 would be subjected to human disturbance from trail users. The breadth of the ecotone (345 feet) will limit disturbance of California clapper rails by people using the new FRM levee along eastern Pond A12 and southern Pond A18, as humans on the top of the levee will be far removed from suitable rail habitat. People using the spur trails and the levee trail along the southern Pond A12 levee, the Pond A12/A13 levee, and the northern Pond A15 levee will be closer to California clapper rail habitat, however, due to the absence of a constructed ecotone.

Interpretive signage will be installed at the edges of sensitive California clapper rail habitat areas discouraging human entry into those areas. If monitoring indicates that disturbance of California clapper rails by humans is adversely affecting rail populations, seasonal closures of portions of these trails would be considered as an adaptive management measure.

Salt Marsh Harvest Mouse

Excavation of pilot channels in the outboard marsh around Ponds A9-A15 has the potential to injure or kill salt marsh harvest mice by crushing or smothering them during the placement of sediment or other materials in suitable habitat, or by excavation of habitat. Such effects are most likely along the pilot channel excavation area near the northeast corner of Pond A9, which provides the highest-quality habitat for this species of all the breach locations. Abundance of salt marsh harvest mice is low in the brackish marsh and narrow areas of salt marsh where breaches and pilot channels are proposed along Alviso Slough. As mentioned previously, prior to or concurrent with restoration of tidal action in Ponds A9, A10, and A11, the berm between Ponds A11 and A12 will be breached. If salt marsh harvest mouse habitat has developed within Pond A12 by that time, there is some potential for effects to individuals due to breaching. Similarly, berms between A14 and A9/A11, and between A13 and A12, will be breached prior to or concurrent with restoration of tidal

action in Ponds A13-A15, potentially resulting in effects to salt marsh harvest mice. Conservation measures will be implemented to minimize the potential for impacts to individual salt marsh harvest mice.

Disturbance of salt marsh harvest mice from pilot channel excavation, ditch block construction, breaching of berms prior to second or third phase breaching, and equipment access for these restoration-related activities would be similar to that described above. Disturbance of salt marsh harvest mice from recreational trail use would be similar to that described for California clapper rail above.

As described for California clapper rail, loss of individual salt marsh harvest mice due to predation could be exacerbated by the proposed project, at least in localized areas, and displacement of the California gull colony from the interior berms separating Ponds A9, A10, and A14 could cause these gulls to relocate in areas where they may be more likely to prey on salt marsh harvest mice.

Monitoring, research, and predator management efforts involving people walking through tidal marshes or boats grounding on marshes could also result in injury or mortality of salt marsh harvest mice or disturbance of breeding, foraging, and sheltering activities. Such activities are expected to be very localized. Effects to salt marsh harvest mice resulting from monitoring, research, and predator management on the Refuge will be covered by the existing biological opinion for the SBSPRP and a future biological opinion for the Refuge's Comprehensive Conservation Plan. Effects to salt marsh harvest mice resulting from perennial pepperweed control are discussed below under the "Perennial Pepperweed Control" section.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

It is well known that the Guadalupe River system, including Alviso Slough, has a relatively high concentration of mercury resulting from sediments washed from historical mercury mines in the upper watershed. Recent testing in Artesian Slough has revealed high mercury concentrations there as well, with total mercury being lower but methylmercury, the bioavailable form, being higher in Artesian Slough than Alviso Slough (City of San Jose 2013). Such mercury may be mobilized when pilot channels are excavated in outboard marshes along Artesian Slough prior to breaching, and the tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Artesian Slough, could mobilize mercury-laden sediment from the slough.

Although the abundance of California clapper rails in the immediate vicinity of Artesian Slough is currently very low, mercury could be mobilized downstream into and along Coyote Slough. Mercury accumulation in eggs is known to affect California clapper rails in the Bay Estuary, with the South Bay containing the highest mercury levels. Although intake is generally not acute enough to result in lethal toxosis of adults or young, mercury is extremely toxic to embryos and thus results in low levels of egg viability, and reduced California clapper rail fecundity. Schwarzbach *et al.* (2006) found high mercury levels and low hatching success (due both to predation and, presumably, mercury) in California clapper rail eggs throughout the Bay. They also suggested that mercury exposure could slow or stunt development of young, possibly increasing predation risk. Mercury exposure has been also linked to reduced body condition in California clapper rails (Ackerman *et al.* 2011), suggesting there are potential detrimental effects on survivorship of adult birds as well. Mean

mercury concentrations in captured California clapper rail blood samples were 0.56 micrograms/ gram (µg/g; or parts per million), 9.87 µg/g in head feathers, and 9.04 µg/g in breast feathers (Ackerman *et al.* 2011). Birds with mercury concentrations in blood over 1.0 µg/g and 9.0 µg/g in feathers are considered at risk for impaired reproduction (Evers *et al.* 2004, Burger and Gochfeld 1997), and several individuals captured in that study had mercury levels above those thresholds. The mercury concentrations in both head and breast feathers in the Ackerman study suggest that rails were exposed to mercury over long periods of time, as those two feather tracts are grown in different stages of molt. This suggests that mercury exposure was chronic and accumulated over time.

Mercury is taken in by California clapper rails primarily through contaminated prey in the form of methylmercury. Methylmercury, unlike elemental mercury, is bioavailable in that it readily binds to living tissue and accumulates in aquatic food webs. For instance, in failed-to-hatch California clapper rail eggs in the Schwarzbach *et al.* (2006) study, methylmercury accounted for 95 percent of total mercury in those eggs, and this ratio of elemental to methylmercury has been found in previous studies as well (see Ackerman *et al.* 2011). In addition to reproductive failure, studies have shown that captive egrets fed doses of 0.5 milligrams of methylmercury were less motivated to hunt food, and had a reduced appetite (Bouton *et al.* 1999, Spalding *et al.* 2000). These effects may be related to reduced body condition, which could ultimately lower survivorship.

Inorganic mercury tends to be converted to methylmercury, primarily under somewhat anoxic conditions (Marvin-DiPasquale *et al.* 2003). California clapper rails are currently exposed to methylmercury when foraging on mudflats and in sloughs with high levels of mercury contamination. The proposed project has the potential to increase the exposure of California clapper rails to mercury by stirring up sediments during vegetation removal and dredging activities. Methylmercury may also be mobilized by the frequent wetting and drying of mercury-contaminated sediments during construction activities. Mercury-contaminated sediments that are currently buried too deep to adversely affect California clapper rails and other species could be mobilized by these activities, thus entering the food chain. The extent to which excavation of pilot channels and scour of sediments in Artesian Slough will release mercury such that it may be more bioavailable to California clapper rails, and to which any increased level of bioavailable mercury affects California clapper rails, is difficult to quantify.

Compared to a managed pond environment, mercury deposited in well-oxygenated marsh plains is not expected to methylate as readily (Grenier *et al.* 2010). Also, it is likely that there will be a relatively low temporal exposure after breaching occurs for mercury to circulate in the slough or restored ponds, methylate, and be incorporated into the food web. Therefore, if there is an increase in methylmercury, it will likely occur for only a short duration. Preliminary data collected for SBSPRP mercury monitoring suggest this is the case. Mercury levels in fish collected in Alviso Slough increased after the Pond A8 notch was opened in June 2011 but had already decreased by October 2011 (SBSPRP 2013). The increase in mercury levels was more pronounced around the notch than at downstream sampling locations, suggesting the effect was localized. Therefore, the loss of individual California clapper rails or reduction in reproductive success of rails is not expected to occur as a result of increased mercury exposure associated with the proposed project.

The effects of mercury on salt marsh harvest mice are largely unknown. However, this species is likely exposed to methylmercury through the tidal marsh food web and mercury concentrations in tidal marshes. Although Artesian Slough methylmercury concentrations are high, tidal marshes

show no evidence of increased bioaccumulation of mercury compared to other South Bay tidal marshes, possibly due to a paucity of organic material in the sediment (Grenier *et al.* 2010). For example, resident songbirds captured in tidal marshes in Alviso Slough showed similar bioaccumulation of mercury as other South Bay marshes (Grenier *et al.* 2010). Because increases in mercury availability are expected to be short-term, as described for the California clapper rail, the potential for increased salt marsh harvest mouse exposure to mercury is relatively low. Therefore, salt marsh harvest mice are not expected to be affected by an increase in mercury exposure related to pilot channel excavation and sediment scour.

Effects of Service-led Actions

Because of the mercury contamination of the Guadalupe River from the New Almaden mine, some of the sediment in Alviso Slough may contain high concentrations of mercury. Such mercury may be mobilized when pilot channels are excavated in outboard marshes along Alviso Slough prior to breaching, and the tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Alviso Slough, could mobilize mercury-laden sediment from Alviso Slough and Ponds A9-A15. Effects of this mercury mobilization on California clapper rails would be as described above for Corps-led activities. The effects of mercury mobilization on salt marsh harvest mice from Service-led activities are expected to be relatively low similar to those described above for Corps-led activities.

Perennial Pepperweed Control

Effects of Corps-led and Service-led Actions

Potential effects on California clapper rail and salt marsh harvest mouse foraging and nesting due to perennial pepperweed control could result from habitat alterations (*e.g.*, native plant mortality) and marsh access through California clapper rail and salt marsh harvest mouse habitat for treatment/ eradication, monitoring, or re-vegetation activities. Ground based spraying via foot or ARGOs and post-treatment monitoring requires access through the marsh and may result in vegetation trampling or salt marsh harvest mouse nest disturbance. Use of ARGOs for control will cause temporary disturbance of marsh vegetation. All treatment crew members will be supervised by a qualified biologist and will be trained to follow the guidelines presented in the "Walking In the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife & Plants" protocol (Appendix A), thereby minimizing disturbance of California clapper rails, salt marsh harvest mice, and their habitats.

Disturbance of the marsh by field crews on-foot will be minimal because crews will be traversing through the marsh only once or twice per year to conduct treatment and monitoring, trails will not be established through the marsh, and no residual effects on marsh habitat quality are anticipated. Field crews will not crush any salt marsh harvest mice or their nests because they will be supervised by a qualified biologist and will avoid walking on high pickleweed vegetation and on wrack, where salt marsh harvest mice are likely to forage or nest. In addition, since crews will be walking slowly, any salt marsh harvest mice present will be able to move out of the immediate area. Due to the minimal amount of habitat disturbance caused by field crews and avoidance of direct impacts to salt marsh harvest mice, access of marshes by field crews on-foot for perennial pepperweed control will avoid the injury and mortality of salt marsh harvest mice and minimize the level of disturbance.

Field crews accessing the marsh via ARGOs for perennial pepperweed control may result in the temporary disturbance of marsh vegetation (habitat degradation) or crushing of individual salt marsh harvest mice or their nests beneath the ARGOs. These vehicles are designed to operate with low ground pressure (about 0.67 pounds per square inch) and distribute weight on specialized tracks. ARGOs exert a ground pressure approximately five times less than that of humans; however, a greater area of marsh vegetation would be disturbed by fields crews on ARGOs than on-foot.

ARGOs may crush and cause dieback of marsh vegetation, particularly sub-shrubby vegetation with brittle stems, such as pickleweed, the primary habitat of the salt marsh harvest mouse. Due to this identified impact, the quantity of suitable California clapper rail and salt marsh harvest mouse habitat directly affected by ARGOs is calculated by the distance within tidal marsh they will be driven to access and treat perennial pepperweed patches. There is a five-foot wide "track impact" from an ARGO traveling through the marsh. This impact would consist of temporary compaction or crushing of pickleweed and other marsh plants, with the vegetation expected to recover fully within a few months of impact. The travel path of ARGOs will be planned to minimize the amount of impact to California clapper rail and salt marsh harvest mouse habitat by traveling in mudflats whenever feasible.

The only perennial pepperweed control action that may temporarily disturb nesting California clapper rails is a portion of the marsh access for eradication activities. Backpack spraying will be used to treat perennial pepperweed within "700-ft Buffer Areas", and disturbance will be localized and very temporary (usually less than 30 minutes). California clapper rails may be harassed by treatment access within "700-ft Buffer Areas" where there is greater than one acre of infested perennial pepperweed and where treatment is likely to exceed 30 minutes. Boat-mounted spraying will be used to treat relatively larger clones along slough edges and may result in a larger scale disturbance (noise), but little immediate habitat destruction. ARGOs will not be used in "700-ft Buffer Areas" for California clapper rails. It is expected that control activities in areas with large acreages targeted for control will result in relatively more disturbance than in those areas with small acreages, given similar California clapper rail densities.

Any ARGOs used in control activities will stay 700 feet from known California clapper rail calling centers and will stay at least 50 feet from channel edges, thereby avoiding rail nest destruction or rail disturbance. However, if the intervening distance across a major slough channel or across a substantial physical barrier between the California clapper rail calling center and the proposed access area is greater than 200 feet, then access may proceed within the breeding season.

Areas where California clapper rails have been detected contain channels and low marsh vegetation used for mating, foraging, and nesting. The majority of perennial pepperweed patches occur in the transition zone and along channel edges dominated by gumplant. Perennial pepperweed patches also occur adjacent to *Spartina foliosa* patches of low marsh tidal deposition areas (wrack lines). Sensitive eradication areas include channel edges and areas where low marsh (*S. foliosa*-dominated) interfaces the pickleweed plain. Herbicide applications are not expected to cause direct mortality of *S. foliosa* and other native plant species if conservation measures are implemented to reduce herbicide spray drift and subsequent mortality of non-target plants. The eradication of perennial pepperweed is not likely to harm California clapper rails as a result of habitat loss because: (1) California clapper rails are not known to use perennial pepperweed as a habitat component, and (2) conservation measures will be implemented that avoid non-target plant eradication.

The herbicides, adjuvants, and dyes proposed for eradication of perennial pepperweed within the action area are also being used to eradicate invasive *Spartina* species in other parts of the Bay Estuary. The herbicides proposed were determined not to have any direct toxic effects to California clapper rails (California State Coastal Conservancy and Service 2003, California State Coastal Conservancy 2005). Direct toxicity of herbicide, surfactant, and colorant applications is unlikely to have significant toxic effects to California clapper rails since herbicides are directed to the upper portion of the plant and dry quickly on the plant leaf surface (usually within a few minutes of application), and exposure of rails to spray solutions would be very temporary. Even if California clapper rails are exposed to small amounts of spray solutions, they will not be injured since these chemicals are considered practically non-toxic to birds (California State Coastal Conservancy and Service 2003). The chemical treatment of perennial pepperweed will reduce expansion and formation of perennial pepperweed monocultures which alter soil conditions and crowd out native plant species used by California clapper rails for nesting and sheltering.

Salt marsh harvest mice are unlikely to come into contact with spray solutions applied to perennial pepperweed since the mice primarily inhabit pickleweed and other high marsh vegetation not targeted for control. Even if salt marsh harvest mice are exposed to small amounts of imazapyr, glyphosate, surfactants, or colorants used in the spray solutions, they would not likely be harmed since these chemicals are considered non-toxic to mammals (California State Coastal Conservancy and Service 2003, California State Coastal Conservancy 2005).

California clapper rails and salt marsh harvest mice will not lose habitat when perennial pepperweed is removed, since the rail and the mouse are not known to utilize perennial pepperweed. Removal of invasive perennial pepperweed and revegetation of the marsh-upland transition zone will provide high quality high tide refugia, a critical component of the habitat for the California clapper rail and salt marsh harvest mouse. Non-native perennial pepperweed threatens the transition zone refugia and tidal marsh habitat for the California clapper rail and salt marsh harvest mouse. Perennial pepperweed displaces higher quality tidal marsh vegetation including marsh gumplant and pickleweed. Perennial pepperweed also provides poor quality high tide refugia cover for the California clapper rail and salt marsh harvest mouse because it is leafless in the winter when the rail and the mouse are in most need of suitable upland cover during the frequent winter extreme high tide and storm events. Without suitable cover, the California clapper rail and salt marsh harvest mouse are vulnerable to predation during extreme high tide events. Therefore, perennial pepperweed control will provide a long-term benefit to the California clapper rail and salt marsh harvest mouse.

Revegetation will occur within the transition zone. Revegetation is not expected to disturb breeding California clapper rails because this activity will occur outside of the rail's breeding season. The transition zone is used by California clapper rails and salt marsh harvest mice primarily during extreme high tide events; therefore, restricting revegetation of the transition zone to low tides will minimize the potential for disturbing any California clapper rails and salt marsh harvest mice. The restoration of native plants within the transition zone will provide California clapper rails and salt marsh harvest mice with high quality high tide refugia, a critical component of population recovery for the rails and the mice.

Pacific Coast Population of the Western Snowy Plover

Loss of Habitat

Effects of Corps-led Actions

Western snowy plovers are not known or expected to nest or forage along the WPCP segment of the FRM levee or in or around Pond A18 under current conditions. As a result, construction and restoration east of Artesian Slough will not result in a net loss of western snowy plover habitat. However, prior to breaching, Pond A18 may be drawn down to facilitate within-pond preparations such as construction of ditch blocks. When Ponds A16 and A17 were drawn down prior to SBSPRP Phase I activities, western snowy plovers used the dried-out pond bottoms for nesting. If Pond A18 is drawn down prior to breaching, then the dried-out pond bottom is likely to attract nesting western snowy plovers. As a result, breaching will flood this temporarily created western snowy plover habitat.

Aside from impacts to temporarily created habitat if Pond A18 is drawn down, construction of the FRM levee will not directly affect any suitable nesting habitat for the western snowy plover. Although this species has nested in the Alviso impoundment, in Ponds A12, A13, and A16, and in New Chicago Marsh, portions of which will be directly impacted by levee construction, the western snowy plover does not nest near the existing non-engineered levees that occur within the proposed construction footprint. Rather, western snowy plovers nest farther from levees, apparently due to the disturbance associated with human use of the levees, use of levees by predatory mammals, and the species' inability to see over levees (and thus detect approaching predators) if the nest is placed too close to the levee. Thus, even under existing conditions, there is a zone close to the levees that has not been used for nesting by western snowy plovers.

However, for these same reasons, FRM levee construction could result in indirect effects to western snowy plovers by causing plovers to avoid using habitat that is otherwise suitable. The ultimate height of the FRM levee is expected to be approximately 10 feet higher than the existing levee on the south side of Pond A16, and the very low levee along the eastern side of A12 is likely to be raised even more, relative to its existing height. The levees may initially be built even higher, as some subsidence is expected over time as materials settle. As a result, the FRM levee will be substantially taller and wider than the existing levees. Western snowy plovers are unlikely to nest very close to the levee for the reasons discussed above, especially when the Bay Trail is developed atop the levee and human activity is even greater than it currently is. As a result, the zone near levees that western snowy plovers avoid for nesting would shift farther from the levee.

The extent of this indirect effect (*i.e.*, the amount of otherwise suitable nesting habitat that will no longer be used by nesting western snowy plovers) is unknown. Western snowy plovers nesting in New Chicago Marsh, on islands in Pond A16, and in Ponds A12 and A13 tend to nest well away from the Pond A16 levee. As a result, it is possible that they nest so far from the levee already that an increase in height of, and human activity along, the levee would have no effect on the plovers' perception of suitable habitat availability. In addition, tidal restoration in Ponds A12 and A13 would make those ponds completely unsuitable for use by nesting western snowy plovers. However, it is possible that increasing the height of the levee would cause plovers to retreat even farther from the levee. It is unknown whether western snowy plovers would continue to nest in the Alviso impoundment after FRM levee construction, and it is possible that plovers might view the entire

impoundment as being no longer suitable due to the taller, wider levee. Use of this impoundment by nesting western snowy plovers has been sporadic (*i.e.*, less than annual), and usually by only a single pair when it is used at all.

Although the number of pairs of western snowy plovers that may no longer nest in the vicinity of the action area as a result of raising the height of the levee is unknown, it is likely that no more than one or two pairs would be affected because areas near the action area levees have been inconsistently used by few plovers in the past. The proposed project will implement compensatory conservation measures by distributing pea gravel or other appropriate substrate on an island in Pond A16, maintaining this island for use by nesting western snowy plovers, and increasing the intensity of predator management in the vicinity. Gravel may make it more difficult for predators such as California gulls and northern harriers to detect western snowy plovers due to camouflage (*e.g.*, plovers may be difficult to distinguish within the gravel from a distance) and increased topographic relief associated with the gravel and footprints left by people distributing the gravel. As a result, predation rates on both western snowy plover eggs and chicks are likely to be lower in areas with such gravel, and more plovers may be attracted to nest in areas with gravel. Providing gravel on an island in Pond A16 is expected to increase western snowy plover nesting abundance, and possibly nesting success, thus compensating for the adverse effects of other proposed project activities on nesting western snowy plovers. These measures are expected to minimize any adverse effects of Corps-led actions on the availability of suitable western snowy plover habitat, or western snowy plover abundance or productivity.

Expansion of the FRM levee into pond, seasonal wetland, and muted tidal/diked marsh habitat will result in filling of ostensibly suitable foraging habitat and, as discussed above, the possible avoidance of foraging habitat that is otherwise suitable but would be too close to the levee following construction. However, western snowy plovers are very rarely seen foraging close to the eastern edges of Ponds A12 and A13, the southern edge of Pond A16, or the northern edge of New Chicago Marsh. As a result, effects of levee construction on western snowy plover foraging habitat are likely limited to reduced use of the Alviso impoundment. As foraging habitat in the vicinity is not likely limiting western snowy plover populations (based on the expanses of suitable foraging habitat present in managed ponds and New Chicago Marsh that is unoccupied at any given time, as well as the abundance of prey in these area), the effects of Corps-led actions on western snowy plover foraging habitat are unlikely to have a substantive effect on western snowy plover populations.

Effects of Service-led Actions

Service-led tidal restoration will result in the loss of all western snowy plover nesting habitat in Ponds A9-A15, as western snowy plovers do not nest in tidal habitats. Further, because this species forages infrequently on tidal mudflats, western snowy plovers are expected to make little use of Ponds A9-A15, even for foraging, once they are restored to tidal action. Based on data from 2012, when five of 13 nests in the proposed project vicinity were in Pond A13 (Donehower *et al.* 2012), and 2013, when two of 10 nests in the proposed project vicinity were in Pond A9 (Robinson-Nilsen *et al.* 2013), up to five pairs of western snowy plovers may be displaced by tidal restoration. Because restoration will be phased, some western snowy plover nesting habitat is expected to be present in Ponds A9-A15 until 2030, when the last of these ponds may be breached.

As discussed previously, the MAM for the SBSPRP will help to achieve the goal of supporting at least 250 individual breeding western snowy plovers in the SBSPRP area, which is half of the number of breeding western snowy plovers required within the San Francisco Bay Recovery Unit for delisting (Service 2007). The SBSPRP will implement adaptive management measures, such as more intensive management of certain ponds for western snowy plovers, as necessary to achieve that goal. The MAM associated with the SBSPRP would therefore assist in compensating for impacts to western snowy plovers from loss of nesting habitat in Ponds A9-A15 by helping to manage for plovers in other SBSPRP ponds. Because some western snowy plover nesting habitat will remain in the Ponds A9-A15 complex until 2030, there is ample time for the MAM associated with the SBSPRP to determine how to increase western snowy plover densities elsewhere prior to complete loss of plover nesting habitat from Ponds A9-A15. As described in previous sections, if the MAM indicates impacts to waterbirds (including western snowy plovers) are too severe, then fewer ponds will be restored to tidal action.

Development of a Bay Trail segment on the FRM levee, which is a Service-led activity, will increase recreational use of the levee top. This will contribute to disturbance of western snowy plovers nesting in adjacent areas, leading to an effective loss of habitat use. Research shows that nesting western snowy plovers within the South Bay are very sensitive to disturbance by recreational trail users and construction activities within 600 feet of their nests (Robinson 2008, San Francisco Bay Bird Observatory and Service 2010).

Direct Effects to Individuals

Effects of Corps-led Actions

As described for California clapper rail above, disturbance such as loud noise or the presence and movement of people, and heavy equipment near western snowy plover habitat may alter bird behavior in ways that result in injury, mortality, or reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to western snowy plover avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or flushing, or altered activity patterns, that reduce energy reserves and increase predation risk. Construction of the Alviso Segment of the FRM levee near western snowy plover habitat in Ponds A12 and A13, the Alviso impoundment, New Chicago Marsh, and A16 could result in disturbance of nesting and foraging plovers in those areas. However, moderate to fairly heavy human use already exists along the levees adjacent to western snowy plover habitat in the proposed project area. Numerous pedestrians and cyclists use the levees around the Ponds A9-A15 complex, between Ponds A15 and A13/A14, and between A16 and New Chicago Marsh on a daily basis. As a result, the western snowy plovers that use habitat adjacent to these levees (a) tend to avoid areas close to the levees used by humans, and (b) are already habituated to the use of humans along those levees. This reduces the extent to which western snowy plovers will be disturbed by levee construction and use of the levees by humans following levee completion.

Nevertheless, to minimize such impacts, work in and adjacent to potential western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, surveys before and during construction would be conducted for nesting western snowy plovers, and appropriate buffers (*i.e.*, 600 feet during construction activities) would be implemented between proposed project activities and nesting western snowy plovers.

Because western snowy plovers are not known or expected to nest very close to the existing levees, no western snowy plover nests or eggs would be located within the footprint of FRM levee construction. If nesting has occurred in areas adjacent to the levees, such as the Alviso impoundment, it is possible that young western snowy plovers could move into the construction footprint. However, if nesting occurs in the construction zone, then a Service-approved biologist will need to clear the area before construction can continue.

If Pond A18 is drawn down prior to breaching, as described previously, then breeding western snowy plovers could be nesting in the pond when construction of ditch blocks and breaching occurs. While adult breeding western snowy plovers would not be injured or killed by restoration-related construction activities or breaching, as they would flee the vicinity of any such activities, their nests, eggs, or young could be crushed, trampled, buried, or lost to flooding as a result of displacement of sediment into nesting habitat during construction of ditch blocks, or levee breaching and flooding of occupied habitat. For example, in 2010, two western snowy plovers nests at Ravenswood Pond SF2 were depredated when construction crews for the SBSPRP were working within 600 feet of the nests (San Francisco Bay Bird Observatory and Service 2010). Therefore, there is the potential for construction activities within 600 feet of a western snowy plover nest to flush the western snowy plover from its nest exposing the nest to depredation. To minimize such impacts, work in and adjacent to potential breeding western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, surveys prior to and during construction would be conducted for nesting breeding western snowy plovers, and appropriate buffers (*i.e.*, 600 feet during construction activities) would be implemented between proposed project activities and nesting western snowy plovers.

Loss of individual western snowy plovers (including eggs and chicks) due to predation could be exacerbated by the proposed project, at least in localized areas. The restoration of tidal marsh habitat will increase habitat for northern harriers, which are known to prey on western snowy plovers. Compensatory mitigation involving an increase in predator management in the New Chicago Marsh/A16 vicinity will reduce any increase in predation resulting from increased northern harrier populations from Corps-led activities.

Maintenance activities along the FRM levee have the potential to disturb nesting and foraging western snowy plovers as well. Recreational use of the Bay Trail segment atop the levee will affect western snowy plovers in adjacent areas to the point that plovers present in areas such as Pond A16 or New Chicago Marsh during levee maintenance activities will already be habituated to some level of human activity on the levee. As a result, routine inspections and minor maintenance activities are not expected to result in an increase in western snowy plover disturbance, relative to other types of levee use. Even mowing along the levee tops is unlikely to cause substantial disturbance of western snowy plovers given the very narrow swaths to be mowed, the brevity of mowing operations, and the distance (330 feet or more) between mowing and western snowy plover habitat. Other maintenance activities involving heavy equipment would be conducted outside of the nesting season to the extent practicable, and if seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting western snowy plovers, and appropriate buffers would be implemented between proposed project activities and nesting western snowy plovers as necessary.
Even with the implementation of conservation measures to minimize disturbance of nesting western snowy plovers, snowy plovers that disperse away from disturbance may not successfully establish new breeding territories and breed. Plovers forced to disperse would need to either maintain existing pair bonds or develop new pair bonds and establish new breeding territories in other

suitable habitat areas. Disturbance that occurs during the non-breeding season could also result in injury, mortality, or the disturbance of western snowy plover foraging and sheltering activities. Displaced individuals could be subjected to injury or mortality from starvation, physiological stress, and increased predation.

Effects of Service-led Actions

Disturbance of western snowy plovers using Ponds A9-A15 may occur due to pilot channel excavation, ditch block construction, and equipment access for these restoration-related activities. The effects of such disturbance would be similar to that described above.

If drawdown of Ponds A9-A15 occurs to facilitate within-pond preparations, western snowy plovers are expected to nest in at least some of these ponds. While adult western snowy plovers would not be injured or killed by restoration-related construction activities, as they would flee the vicinity of any such activities, their nests, eggs, or young could be crushed, trampled, buried, or lost to flooding as a result of displacement of sediment into nesting habitat during berm lowering or construction of ditch blocks, or levee breaching and flooding of occupied habitat. To minimize such impacts, work in and adjacent to potential western snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-and during construction surveys would be conducted for nesting western snowy plovers, and appropriate buffers would be implemented between proposed project activities and nesting western snowy plovers.

As described for California clapper rail above, loss of individual western snowy plovers, eggs, and young may increase as a result of predation. An increase in tidal marsh habitat will result in an increase in northern harrier populations, and displacement of the California gull colony on the interior berms separating Ponds A9, A10, and A14 may cause gulls to relocate to areas closer to high densities of nesting western snowy plovers. Both the northern harrier and California gull are important predators of western snowy plovers in the South Bay. Predator management and MAM performed by the Refuge and the SBSPRP will help to minimize the risk of predation on western snowy plovers.

Service-led activities include the provision of recreational trails. Human activity may increase in areas where trails and observation platforms are to be opened or improved. Studies of the effects of recreational trail use in the South Bay on western snowy plovers showed that trail users caused western snowy plovers to flush from their nests when walkers approached on average within 538 feet when approached directly or 478 feet when passed tangentially (Robinson 2008). Use of the trail along the new FRM levee is likely to increase once this levee is connected to other Bay Trail segments at its northeast end, but the removal of a loop trail in the A9-A15 complex may tend to reduce trail use. Management of potential disturbances in adjacent habitat areas (such as Ponds A9-A15 that have not yet been converted to tidal habitats) from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails. Increased recreational trail use adjacent to western snowy plover habitat could have the same disturbance effects as described above.
Interpretive signage will be installed at the edges of sensitive habitat areas discouraging human entry into those areas. If monitoring indicates that disturbance of western snowy plovers by humans is adversely affecting plover populations, seasonal closures of portions of these trails would be considered as an adaptive management measure.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

Studies in San Diego County (Hothem and Powell 2000), at Point Reyes (Schwarzbach *et al.* 2005), and in the South Bay (Schwarzbach and Adelsbach 2003) have found elevated mercury levels in western snowy plover eggs. At Point Reyes, high levels of mercury in unhatched eggs were thought to be a possible reason for the inviability of these eggs. In the San Diego County and South Bay studies, however, concentrations of mercury in western snowy plover eggs were below known embyrotoxic thresholds established for other species.

Western snowy plovers are currently exposed to mercury in ponds containing mercury-contaminated water or sediment. Proposed tidal restoration activities that stir up contaminated sediments, such as pilot channel excavation, construction of ditch blocks, and scour due to increased tidal prism would all occur just prior to, or as a result of, tidal restoration. Although western snowy plovers foraging on intertidal mudflats may be affected by increased mercury mobilization resulting from these activities, activities that stir up mercury-laden sediments in tidal habitats are expected to have little effect on snowy plovers due to the infrequency with which snowy plovers forage in intertidal habitats in the proposed project area. Furthermore, western snowy plovers are not known to use the Pond A18 area under existing conditions, and proposed project activities are not expected to enhance conditions for western snowy plovers in A18 after proposed project completion.

Effects of Service-led Actions

Potential effects of mercury mobilization and exposure on western snowy plovers, resulting from Service-led activities, are expected to be similar to those described above for the Corps-led activities.

California Least Tern

California least terns do not nest in the action area, and thus the proposed project is not expected to result in in any effects to nesting California least terns. California least terns have been observed foraging in the action area's ponds (A9, A11, and A14) only rarely, and they have not been observed foraging in Pond A18. Although they could potentially forage in any of these ponds that contain fish, survey data collected for the SBSPRP and incidental observations by birders indicate that California least terns visit the action area (as a post-breeding forager) only irregularly and in low numbers.

Habitat Modification

Effects of Corps-led Actions

Construction of the FRM levee and the tide gate and pedestrian bridge in Artesian Slough will not affect California least tern foraging or roosting habitat. Although California least terns have not been recorded foraging in Pond A18, they could potentially forage there (albeit irregularly and in low numbers, given the lack of records). Drawing down Pond A18 prior to breaching would eliminate California least tern foraging habitat in the pond in the short term, and restoration of Pond A18 to tidal habitats would reduce the extent of suitable foraging habitat available to California least terns in the longer term. However, tidal marsh restoration is expected to benefit fish populations

considerably by providing nursery habitat in the extensive channel networks that will be restored and by exporting organic material to aquatic habitats outside the restored habitat. As a result, tidal restoration is expected to increase fish abundance (through improved water quality, food resources, and spawning and rearing habitat) in the open waters of the Bay where California least terns also forage (in addition to foraging in managed ponds), thus increasing prey availability in the South Bay for California least terns. Due to the low level of California least tern use of Pond A18 and the benefits of tidal restoration to prey fish populations, Corps-led actions will not have a substantive adverse effect on California least tern habitat and prey, and they may have a beneficial effect.

Effects of Service-led Actions

Service-led tidal restoration will result in the conversion of managed pond habitat in Ponds A9-A15 to tidal habitats. Drawing down these ponds prior to breaching would eliminate California least tern foraging habitat in the ponds in the short term, and in the longer term, there would be a net reduction in potential foraging habitat for the California least tern due to the conversion of aquatic habitat within these ponds to mostly vegetated habitats. However, California least terns have only been recorded foraging in Ponds A9-A15 infrequently and in low numbers. Also, as noted previously, tidal restoration is expected to have substantial beneficial effects on South Bay fish populations. Due to the low level of California least tern use of Ponds A9-A15 and the benefits of tidal restoration to prey fish populations, Service-led restoration activities will not have a substantive adverse effect on California least tern habitat and prey, and they may have a beneficial effect.

Disturbance of Foraging Individuals

Effects of Corps-led Actions

Because California least terns have not been recorded using Pond A18 or any of the other ponds near the FRM levee (*i.e.*, A12, A13, or A16), there is little potential for disturbance of foraging California least terns from Corps-led actions. If individuals were to forage in these ponds during FRM levee construction and they were disturbed by construction activities, they would simply move away to other, more traditionally used foraging areas.

Effects of Service-led Actions

Disturbance such as loud noise or the presence and movement of people and heavy equipment near California least tern foraging habitat may alter the tern's foraging behavior. Such disturbance could result in temporary or permanent habitat loss due to California least tern avoidance of areas that have suitable habitat but intolerable levels of disturbance; a reduction in foraging efficiency if high-quality foraging areas are impacted; and increased movement or altered activity patterns that reduce energy reserves and increase predation risk.

Because California least terns have been recorded using Ponds A9-A15 for foraging infrequently and in low numbers, the number of individuals that could be disturbed by Service-led construction or recreational activities is very low. If individuals were to forage in these ponds during restoration-related construction or breaching activities, or during high levels of recreation-related activity, and they were disturbed by those activities, they would simply move away to other, more traditionally used foraging areas.

Effects Due to an Increase in Mercury Exposure

Effects of Corps-led Actions

Because fish bio-accumulate methylmercury, and California least terns eat almost exclusively small fish, there is some potential for mercury mobilized by Corps-led restoration activities (as described above for California clapper rail) to adversely affect California least terns. California least terns are currently exposed to mercury in the South Bay by foraging on fish in contaminated tidal habitats containing mercury-contaminated water or sediment during their post-breeding period. Restoration activities in Pond A18 will mobilize contaminated sediments, and therefore there is the potential to increase California least terns' exposure to mercury. Methylmercury may also be mobilized by the frequent wetting and drying of mercury-contaminated sediments during construction activities. Such exposure could potentially affect the development of juveniles that ingest mercury in food taken during the post-breeding period and may affect fecundity in adults that ingest contaminated fish.

Recent biosentinel sampling in South Bay managed ponds and marshes indicates that mercury concentrations in fish are above the Bay mercury total maximum daily load of 0.03 μg/g for small fish (San Francisco Bay Regional Water Quality Control Board 2006). Mean mercury levels of longjaw mudsuckers and threespine sticklebacks in Alviso Slough fringe marshes were 0.11 μg/g and 0.16 μg/g, respectively (Grenier *et al.* 2010). These levels were higher (but not significantly) than in other South Bay reference sites (mudsuckers: 0.08 μg/g, stickleback: 0.11 μg/g). Based on this information, California least terns foraging in the South Bay could be exposed to mercury levels that are detrimental to piscivorous birds even in the absence of the proposed project. This is evident in Forster's terns (*Sterna forsteri*), a better-studied tern species that breeds in the South Bay, and thus has higher exposure to mercury than California least terns. In a contaminants study of Forster's terns, approximately 50 percent of captured terns were considered at or above moderate risk (> 1.0 μg/g), 13 percent were at or above high risk (>3.0 μg/g), and 9 percent were at or above extra-high risk (>4.0 μg/g) for impaired reproduction based on their blood mercury concentrations (Ackerman *et al.* 2008a). Blood sampling over time (between pre-breeding and breeding stages), suggests that breeding terns were at higher risk due to mercury increasing in their blood, suggesting terns' mercury concentrations increased with the time they spent foraging while in the Bay (Ackerman *et al.* 2008a). Blood mercury concentrations were highest in terns captured in the southernmost portions of the Bay, in the Alviso salt pond complex, including Pond A8 (Ackerman *et al.* 2008a). Unexpectedly, blood mercury concentrations in Forster's terns were substantially higher approximately two months after arriving in the Bay (*i.e.*, the period between pre-breeding and breeding) than observed in Caspian terns (*Hydroprogne caspia*) during the same time period (Eagles-Smith *et al.* 2009). Caspian terns had much higher mercury levels upon arriving, but Forster's terns mercury levels were soon elevated beyond those of Caspian terns, despite the fact that Caspian terns forage on larger prey (*i.e.*, at higher trophic levels). This was likely due to differences in foraging ecology, as Caspian terns tend to forage in the open bay waters or at inland reservoirs and Forster's terns forage mainly in ponds and tidal marsh channels (Ackerman *et al.* 2008b). As noted above, open waters in the Bay are less likely to methylate mercury than tidal marsh areas (Marvin-DiPasquale *et al.* 2003), and ponds have the potential to methylate mercury due to high levels of degradable organic matter (Grenier *et al.* 2010). Therefore, terns that forage in ponds are much more likely to be exposed to mercury than those foraging in open bay waters.

Although mercury concentrations in post-breeding California least terns in the South Bay are largely unknown, it would be expected that California least terns' exposure to mercury in the South Bay is substantially less than both Caspian and Forster's terns. Because California least terns occur only in the South Bay during post-breeding periods, they would be exposed to mercury for a relatively brief period of time. Further, because they tend to forage in open bay waters or in managed ponds in the Mountain View area (where legacy contamination by mercury should be lower than in areas that receive drainage from the mercury mines in the Guadalupe River watershed or in Artesian Slough), their exposure to mercury should be less than those of Forster's terns. Also, because they eat smaller fish than Caspian terns, California least terns likely accumulate mercury slower than Caspian terns.

California least terns do appear to have some exposure to mercury from central San Francisco Bay (Central Bay) foraging areas near their colonies. Hothem and Zador (1995) analyzed contaminant levels in California least tern eggs collected at the Oakland airport and Alameda Point colonies, and from five colonies along San Diego Bay. Mercury was detected in all eggs, but concentrations were higher in eggs from the Central Bay, with an average of 1.88 μg/g in Central Bay colonies and 1.07 μg/g in San Diego colonies. In comparison, concentrations of mercury in collected Forster's tern eggs averaged 1.35 μg/g (Ackerman and Eagles-Smith 2009). Egg mercury concentrations above 1.0 μg/g is considered high enough for impaired hatchability and embryonic mortality in birds (Scheuhammer *et al.* 2007), and although eggs with concentrations above 1.0 μg/g can hatch, there may be residual effects of mercury on chick mortality after hatching (Ackerman and Eagles-Smith 2009). This suggests that Forster's terns' exposure to mercury during the pre-breeding and breeding periods in the South Bay is higher than California least terns foraging in the Central Bay during the same periods, due in part to overall higher mercury concentrations in the South Bay and their use of pond and tidal marsh foraging sites (as opposed to open bay waters). Because maternally-deposited mercury in eggs is a result of recent dietary exposure (Heinz and Hoffman 2003), mercury in California least tern eggs likely is associated with foraging sites near colonies and not associated with mercury from the South Bay that they are exposed to during post-breeding periods.

Although the potential effects of increased mercury exposure on California least terns resulting from the proposed project are difficult to determine, California least terns are unlikely to be affected substantially by an increase in mercury exposure from the proposed project. This is because California least terns tend to forage in open water habitats in the Bay or managed ponds in the Mountain View area, where their exposure to mercury is lower than if they foraged more frequently in ponds in the Alviso area and/or in marshes like Forster's terns. Also, mercury that may impair California least tern reproduction is more likely to be derived from pre-breeding and breeding foraging sites than post-breeding staging areas in the South Bay. Finally, the increase in mercury mobilization resulting from Corps-led activities is expected to be relatively brief in duration.

Effects of Service-led Actions

Potential effects of mercury mobilization and exposure on California least terns, resulting from Service-led activities in Ponds A9-A15, are expected to be similar to those described above for Corps-led activities.

San Francisco Bay-Delta DPS of the Longfin Smelt

Habitat Modification

The proposed project is expected to substantially increase and improve longfin smelt habitat in the action area. The combined tidal restoration efforts of the Corps and the Service are expected to restore and preserve 2,746 acres of longfin smelt habitat.

Effects of Corps-led Actions

The Corps-led action to restore tidal influence to Pond A18 in the long-term is projected to restore approximately 736 acres of tidal/brackish marsh within the former salt pond and improve food-web productivity by increasing potential foraging habitat for longfin smelt. Construction of the pedestrian bridge over Artesian Slough will temporarily disturb about 1.04 acres of tidal freshwater marsh habitat for the longfin smelt within the slough.

Effects of Service-led Actions

The Service-led action to restore tidal influence to Ponds A9-15 in the long-term is projected to restore approximately 2,010 acres of tidal marsh within the former salt ponds and improve food-web productivity by increasing potential foraging habitat for longfin smelt.

Effects to Individuals

Effects of Corps-led Actions

While tidal marsh restoration in Pond A18 will be beneficial to the longfin smelt in the long-term, these actions are expected to result in adverse effects to adult and juvenile longfin smelt in the short-term during the construction phase. These actions are not expected to affect longfin smelt larvae and eggs because the proposed actions will be accomplished outside of the spawning and rearing period for this species, during the Service's recommended in-water work window for longfin smelt, from June 1 through November 30.

Adverse effects to adult and juvenile longfin smelt are expected as a result of the proposed in-water construction for the proposed project. The in-water construction requires utilization of heavy equipment (*e.g.*, excavators, bulldozers, dump trucks, and vibratory pile drivers) to place and grade new material for levee construction, remove material for breaches and pilot channels, dewatering and temporary installation of sheet piling cofferdams to facilitate tidal restoration to Pond A18, along with corresponding installation of new water control structures and to install forty new 12-inch steel piles to form the pedestrian bridge. The in-water construction may result in: (1) elevated turbidity levels; (2) potentially spill contaminants; (3) increased hydroacoustics; (4) entrainment or accidental burial of longfin smelt; (5) stranding of longfin smelt; and (6) temporary habitat alteration. The effects of the proposed project detailed below will be minimized by the proposed conservation measures included in the project description.

Elevated turbidity levels from increased suspended sediments may cause short-term behavioral changes including disruption to feeding activities or result in temporary displacement from preferred habitats. These potential behavioral changes due to turbidity will be minimized by limiting soil

disturbance to the smallest footprint necessary, developing a Stormwater Management Plan focused on use of erosion-control materials and stabilizing all disturbed areas within 12 hours, if a break in work is expected longer than seven days.

Heavy equipment has the potential to spill/ leak chemical contaminants or hazardous materials (*e.g.*, gasoline, oil, grease, concrete) into the water that may cause direct injury and mortality of longfin smelt. Potential accidental hazardous spill events will be minimized by maintaining all equipment to be free of petroleum leaks, having spill prevention kits in close proximity, and developing and implementing a Hazardous Materials Management/Fuel Spill Containment Plan.

Pile diving can generate increased hydroacoustics that may cause stress, injury, or mortality of longfin smelt. Potential increased hydroacoustics resulting from pile driving will be minimized by performing all pile diving using a vibratory hammer. Based on hydroacoustic monitoring data presented in the Biological Assessment, installation of the forty 12-inch steel piles using a vibratory hammer is estimated to result in peak sound pressure levels of approximately 150 decibels (dB), below the Fisheries Hydroacoustic Working Group's criteria for injury to fish of less than 2 grams (*i.e.*, 206 dB peak and 187 dB accumulated) (Fisheries Hydroacoustic Working Group 2008). To define the extent of increased hydroacoustics produced from pile driving, the Practical Spreading Model was used, as described in Davidson (2004) and Thomsen *et al.* (2006). The Practical Spreading Model estimates the distance at which underwater sound pressure levels created during vibratory pile installation; using the expected peak sound level of 150 dB, attenuated to estimated background levels (*i.e.*, 135 dB), it is expected increased pressure levels would not likely be detected beyond 328 feet from installation. Vibratory hammers avoid the abrupt over-and-under pressure changes exhibited by impact hammers.

Operating heavy equipment in-water or adjacent to waters can potentially cause entrainment or accidental burial, and dewatering may cause stranding; both result in direct injury and mortality to longfin smelt. Potential stress, injury, or mortality resulting from entrainment or accidental burial in heavy equipment or disturbed soils along with stranding of fish related to dewatering will be minimized by conducting all construction near or in-waters at low tide and/or allowing ample amount of time for dewatering, which is expected to allow for longfin smelt escapement during desiccation of the area, to the extent practicable. Cofferdams will be utilized to preclude longfin smelt entering areas of disturbance.

Temporary habitat alteration during construction can result in a temporary loss of prey organisms. Potential stress, injury, or mortality produced by loss of prey organisms due to habitat alteration will be minimized by precluding access for fish during construction by utilizing cofferdams to the extent feasible and providing channels that are adequate for the ingress and egress of longfin smelt while restoring tidal circulation to Pond A18.

Mercury is present in the sediments of the action area and throughout the Bay. Methylmercury is produced in aquatic ecosystems by the methylation of inorganic mercury by micro-organisms. Mercury may be mobilized when pilot channels are excavated in outboard marshes along Artesian Slough prior to breaching, and the tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Artesian Slough, could mobilize mercury-laden sediment from the slough. Mercury could be mobilized downstream into and along Coyote Slough. Longfin smelt in the action area are exposed to methylmercury through their diet, but no information is available on the effects of dietary mercury on longfin smelt. Mercury body burdens have been

documented in fish utilizing similar habitat and prey to longfin smelt. For example, Greenfield *et al.* (2013) found tissue concentrations of methylmercury in Mississippi silversides at Alivso Slough which have been documented to impair predator avoidance in golden shiner (Webber and Haines 2003). Increased mobilization could alter physical conditions favoring transformation of mercury to methylmercury, and thus increasing mercury bioavailability. Methylmercury may also be mobilized by the frequent wetting and drying of mercury-contaminated sediments during construction activities. Thus, methylmercury ingestion and accumulation by longfin smelt is expected to occur, and mobilization of mercury from Corps-led actions could elevate mercury levels in longfin smelt. A net methylmercury increase resulting from habitat restoration is not preventable, is unpredictable, and there are very few management tools available to minimize effects.

Perennial pepperweed may be present in the action area and may require spraying of glyphosate or imazapyr near aquatic habitats for control purposes following tidal restoration, as fully described in the project description. The NMFS's programmatic conference and biological opinion on aquatic restoration actions in the States of Oregon and Washington (NMFS 2013) documented that spraying of aquatic-formulated glyphosate or imazapyr following aquatic restoration could result in adverse effects to fish. They determined that herbicide applications can result in herbicide drift or transportation into aquatic habitat that will harm listed species by chemically impairing normal fish behavioral patterns related to feeding, rearing, and migration. Effects resulting from the application of glyphosate or imazapyr following development of Ponds A12 and A18 ecotones or restoration of tidal influence to Pond A18 will be minimized by applying herbicides in accordance with the methods described in the Service's San Pablo Bay National Wildlife Refuge *Lepidium latifolium* Control Plan by Hogle *et al.* (2007).

Effects of Service-led Actions

While tidal marsh restoration in Ponds A9-A15 will be beneficial to the longfin smelt in the long-term, these actions are expected to result in adverse effects to adult and juvenile longfin smelt in the short-term during the construction phase. These effects are not expected to affect longfin smelt larvae and eggs because the proposed actions will be accomplished outside of the spawning and rearing period for the species, during the Service's recommended in-water work window for longfin smelt, from June 1 through November 30.

Adverse effects to adult and juveniles longfin smelt are expected as a result of in-water or near-water construction required to accomplish tidal restoration of Ponds A9-15. The in-water construction may result in: (1) elevated turbidity levels; (2) potentially spill contaminants; (3) entrainment or accidental burial of longfin smelt; (4) stranding of longfin smelt; and (5) temporary habitat alteration. The effects of the proposed project are detailed below and will be minimized by the proposed conservation measures included in the project description.

Elevated turbidity levels from increased suspended sediments may cause short-term behavioral changes including disruption to feeding activities or result in temporary displacement from preferred habitats. These potential behavioral changes due to turbidity will be minimized by limiting soil disturbance to the smallest footprint necessary, developing a Stormwater Management Plan focused on use of erosion-control materials, and all disturbed areas will be stabilized within 12 hours, if a break in work is expected longer than seven days.

Heavy equipment has the potential to spill/ leak chemical contaminants or hazardous materials (*e.g.*, gasoline, oil, grease, concrete) into the water that may cause direct injury and mortality of longfin smelt. Potential accidental hazardous spill events will be minimized by maintaining all equipment to be free of petroleum leaks, spill prevention kits in close proximity, and developing and implementing a Hazardous Materials Management/Fuel Spill Containment Plan.

Operating heavy equipment in-water or adjacent to waters can potentially cause entrainment or accidental burial of longfin smelt, and dewatering may cause stranding; both would result in direct injury and mortality to longfin smelt. Potential stress, injury, or mortality resulting from entrainment or accidental burial in heavy equipment or disturbed soils along with stranding of fish related to dewatering will be minimized by conducting all construction near or in-waters at low tide and/or allowing ample amount of time for dewatering, which is expected to allow for longfin smelt escapement during desiccation of the area, to the extent practicable. Cofferdams will be utilized to preclude fish entering area of disturbance.

Temporary habitat alteration during construction can result in a temporary loss of prey organisms. Potential stress, injury, or mortality produced by loss of prey organisms due to habitat alteration will be minimized by precluding access during construction by utilizing cofferdams to the extent feasible and providing channels that are adequate for the ingress and egress of longfin smelt while restoring tidal circulation to Ponds A9-15.

Potential effects of mercury mobilization and exposure on longfin smelt, resulting from Service-led activities, are expected to be similar to those described above for Corps-led activities. Because of the mercury contamination of the Guadalupe River from the New Almaden mine, some of the sediment in Alviso Slough may contain high concentrations of mercury. Such mercury may be mobilized when pilot channels are excavated in outboard marshes along Alviso Slough prior to breaching, and the tidal action through those channels, as well as the increase in tidal prism and associated scour of sediments in Alviso Slough, could mobilize mercury-laden sediment from Alviso Slough and Ponds A9-A15.

Potential effects on the longfin smelt of herbicide use during perennial pepperweed control within Ponds A9-A15 resulting from Service-led activities are expected to be similar to those described above for Corps-led activities.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion and conference opinion. Future Federal actions unrelated to the proposed project are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

Climate Change

The global average temperature has risen by approximately 0.6 degree Centigrade during the 20th Century (International Panel on Climate Change [IPCC] 2001, 2007a, 2007b; Adger *et al.* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IPCC 2001, 2007a, 2007b; Adger *et al.* 2007), and that it is "very likely" that it is largely due to man-made emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007).

Ongoing climate change (Inkley *et al.* 2004, Adger *et al.* 2007, Kanter 2007) likely imperils the California clapper rail, salt marsh harvest mouse, Pacific Coast population of the western snowy plover, California least tern, and San Francisco Bay-Delta DPS of the longfin smelt and the resources necessary for their survival, since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, diseases, and non-native competitors. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat. Rising sea levels are likely to inundate much of the remaining salt marsh habitat available for the California clapper rail and salt marsh harvest mouse. Without upland habitat buffers available for the landward transgression of the marsh, the amount of suitable salt marsh habitat is likely to decrease with rising sea levels. The proposed project will reduce the cumulative effects of the loss of suitable salt marsh habitat within the action area from sea level rise by construction of the 345-foot-wide ecotone berms along Ponds A12 and A18 which will create an upland habitat buffer that will allow for the landward transgression of the marsh.

Conclusion

After reviewing the current status of the California clapper rail and salt marsh harvest mouse, the environmental baseline for these species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of these species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual California clapper rails and salt marsh harvest mice; (2) the avoidance of disturbing any breeding California clapper rails; (3) the restoration of at least 517 acres of tidal salt marsh/brackish marsh habitat and creation of 67 acres of ecotone habitat for the California clapper rail and salt marsh harvest mouse within Pond A18; (4) the restoration of at least 300 acres of tidal salt marsh habitat and creation of 30 acres of ecotone for the California clapper rail and salt marsh harvest mouse within Pond A12; (5) the restoration of additional tidal marsh habitat for the California clapper rail and salt marsh harvest mouse within some of the Ponds A9-A15 under an adaptive management plan; (6) the enhancement of tidal marsh habitat for the California clapper rail and salt marsh harvest mouse along Artestian, Coyote, and Alviso sloughs through salinization of freshwater and brackish marsh habitat from increased tidal prism; and (7) the implementation of a long-term predator management plan and invasive plant species control plan.

After reviewing the current status of the Pacific coast population of the western snowy plover, the environmental baseline for this species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of this species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual western snowy plovers; (2) the avoidance of disturbing any breeding western snowy plovers during construction of the proposed project; (3) the implementation of a long-term predator management plan; (4) the enhancement of nesting habitat for western snowy plovers within Pond A16; and (5) the proposed project will enable the SBSPRP to fulfill their commitment to maintaining at least 250 breeding individual western snowy plovers within the SBSPRP area through adaptive management of suitable nesting habitat.

After reviewing the current status of the California least tern, the environmental baseline for this species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of this species. We based this determination on the following: (1) successful implementation of the conservation measures described in this biological opinion will minimize the adverse effects on individual California least terns; (2) the avoidance of disturbing any breeding California least terns; and (3) the increase in the abundance of prey fish populations for the California least tern in the South Bay through tidal marsh restoration.

After reviewing the current status of the San Francisco Bay-Delta DPS of the longfin smelt, the environmental baseline for this species within the action area, the effects of the proposed project and the cumulative effects, it is the Service's conference opinion that the proposed project is not likely to jeopardize the continued existence of this species. We based this determination on the expected long-term habitat benefits resulting from tidal restoration and the proposed minimization measures utilized during construction.

INCIDENTAL TAKE STATEMENT

Section 9 of the Endangered Species Act and Federal regulations pursuant to section 4(d) of the Act, prohibit take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. The Service defines harassment as an intentional or negligent act or omission that creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. The Service defines harm to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited, provided such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below for the California clapper rail, salt marsh harvest mouse, Pacific coast population of the western snowy plover, and California least tern are nondiscretionary, and must be implemented by the Corps and the Refuge so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption under section 7(o)(2) to apply. The Corps and the Refuge have a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps or the Refuge: (1) fail to require the applicant or any of its contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms, and/or (2) fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or the Refuge must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

The prohibitions found in section 9 of the Act against taking of species do not apply until the species is listed. Therefore, the incidental take statement for the San Francisco Bay-Delta DPS of the longfin smelt does not become effective until such time as the species is listed and the conference opinion is adopted as a biological opinion issued through formal consultation. However,

the Service advises the Corps and the Refuge to consider implementing the following reasonable and prudent measures as they apply to the longfin smelt. If this conference opinion is adopted as a biological opinion following a listing or designation, these measures, with their implementing terms and conditions, will be non-discretionary.

Amount or Extent of Take

California Clapper Rail

The Service anticipates incidental take of individual California clapper rails will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, their elusive and cryptic behavior, and the difficulty of finding killed or injured animals. Due to the difficulty in quantifying the number of California clapper rails that will be taken as a result of the proposed project, the Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all California clapper rails within the 1.04 acres of tidal freshwater marsh foraging/dispersal habitat disturbed along Artesian Slough during tide gate and pedestrian bridge construction.

2. The harassment of all California clapper rails within the 0.11 acre of tidal/brackish marsh foraging/dispersal habitat disturbed along the outboard Pond A18 levee during breaching and excavating the pilot channels.

3. The harassment and non-lethal harm of all California clapper rails within 17 acres of tidal marsh habitat lost due to scour along Artesian and Coyote sloughs.

4. The annual harassment of all California clapper rails within perennial pepperweed treatment areas in Pond A18.

5. The ongoing harassment by trail users of all California clapper rails within 50 feet of the pedestrian bridge constructed over Artesian Slough.

Service-led Actions

1. The harassment of all California clapper rails within the 0.06 acre of tidal/brackish marsh foraging/dispersal habitat disturbed along the outboard levees of Ponds A9-A15 during breaching and excavating the pilot channels.

2. The harassment and non-lethal harm of all California clapper rails within 40 acres of tidal marsh habitat lost due to scour along Alviso and Coyote sloughs.

3. The ongoing harassment by trail users of all California clapper rails within 50 feet of the segments of the trails constructed without a wide ecotone berm along the southern Pond A12 levee, the Pond A12/A13 levee, and the northern Pond A15 levee once tidal marsh is restored to these ponds.

4. The ongoing harassment of all California clapper rails within 50 feet of the Ponds A9-A15 levees during levee operation and maintenance activities.

5. The annual harassment of all California clapper rails within perennial pepperweed treatment areas in Ponds A9-A15.

Salt Marsh Harvest Mouse

The Service anticipates incidental take of individual salt marsh harvest mice will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, their elusive and cryptic behavior, and the difficulty of finding killed or injured animals. Due to the difficulty in quantifying the number of salt marsh harvest mice that will be taken as a result of the proposed project, the Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment and harm of all salt marsh harvest mice within the 13.65 acres of low quality salt marsh habitat disturbed along the edges of the Alviso impoundment, the northern edge of New Chicago Marsh, adjacent to the southern levee of Pond A16, and along both northern and southern sides of the existing Pond A18 levee during construction of the FRM levee and the Artesian Slough tide gate and pedestrian bridge.

2. The harassment and harm of all salt marsh harvest mice within the 0.11 acre of salt/brackish marsh habitat disturbed on the outboard Pond A18 levee along Artesian and South Coyote sloughs during breaching and excavation of the pilot channels.

3. The harassment and non-lethal harm of all salt marsh harvest mice within 17 acres of tidal marsh habitat lost due to scour along Artesian and Coyote sloughs.

4. The ongoing harassment and harm of all salt marsh harvest mice within 25 feet of the FRM levee top during levee operation and maintenance activities (*e.g.*, mowing a 15-foot wide strip of ruderal grassland habitat adjacent to the levee crown once per year).

5. The ongoing harassment by trail users of all salt marsh harvest mice within 25 feet of the pedestrian bridge constructed over Artesian Slough.

6. The annual harassment of all salt marsh harvest mice within perennial pepperweed treatment areas in Pond A18.

Service-led Actions

1. The harassment and harm of all salt marsh harvest mice within the 0.06 acre of tidal/brackish marsh habitat disturbed along the outboard levees of Ponds A9-A15 during breaching and excavating the pilot channels.

2. The harassment and non-lethal harm of all salt marsh harvest mice within 40 acres of tidal marsh habitat lost due to scour along Alviso and Coyote sloughs.

3. The capture of all salt marsh harvest mice on Refuge lands within the construction footprint in the action area during construction of the proposed project.

4. The ongoing harassment by trail users of all salt marsh harvest mice within 25 feet of the trails constructed along New Chicago Marsh and Ponds A12, A13, A15, and A18 once tidal marsh is restored to these ponds and ecotone habitat is created along Ponds A12 and A18.

5. The ongoing harassment of all salt marsh harvest mice within 25 feet of the Ponds A9-A15 levees during levee operation and maintenance activities.

6. The annual harassment of all salt marsh harvest mice within perennial pepperweed treatment areas in Ponds A9-A15.

Pacific Coast Population of the Western Snowy Plover

The Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all western snowy plovers within 600 feet of the Alviso Segment of the FRM levee in Ponds A12 and A13, the Alviso impoundment, New Chicago Marsh, and Pond A16 during construction of the proposed project.

2. The harassment and harm of two (2) breeding pairs of western snowy plovers due to the loss of breeding habitat in the Alviso impoundment and northern New Chicago Marsh due to the raising and widening of the FRM levee.

3. The annual harassment of all of western snowy plovers within 600 feet of the FRM levee during levee operation and maintenance activities adjacent to Pond A16, New Chicago Marsh, and the Alviso impoundment.

Service-led Actions

1. The harassment and harm of five (5) breeding pairs of western snowy plovers after the permanent loss of 2,010 acres of potential salt pond nesting habitat within Ponds A9-A15.

2. The ongoing harassment by trail users of all western snowy plovers within 600 feet of the Bay Trail along the FRM levee adjacent to Pond A16, New Chicago Marsh, and the Alviso impoundment.

California Least Tern

The Service is quantifying take incidental to the proposed project as the following:

Corps-led Actions

1. The harassment of all foraging and roosting California least terns within 300 feet of construction activities at Pond A18 and the FRM levee.

2. The harassment and harm of two (2) individual California least terns after the permanent loss of 736 acres of salt pond foraging habitat within Pond A18.

Service-led Actions

1. The harassment of all foraging and roosting California least terns within 300 feet of construction activities at Ponds A9-A15.

2. The harassment and harm of four (4) individual California least terns after the permanent loss of 2,010 acres of salt pond foraging habitat within Ponds A9-A15.

3. The ongoing harassment of all foraging and roosting California least terns by trail users within 300 feet of the trails along Ponds A18, A12, A13, and A15 until these ponds are restored to tidal marsh.

San Francisco Bay-Delta DPS of the Longfin Smelt

The Service anticipates that incidental take of longfin smelt in adult or juvenile life-stages will occur due to project-related activities, however, it is difficult to determine the number of individual longfin smelt that could be subject to incidental take in the action area because of the species' cryptic and elusive nature, and the lack of abundance information from scientific surveys within the action area itself. Therefore, the Service is quantifying take incidental to the proposed project as the following:

Service-led Actions

The Service anticipates that all individual longfin smelt adults and juveniles within 2,010 acre-feet of water in Ponds A9-A15 will be subject to incidental take in the form of harm, harassment, injury, and mortality during the tidal restoration.

Effect of the Take

In the accompanying biological opinion and conference opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, California least tern, and San Francisco Bay-Delta DPS of the longfin smelt.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measures are necessary and appropriate to minimize the effects of the proposed project on the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, California least tern, and San Francisco Bay-Delta DPS of the longfin smelt:

1. The Corps through the CSCC, City of San Jose, and SCVWD will minimize adverse effects to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, and California least tern in the action area for the Corps-led actions by following the project description as modified by the terms and conditions.

2. The Refuge through the CSCC, City of San Jose, and SCVWD will minimize adverse effects to the California clapper rail, salt marsh harvest mouse, Pacific coast population of western snowy plover, California least tern, and San Francisco Bay-Delta DPS of the longfin smelt in the action area for the Service-led actions by following the project description as modified by the terms and conditions.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and the Refuge shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These Terms and Conditions are nondiscretionary.

The following Term and Condition implements Reasonable and Prudent Measure Number One (1):

1. The Corps shall ensure that the CSCC, City of San Jose, and SCVWD minimize proposed project related effects of mobilization of methylmercury by minimizing the frequency and duration of methylization by minimizing the number of times mercury-contaminated soils are wetted and dried during construction of the proposed project (this measure does not apply to imported soils that meet contaminants screening criteria for mercury).

The following Term and Condition implements Reasonable and Prudent Measure Number Two (2):

1. The Refuge shall ensure that the CSCC, City of San Jose, and SCVWD minimize proposed project related effects of mobilization of methylmercury by minimizing the frequency and duration of methylization by minimizing the number of times mercury-contaminated soils are wetted and dried during construction of the proposed project (this measure does not apply to imported soils that meet contaminants screening criteria for mercury).

Reporting Requirements

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, the Corps and the Refuge shall adhere to the following reporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the Corps or the Refuge must reinitiate formal consultation as per 50 CFR 402.16.

1. The Service must be notified within one (1) working day of the finding of any injured or dead listed species or any unanticipated damage to its habitat associated with the proposed project. Notification will be made to the Coast/Bay Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600, and must include the date, time, and precise location of the individual/incident clearly indicated on a U.S. Geological Survey 7.5 minute quadrangle or other maps at a finer scale, as requested by the Service, and any other pertinent information. When an injured or dead individual of the listed species is found, the Corps or the Refuge shall follow the steps outlined in the Disposition of Individuals Taken section below.

2. The Corps and/or the Refuge shall provide annual updates and interim progress reports to the Service on the status of the implementation of the proposed project, avoidance and

minimization measures, predator management, monitoring of the tidal marsh restoration areas, monitoring of the Pond A16 western snowy plover nesting habitat enhancements, and adaptive management.

Disposition of Individuals Taken

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, avoidance and minimization measures implemented, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact person is the Coast/Bay Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should develop, fund, and annually implement an avian and mammalian predator monitoring and management program within suitable habitat for the salt marsh harvest mouse, California clapper rail, western snowy plover, and California least tern around the Bay.

2. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should remove raptor nest and perch sites or install raptor perching deterrents within suitable habitat for the salt marsh harvest mouse, California clapper rail, western snowy plover, and California least tern around the Bay.

3. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should control invasive plant species (*e.g.*, perennial pepperweed) within suitable habitat for the salt marsh harvest mouse and California clapper rail.

4. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should import clean fill to raise the elevations of subsided salt ponds to accelerate the timeline of tidal marsh restoration.

5. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should install high-tide refugia islands planted with marsh gumplant for salt marsh harvest mice and California clapper rails within tidal marshes that lack sufficient high-tide refugia.

6. The Corps, the Refuge, CSCC, the City of San Jose, and SCVWD should minimize the effects of atmospheric nitrogen deposition from nitrogen oxides emissions in construction vehicle traffic exhaust in facilitating the spread of invasive plant species into naturally

nutrient-poor serpentine grassland habitat for the threatened Bay checkerspot butterfly and listed serpentine plants in the Santa Clara Valley by contributing funding to the management of invasive plant species in serpentine grassland habitat that supports these listed species.

7. The Corps and the Refuge should report sightings of any listed or sensitive animal species to the CNDDB of the CDFW. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed South Bay Shoreline Phase 1 Study in Santa Clara County, California. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any additional take will not be exempt from the prohibitions of section 9 of the Act, pending reinitiation.

If you have any questions regarding this biological opinion and conference opinion on the effects of the proposed South Bay Shoreline Phase 1 Study, please contact Joseph Terry, Senior Biologist, or Ryan Olah, Coast/Bay Division Chief, at the Sacramento Fish Wildlife Office at the letterhead address, telephone at (916) 414-6600, or via email (Joseph_Terry@fws.gov or Ryan_Olah@fws.gov). The contacts at the San Francisco Bay-Delta Fish and Wildlife Office are Armin Halston, Fish and Wildlife Biologist, or Kim Squires, Section 7 Coordinator, by telephone at (916) 930-5670 or via email (Armin_Halston@fws.gov or Kim_Squires@fws.gov).

cc:
Kim Squires, San Francisco Bay/Delta Fish and Wildlife Office, Sacramento, California
Brenda Blinn, California Department of Fish and Wildlife, Napa, California
Melisa Amato, Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California
Johnathon Bishop, National Oceanic and Atmospheric Administration/National Marine Fisheries Service, Santa Rosa, California

LITERATURE CITED

Ackerman, J. T. and C.A. Eagles-Smith. 2009. Integrating toxicity risk in bird eggs and chicks: using chick down feathers to estimate mercury concentrations in eggs. Environmental Science Technology 43:2166-2172.

Ackerman, J.T., C.A. Eagles-Smith, J.Y. Takekawa, J.D. Bluso, T.L Adelsbach. 2008a. Mercury concentrations in blood and feathers of pre-breeding Foster's terns in relation to space use of San Francisco Bay habitats. Environmental Toxicology and Chemistry 27:897-908.

Ackerman, J.T., C.A. Eagles-Smith, J.Y. Takekawa, S.A. Iverson. 2008b. Survival of postfledging Forster's terns in relation to mercury exposure in San Francisco Bay. Ecotoxicology 17:789-801.

Ackerman, J.T., M. Marvin-DiPasquale, D. Slotton, M. Herzog, and C. Eagles-Smith. 2011. The Effects of Wetland Restoration on Mercury Bioaccumulation in the South Bay Salt Pond Restoration Project: Using the Biosentinel Toolbox to Monitor Changes Across Multiple Habitats and Spatial Scales. http://www.southbayrestoration.org/documents/technical/Biosentinel%20Hg%20Annual%20Report%202010_Jan28_2011.pdf. Accessed on December 9, 2014.

Adger, P., P. Aggarwal, S. Agrawala, J. Alcamo, A. Allali, O. Anisimov, N. Arnell, M. Boko, O. Canziani, T. Carter, G. Cassa, U. Confalonieri, R. Cruz, E. de Alba Alcaraz, W. Eastreling, C. Field, A. Fischlin, B. Fitzharris, C.G. Garcia, C. Hanson, H. Harasawa, K. Hennessy, S. Huq, R. Jones, L.K. Bogataj, D. Karoly, R. Kliein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrin, L.J. Mata, R. McLean, B. Menne, G. Midgley, N. Mimura, M.Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nichols, B. Novaky, L. Nurse, A. Nyon, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P.R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J. van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P. Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Brussels, Belgium. 987 pp.

Albertson, J.D. 1995. Ecology of the California Clapper Rail in South San Francisco Bay. Unpublished Master's Thesis. San Francisco State University. San Francisco, California. 199 pp.

Bouton, S.N., P.C. Frederick, M.G. Spalding, H. McGill. 1999. Effects of chronic, low concentrations of dietary methymmercury on the behavior of juvenile great egrets. Environmental Toxicology and Chemistry 18:1934-1939.

Burger, J. and M. Gochfeld. 1997. Risk, mercury levels, and birds: relating adverse laboratory effects to field biomonitoring. Environmental Research 75:160-172.

California Department of Fish and Game. 2009. A status review of the Longfin Smelt (*Spirinchus thaleichthys*) in California. Report to the Fish and Game Commission. California Department of Fish and Game.

California Department of Fish and Wildlife (CDFW). 2014. California Natural Diversity Database. RareFind version 5. Natural Heritage Division. Sacramento, California.

California State Coastal Conservancy and U.S. Fish and Wildlife Service (Service). 2003. Final Programmatic Environmental Impact Statement/Environmental Impact Report for the San Francisco Estuary Invasive Spartina Control Program - Volumes I and II, September 2003.

California Department of Fish and Wildlife (CDFW). 2014. California Natural Diversity Database. RareFind version 5. Natural Heritage Division. Sacramento, California.

California State Coastal Conservancy and U.S. Fish and Wildlife Service (Service). 2003. Final Programmatic Environmental Impact Statement/Environmental Impact Report for the San Francisco Estuary Invasive Spartina Control Program - Volumes I and II, September 2003. California State Coastal Conservancy, Oakland, California, and San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

California State Coastal Conservancy. 2005. Addendum to the Final Programmatic Environmental Impact Report for the San Francisco Estuary Invasive Spartina Project: Spartina Control Program. California State Coastal Conservancy, Oakland, California.

City of San Jose. 2013. Pond A18 2013 annual self-monitoring report. Prepared for the San Francisco Bay Regional Water Quality Control Board, Oakland, California.

Chesser, R.T, R.C. Banks, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, A.G. Navarro-Sigüenza, P.C. Rasmussen, J.V. Remsen, Jr., J.D. Rising, D.F. Stotz, and K. Winker. 2014. Fifty-Fifth Supplement to the American Ornithologists' Union *Check-list of North American Birds*. The Auk: October 2014, Vol. 131, No. 4, pp. CSi-CSxv. http://aoucospubs.org/doi/full/10.1642/AUK-14-124.1. Accessed on August 7, 2014.

Davidson, M. 2004. Transmission loss. Pages lecture structure obtained from website in IOM. Studies, editor. University of Plymouth, Drake Circus, Plymouth, Devon, United Kingdom. http://freespace.virgin.net/mark.davidson3/TL/TL.html

Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). 2012. Don Edwards San Francisco Bay National Wildlife Refuge Avian Predator Management Plan. Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California.

Donehower, C., K. Tokatlian, C. Robinson-Nilsen, and C. Strong. 2012. Western Snowy Plover Monitoring in the San Francisco Bay, Annual Report 2012. San Francisco Bay Bird Observatory, Milipitas, California and U.S. Fish and Wildlife Service, Newark, California.

Eagles-Smith, C.A., J.T. Ackerman, S.E.W. De La Cruz, and J.Y. Takekawa. 2009. Mercury bioaccumulation and risk to three waterbird foraging guilds is influenced by foraging ecology and breeding stage. Environmental Pollution 157:1993-2002.

EDAW, Inc. 2007. Draft Alviso Slough Restoration Project Fisheries and Aquatic Resources Technical Report.

EDAW, Philip Williams and Associates, Ltd., H.T. Harvey & Associates, Brown and Caldwell, and Geomatrix. 2007. South Bay Salt Pond Restoration Project Final Environmental Impact Statement/Report. December. http://www.southbayrestoration.org/EIR/. Accessed on December 3, 2014.

ESA and Philip Williams & Associates, Ltd. 2012. Shoreline Study Preliminary Alternatives and Landscape Evolution. Memorandum to the California State Coastal Conservancy.

Evers, D.C., O.P. Lane, L. Savoy, and W. Goodale. 2004. Assessing the Impacts of Methylmercury on Piscivorous Wildlife Using a Wildlife Criterion Value Based on the Common Loon, 1998–2003. Gorman (ME): BioDiversity Research Institute. Report no. BRI 2004-05.

Fisheries Hydroacoustic Working Group. 2008. Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities. Memorandum to Applicable Agency Staff. National Marine Fisheries Service, Northwest and Southwest Regions, U.S. Fish and Wildlife Service Regions 1 and 8, California/Washington/Oregon Departments of Transportation, California Department of Fish and Game, and U.S. Federal Highway Administration.

Foerster, K.S and J.E. Takekawa. 1991. San Francisco Bay National Wildlife Refuge Predator Management Plan and Final Environmental Assessment. U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

Foin, T. C, E. J. Garcia, R. E. Gill, S. D. Culberson, and J. N. Collins. 1997. Recovery strategies for the California clapper rail (*Rallus longirostris obsoletus*) in the heavily-urbanized San Francisco estuarine ecosystem. Landscape and Urban Planning 38(3):229-243.

Geissel, W., H. Shellhammer, and H. T. Harvey & Associates. 1988. The ecology of the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in a diked salt marsh. Journal of Mammalogy 69:696-703.

Greenfield, B.K., A.R. Melwani, R. M. Allen, D.G. Slotton, S.M. Ayers, K.H. Harold, K. Ridolfi, A. Jahn, J.L. Grenier, and M.B. Sandheinrich. 2013. Seasonal and annual trends in forage fish concentrations, San Francisco Bay. Science of the Total Environment 222:591-601.

Grenier, L., M. Marvin-DiPasquale, D. Drury, J. Hunt, A. Robinson, S. Bezalel, A. Melwani, J. Agee, E. Kakouros, L. Kieu, L. Windham-Myers, J. Collins. 2010. South Baylands Mercury Project Final Report.

HDR. 2014. Administrative Draft Integrated Document. U.S. Army Corps of Engineers-San Francisco District South San Francisco Bay Shoreline Phase I Study.

H.T. Harvey & Associates (HTH). 2007. Marsh Studies in South San Francisco Bay: 2005-2008. California Clapper Rail and Salt Marsh Harvest Mouse Survey Report, 2006. Prepared for the City of San Jose, San Jose, California.

_____. 2012. Marsh Plant Associations of South San Francisco Bay: 2012 Comparative Study. Draft Report. Prepared for City of San Jose. Report No. 477-30.

_____. 2013. Santa Clara Valley Water District Alviso Slough Project Biological Assessment for the California Clapper Rail, Salt Marsh Harvest Mouse, California Least Tern, West Snowy Plover, California Central Coast Steelhead, and Green Sturgeon, and Essential Fish Habitat Assessment. Project # 3270-11. June. Prepared for the Santa Clara Valley Water District, San Jose, California. 91 pp. plus figures.

_____. 2014. Draft South San Francisco Bay Shoreline Phase 1 Biological Assessment for the Salt Marsh Harvest Mouse, California Ridgway's Rail, Western Snowy Plover, California Least

Tern, Central California Coast Steelhead, Green Sturgeon, and Longfin Smelt and Essential Fish Habitat Assessment. November. Prepared by H.T. Harvey & Associates, Los Gatos, California, for the U.S. Army Corps of Engineers, San Francisco District, San Francisco, California.

Heinz, G.H. and D.J. Hoffman. 2003. Embryotoxic thresholds of mercury: Estimates from individual mallard eggs. Archives of Environmental Contamination and Toxicology 44:257-264.

Hobbs, J.A., P. Moyle, and N. Buckmaster. 2012. Monitoring the response of fish communities to salt pond restoration: Final report. Prepared for the South Bay Salt Pond Restoration Program and Resource Legacy Fund. University of California, Davis, California.

Hogle, I., R. Spenst, S. Leininger, and G. Block. 2007. San Pablo Bay National Wildlife Refuge *Lepidium latifolium* Control Plan. Prepared for the San Pablo Bay National Wildlife Refuge, Petaluma, California.

Hothem, R.L. and A.N. Powell. 2000. Contaminants in eggs of western snowy plovers and California least terns: is there a link to population decline? Environmental Contamination and Toxicology 65:42-50.

Hothem, R.L., and S.G. Zador. 1995. Environmental Contaminants in Eggs of California Least Terns (*Sterna antillarum browni*). Bulletin of Environmental Contamination and Toxicology 55:658-665.

Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffin, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Review 04-2. 26 pp.

International Panel on Climate Change (IPPC). 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson, editors). Cambridge University Press, New York, New York. 881 pp. http://www.ipcc.ch/. Accessed on March 22, 2013.

_____. 2007a. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, editors. Cambridge University Press, New York, New York. 996 pp. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm. Accessed on September 25, 2009.

_____. 2007b. Climate Change 2007: The Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R.K. Pachauri and A. Reisinger, editors. IPCC, Geneva, Switzerland. 104 pp. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm. Accessed on September 25, 2009.

Kanter, J. 2007. Scientists detail climate changes, Poles to Tropics. New York Times. April 10, 2007.

Maley, J. M., and R.T. Brumfield. 2013. Mitochondrial and next-generation sequence data used to infer phylogenetic relationships and species limits in the Clapper/King rail complex. Condor 115:316–329. http://aoucospubs.org/doi/abs/10.1525/cond.2013.110138. Accessed on August 7, 2014.

Marschalek, D.A. 2006. California Least Tern Breeding Survey, 2005 Season. California Department of Fish and Game, South Coast Region, San Diego, CA. Species Conservation and Recovery Program Report, 2006-01.

Marvin-DiPasquale, M.C., J.L. Agee, R.M. Bouse, B.E. Jaffe. 2003. Microbial cycling of mercury in contaminated pelagic and wetland sediments of San Pablo Bay, California. Environmental Geology 43:260-267.

National Marine Fisheries Service (NMFS). 2013. Reinitiation of the Endangered Species Act Section 7 Formal Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Aquatic Restoration Activities in the States of Oregon and Washington (ARBO II). 25 April 2013.

Olofson Environmental, Inc. 2012. 2012 Clapper rail surveys for the San Francisco Estuary Invasive Spartina Project. December. Prepared for the State Coastal Conservancy, San Francisco Estuary Invasive Spartina Project, Oakland, California. http://spartina.org/project_documents/revegetation_program/CLRA%20Report%202012.pdf. Accessed on December 4, 2014.

_____. 2014. 2014 Clapper Ridgway's rail surveys for the San Francisco Estuary Invasive Spartina Project. October. Prepared for the State Coastal Conservancy, San Francisco Estuary Invasive Spartina Project, Oakland, California. http://spartina.org/documents/RIRAReport2014_sm_000.pdf. Accessed on December 16, 2014.

Overton, C.T., M.L. Casazza, J.Y. Takekawa, D.R. Strong, and M. Holyoak. 2014. Tidal and seasonal effects on survival of the endangered California clapper rail: does invasive Spartina facilitate greater survival in a dynamic environment? Biological Invasions. doi: 10.1007/s10530-013-0634-5. http://www.werc.usgs.gov/ProductDetails.aspx?ID=5003. Accessed on June 17, 2014.

Paton, P.W.C. and V.C. Bachman. 1996. Impoundment drawdown and artificial nest structures as management strategies for snowy plovers. International Wader Studies 9:64-70.

Philip Williams & Associates, Ltd. and P.M. Faber. 2004. Design guidelines for tidal wetland restoration in San Francisco Bay.

Robinson, C. 2008. Western Snowy Plover Use of Managed Salt Ponds at Eden Landing, Hayward, CA. Masters of Science thesis. San José State University, San Jose, California.

Robinson, A. and B.K. Greenfield. 2011. LTMS Longfin Smelt Literature Review and Study Plan. San Francisco Estuary Institute. Prepared for the Long-term Management Strategy for Dredged Materials in San Francisco Bay.

Robinson-Nilsen, C., K. Tokatlian, J. Scullen, C. Burns, and C. Strong. 2013. Western Snowy Plover Monitoring in the San Francisco Bay, Annual Report 2013. San Francisco Bay Bird Observatory, Milipitas, California and U.S. Fish and Wildlife Service, Newark, California.

Rosenfield, J.A. 2009. Distribution and abundance trends of Longfin smelt in the San Francisco Estuary. Green Sturgeon, Longfin Smelt, and Dredging Operations Symposium. San Francisco Estuary Institute, Oakland, California.

San Francisco Bay Bird Observatory and U.S. Fish and Wildlife Service (Service). 2010. Western snowy plover numbers, nesting success, fledging success and avian predator surveys in the San Francisco Bay, 2010. Prepared by Caitlin Robinson-Nilsen, San Francisco Bay Bird Observatory, Milpitas, California, and Cheryl Strong, Don Edwards San Francisco Bay National Wildlife Refuge, Newark, California. http://www.fws.gov/arcata/es/birds/WSP/documents/siteReports/California/RU3_SNPL_Report_2010.pdf. Accessed on August 11, 2011.

San Francisco Bay Regional Water Quality Control Board. 2006. Mercury in San Francisco Bay Total Maximum Daily Load (TMDL) Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. Final Report. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

San Francisco Estuary Institute. Undated. Salt Marsh Harvest Mouse, *Reithrodontomys raviventris*, Database and Maps. Developed by Howard Shellhammer, H.T. Harvey & Associates. http://www.sfei.org/content/salt-marsh-harvest-mouse-database-and-maps. Accessed on June 16, 2014.

Scheuhammer, A.M., M.W. Meyer, M.B. Sandheinrich, and M.W. Murray. 2007. Effects of environmental health of wild birds, mammals, and fish. Ambio 36:12-18.

Schwarzbach, S. and T. Adelsbach. 2003. Field assessment of avian mercury exposure in the Bay-Delta ecosystem. Final Report to the California Bay Delta Authority. Sacramento, California. pp. 30.

Schwarzbach, S.E., J.D. Albertson, and C.M. Thomas. 2006. Effects of predation, flooding, and contamination on the reproductive success of California clapper rails (*Rallus longirostris obsoletus*) in San Francisco Bay. Auk 123:45-60.

Schwarzbach, S.E., M. Stephenson, T. Ruhlen, S. Abbott, G.W. Page, and D. Adams. 2005. Elevated mercury concentrations in failed eggs of the Snowy Plovers at Point Reyes National Seashore. Baseline 50:1444-1447.

Sexson, M.G. and G.H. Farley. 2012. Snowy plover nest survival in Kansas and effective management to counter negative effects of precipitation. Journal of Wildlife Management 76:1587-1596.

Shellhammer, H. 1978. Studies on *Reithrodontomys raviventris raviventris* in the Alviso Marshes, California. San Francisco Bay National Wildlife Refuge, Newark, California.

South Bay Salt Pond Restoration Project (SBSPRP). 2013. Summary of Recent Mercury and Alviso Slough/Pond A8 Results. Meeting notes taken by Laura Valoppi, Lead Scientist of the South Bay Salt Pond Restoration Project, April 2013.

Spalding, M.G., P.C. Frederick, H.C. McGill, S.N. Bouton, L.J. Richey, I.M. Schumacker, C.G.M. Blackmore, and J. Harrison. 2000. Histologic, neurologic, and immunologic effects of methylmercury in captive great egrets. Journal of Wildlife Diseases 36:423-435.

Thomsen, F.K, Ludemann, R. Kafemann, and W. Piper. 2006. Effects of offshore wind farm noise on marine mammals and fish. Cowrie, Ltd., Hamburg, Germany.

U.S. Fish and Wildlife Service (Service). 1998. Consultation Handbook. Procedures for conducting consultation and conference activities under Section 7 of the Endangered Species Act. U.S. Fish and Wildlife Service and National Marine Fisheries Service. March 1998 Final.

_____. 2006. California Least Tern (*Sternula antillarum browni*) 5-Year Review Summary and Evaluation. Carlsbad Fish and Wildlife Office, Carlsbad, California. 33 pp. http://ecos.fws.gov/docs/five_year_review/ doc775.pdf. Accessed on November 25, 2014.

_____. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In 2 volumes. California/Nevada Operations Office, Sacramento, California. xiv + 751 pages. http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf. Accessed on November 25, 2014.

_____. 2008. Formal Endangered Species Consultation on the South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California. August 12. U.S. Fish and Wildlife Service file number 81420-F-08-0621-1. Sacramento Fish and Wildlife Office, Sacramento, California. 189 pp.

_____. 2010. Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*) 5-Year Review Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. 49 pp. http://www.fws.gov/ecos/ajax/docs/five_year_review/doc3221.pdf. Accessed on February 24, 2014.

_____. 2012a. Don Edwards San Francisco Bay National Wildlife Refuge Comprehensive Conservation Plan. San Francisco Bay National Wildlife Refuge Complex, Fremont, California.

_____. 2012b. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the San Francisco Bay-Delta Population of the Longfin Smelt as Endangered or Threatened; Proposed Rule. Federal Register 77:19755-19797. http://www.fws.gov/sfbaydelta/species/longfin_smelt.cfm. Accessed on November 25, 2014.

_____. 2013. Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. Sacramento Fish and Wildlife Office, Sacramento, California. xviii + 605 pp. http://www.fws.gov/sacramento/es/Recovery-Planning/Tidal-Marsh/es_recovery_tidal-marsh-recovery.htm. Accessed on December 16, 2014.

_____. 2014a. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register 79:72449-72497.

_____. 2014b. 2014 Summer Window Survey for Snowy Plovers on U.S. Pacific Coast with 2005-2013. Arcata Fish and Wildlife Office, Arcata, California. http://www.fws.gov/arcata/es/birds/WSP/plover.html. Accessed on December 16, 2014.

Webber, H.M. and T.A. Haines. 2003. Mercury effects on predator avoidance behavior of a forage fish, golden shiner (*Notemigonus crysoleucas*). Environmental Toxicology and Chemistry (22)7:1556-1561.

Personal Communications

Liu, Leonard. 2012. Biologist, Wetlands Ecology Division, PRBO Conservation Science, Petaluma, California.

Strong, Cheryl. 2012. Wildlife Biologist, Don Edwards San Francisco Bay National Wildlife Refuge, Fremont, California.

Appendix A: Walking In the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife & Plants

December 15, 2004

I. Safety

A. *Before heading out into the marsh check the tides*: tides can affect your ability to move through the marsh. Be aware of how long you plan to be in the marsh, what channels you may have to cross, and how the tides will change while you are in the field.

B. *Plan your route through the marsh*: use existing aerial imagery and maps to identify channels and sloughs that may impede access. When available, use high points such as boardwalks or levees to scope out a route. Scoping a route can be especially important in scenarios where visibility across the marsh is low (*e.g.*, South Bay, Suisun). It may be necessary to flag stations and/or access corridors through the marsh prior to surveys. If more than one person is accessing the marsh, travel together along major access routes to avoid the development of multiple paths. At the end of the sampling period, persons furthest out should walk out first, meeting up with others along the major access route… this minimizes the potential of people getting lost and ensures that anyone who is injured will be found in a timely manner (before everyone else has left the marsh). The goal should be to plan a safe route into and out of the marsh while minimizing travel and pathways.

C. *Channels and sloughs*: Avoid jumping channels in locations where you cannot see through vegetation on the opposite bank. Thick vegetation (*e.g.*, pickleweed, gumplant) can obscure the edge of the bank. Considerations before jumping: depth of water/channel, steepness of the channel edges, tide levels. If you are not confident that you can make the jump and the edges have high dense vegetation that you cannot see through… DO NOT JUMP.

D. *Getting stuck in the mud*: If you are sinking into mud, try to keep moving to avoid getting stuck further. If a leg gets stuck, try to twist your leg to break the suction while leaning your weight on your other leg or knee. Use whatever material you have available (e.g., clipboard, backpack) for leverage (*e.g.*, lean on those items).

E. *Other*: Besides general items such as water and food, it's a good idea to bring a flashlight and a phone (+GPS) in cases of an emergency. Let someone know what marsh area you will be in and when you plan to complete work for the day. Designate an end time and final meeting place when more than one person is out in the marsh at the same time.

II. Avoiding Impacts to Wildlife and Plants

A. *Movement through the Marsh*. While walking through the marsh, keep noise to a minimum. Avoid using multiple pathways through the marsh. Use trails if they exist. Plan and map your route to minimize environmental impacts and decrease running into hazards/barriers such as large channels. When looking for a suitable place to jump a channel, do not walk along the edge of the channel/slough because these areas provide nesting habitat for many species including the endangered California clapper rail. To find an alternate jump site, walk parallel to the channel at a distance where vegetation is lower in height and where visibility

of the ground surface is greater. At all times, observe the environment you are walking through to avoid disturbance. Choose channel jump sites where vegetation is lower or you can clearly discern what you are jumping onto. In general, avoid walking adjacent and parallel to channels/sloughs.

B. *Avoiding nests and nest substrates.* Tidal marsh species have nests that are well concealed and therefore easy to disturb when walking through the marsh. To avoid stepping on a nest, do not walk through thick vegetation or areas where you cannot see through to the ground. Avoid walking on vegetation whenever possible since plants serve as nesting substrate for many species in the marsh. In general, be aware of the area you are walking through.

C. *Bird Behavior.* If a bird vocalizes or flushes within close range of where you are standing or walking (*e.g.*, < 10-m), it is possible that a nest or young are nearby. When these circumstances arise, stop whatever you are doing and leave the immediate area (be sure to watch where and what you are walking on). Choose an alternate route through the marsh, identify the new route and location of the sighting/occurrence on a map, and record coordinates of the location if possible. Be sure to pass this information on to others that may use the same route or are conducting surveys in the same area. Be very observant of where you walk as you leave the area. There exists the possibility that you could step on a nest or young, both of which can be concealed by vegetation and are cryptic. When alarmed, individuals may freeze in place (especially juveniles).

D. *Tidal lagoons/ponds.* Avoid walking along tidal lagoons and ponds in marsh interiors that support foraging, roosting, or nesting shorebirds and waterfowl. Be observant of the distance at which birds flush or become alarmed.

E. *Tides.* Avoid conducting surveys during high tides as much as possible. These are periods when many wildlife species are at greatest risk (*e.g.*, predation). If your surveys require a high tide, be aware of the increased risk you may cause for wildlife and take all precautions to reduce that risk (*e.g.*, avoiding areas where sensitive species are known to occur).

Appendix B9

Pertinent Correspondence

Revised NOTICE OF PREPARATION

From: Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

Subject: **Revised Notice of Preparation of a Draft Environmental Impact Report**

Project Title: South San Francisco Bay Shoreline Phase I Study

State Clearinghouse Number: 2006012020

Project Location: South San Francisco Bay Shoreline between the Guadalupe River and Coyote Creek, San Jose, California.

This NOP updates the previously released joint NOP/NOI dated January 6, 2006 for the South San Francisco Bay Shoreline Study. The revisions are related to changing the CEQA Lead Agency and adding detail to the proposed project description for the Alviso Ponds and Santa Clara County Interim Feasibility Study.

The Santa Clara Valley Water District will be the Lead Agency under CEQA and will prepare an environmental impact report for the above project. The District needs to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but **not later than 30 days after receipt of this notice**.

Please send your response to:

Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118
(408) 630-3095
michaelmartin@valleywater.org

Please provide the name of a contact person in your agency.

FOR Beau Goldie
Chief Executive Officer

18 August 2014
Date

Revised Notice of Preparation
Draft Environmental Impact Report/Statement
South San Francisco Bay Shoreline Phase I Study
Santa Clara County, California
August 2014

Introduction

A joint NOP/NOI was circulated and a public meeting held in 2006 for the entire South San Francisco Bay Shoreline Project, which encompasses all of the bay shoreline in Santa Clara County and the southern portions of San Mateo and Alameda Counties and includes the Alviso, Ravenswood, and Eden Landing pond complexes. The project proponents have decided to move forward with a segment of the overall Shoreline Project for the area between the Guadalupe River and Coyote Creek in San Jose. This NOP is released to obtain comments on a project for the Phase I Study which is focused on this area.

A joint Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) (hereafter referred to as the "EIR/S") will be prepared for the South San Francisco Bay Shoreline Phase I Study (Project). The document will identify and evaluate possible environmental impacts of Project alternatives, and develop strategies to avoid, reduce, or compensate for any significant impacts.

As the lead agency responsible for compliance with the California Environmental Quality Act (CEQA), the Santa Clara Valley Water District (District) has determined that the Project may have a significant impact on the physical environment, and has decided to prepare an EIR/S to provide ample opportunity for public disclosure and participation in the planning and decision making process. The purpose of the draft EIR/S process is to develop and assess a recommended plan and alternatives for the Project and to avoid and mitigate significant adverse effects on environmental resources, while aiming to achieve the primary project objectives.

This document, which serves as the Notice of Preparation (NOP) required by CEQA and the state's CEQA Guidelines (CCR §15082), contains a brief description of the Project, including its goals and objectives, the Project alternatives identified to date, possible environmental impacts, and the resulting need for an EIR/S. It also discusses the process that will be used to determine the scope of analysis in the EIR/S, and provides an overview of the opportunities for participation in review of the EIR/S, along with contact information.

Project Overview

The District, as a local sponsor of the Project, is undertaking the environmental review process in conjunction with the U.S. Army Corps of Engineers (Corps), the federal sponsor, and the U.S. Fish and Wildlife Service, the landowner. Pending the outcome of the environmental review process and any subsequent design revisions to improve the project, the proposed Project will be submitted to the District Board of Directors for their review and potential approval. This process is aimed to provide the public with a clear understanding of the activities, elements, and methods involved with the proposed Project. However, this project description does not presume that the proposed Project is considered approved, or will necessarily be approved until

the complete environmental and planning process occurs according to CEQA guidelines and internal District Project review and approval process. The State Coastal Conservancy is an additional local sponsor and will also need to approve the Project before it will proceed as a responsible agency under CEQA.

Background

The Project area has considerable risk for tidal flooding due to low-lying terrain that is bordered by pond levees originally designed and constructed for commercial salt pond purposes rather than for flood risk management. The levees protecting these areas are mostly dikes that were created as early as the 1920s. The area south of the ponds is now nearly all urbanized with high-value development and includes transportation corridors, a wastewater plant, and other critical infrastructure. In addition, substantial sea level rise expected during the period of analysis for this study (2017–2067) will exacerbate risks from tidal flooding.

A second challenge is that the historic creation of extensive managed salt ponds in the South Bay, as well as filling of marshes and mudflats for landfills and development has resulted in the loss of most tidal salt marsh habitat in the area. In addition, degradation of remaining tidal marsh habitat from water pollution (now mostly abated), habitat fragmentation, and invasive plants has resulted in severe losses of habitat quantity and quality for salt marsh plants and wildlife leading to the listing of several species under the Endangered Species Act (both Federal and State) and severe losses of the ecosystem functions and services associated with tidal marshes and estuaries.

The Project proponents propose to reduce tidal flood risk in the area, which will also facilitate the tidal marsh restoration activity. Both flood risk management and ecosystem restoration are important to the local community and the larger South Bay area.

Goals and Objectives

The investigation of the problems and opportunities in the study area led to the establishment of the following planning objectives:

- Reduce the risk to public health, human safety, and the environment due to tidal flooding along the South Bay shoreline in Santa Clara County.
- Reduce potential economic damages due to tidal flooding in areas near the South Bay shoreline in Santa Clara County.
- Increase contiguous tidal marsh to restore ecological function and habitat quantity, quality, and connectivity in the Study Area for native, resident plant and animal species, including special-status species such as steelhead trout, California clapper rail, and salt marsh harvest mouse.
- Provide opportunities for public access, education, and recreation in the Study Area.

Alternatives Being Considered

A range of project element alternatives have been developed, including a No Project alternative, all of which will be discussed in the EIR/S. The project elements include:

Levee Segment
Three levee alignments are considered between the Guadalupe River (at the Alviso Marina) and Artesian Slough. This levee would address flood risk to the community of Alviso and State Route 237, which is an important commuter corridor for Silicon Valley. The community of Alviso has a history of fluvial flooding from Guadalupe River, which is east of the community. As a result, many of the residential structures have been rebuilt or raised substantially so that the finished floor elevation is as much as 6 feet or more above the ground. Fluvial flood risk has been reduced through local and Federal projects. However, flood risk in the Alviso area is the highest of any area along San Francisco Bay because of subsidence from historical groundwater withdrawal to support the historical agricultural industry.

The three potential alignments include Alviso North, Alviso Railroad Spur; and Alviso South. The Alviso North alignment, which is located entirely on Refuge lands, would roughly follow the western and northern outer levees of the New Chicago Marsh along the existing margins of Ponds A12, A13, and A16. It would be the farthest from the community of Alviso, and extend flood risk management to the Marsh. The Alviso South alignment would follow the southwest outer levee of New Chicago Marsh and would be the closest to the community of Alviso. The Alviso Railroad Spur alignment would coincide with the Alviso North alignment on the western portion, follow the alignment of the existing railroad spur levee through the Marsh, and coincide with the Alviso South alignment at the eastern portion. This alignment would be located between the North and South alignments and be intermediate in distance from the community of Alviso.

A railroad gate would be constructed across the Union Pacific Railroad tracks where they cross the proposed levee. A tide gate is proposed across Artesian Slough to prevent water from overtopping existing levees along the slough during future high-tide events. From Artesian Slough to Coyote Creek the levee would follow the Water Pollution Control Plant (WPCP) South alignment that runs west to east in a stair-step pattern along the north border of the existing WPCP infrastructure to the existing levee along the eastern side of Pond A18. A separate WPCP North alignment that partially bisects Pond A18 was determined to be infeasible.

Ecosystem Restoration
The habitat restoration strategy is to convert the former salt ponds in front of the proposed levee into tidal wetlands through a phased restoration process guided by adaptive management. Currently, the managed ponds provide habitat for migratory birds and waterfowl, and the project proponents are committed to maintaining these populations. However, there is also a bay-wide goal to increase the acreage of tidal marsh and associated habitats. Without a project, the ponds would continue to be managed as ponds, potentially with some limited enhancement to support the species that currently use the ponds. Restoring the ponds without a flood control element would put inland areas at flood risk.

Restoration actions seek to establish vegetated tidal wetlands with goals of maximizing long-term habitat benefits, particularly in consideration of potential sea level rise. Two levels of restoration are considered; "basic," which represents a baseline of actions needed to restore the ponds, and "accelerated," which involves more direct intervention and additional actions above the basic level to speed up the restoration process.

Transitional Habitat
Transitional habitat is defined as a transition area between two distinct habitats (in this case, tidal wetland and upland habitat on the levee). Transitional habitat can provide large expanses of habitat that have been missing from the Bay, attenuate waves and reduce wave run-up, and

increase habitat resiliency by providing space for marshes to retreat inland in the face of sea level rise. Three levels of transitional habitat are considered: 100:1 slopes, which would provide the most expansive habitat; 30:1 slopes; and a 50-foot-wide flat bench to provide a minimal amount of refugia immediately following construction.

Recreation Measures
Recreation measures are included to provide additional recreation benefits associated with proposed ecosystem restoration features and to compensate for the loss of public access as the ponds in the Refuge are breached and restored to tidal marsh. The recreation measures include multi-use trails on top of the new proposed flood risk management levee with connection to the Bay Trail network, viewing platforms and benches, and trail upgrades to be made to an existing segment of the Bay Trail system along State Route 237.

Preferred Alternative

The District preferred alternative would include engineered levees along the Alviso North and WPCP South alignments following existing levees built to protect against the 1-percent tidal event with anticipated sea level rise; a tide gate across Artesian Slough; "basic" restoration of Ponds A9, A10, A11, A12, A13, A14, A15, and A18; a transition habitat slope of 30:1; and the recreation measures. The flood protection components would be constructed between 2017 and 2020. Restoration of the ponds and recreation elements would take place between 2020 and 2031 with monitoring and adaptive management occurring throughout the period. See Figure 3.

Other alternatives to be evaluated in the EIR/S are shown below. The District preferred alternative is listed as "Alternative 3".

Alternatives To Be Evaluated in the EIR/S

Alternatives		Flood Risk Management		Ecosystem Restoration	
Alt #	**Summary**	**Alignment**	**LOP**	**In-pond Preparation**	**Transitional Habitat**
1	No Action	None	Existing	None	None
2	Alviso North with 4% ACE and Bench	North	25-year	Basic	50-foot-wide bench
3	Alviso North with 1% ACE and 30:1 Ecotone	North	100 year	Basic	Ecotone with 30:1 side slopes
4	Alviso Railroad with 1% ACE and Bench	Railroad Spur	100 year	Basic	50-foot-wide bench
5	Alviso South with 1% ACE and Bench	South	100 year	Basic	50-foot-wide bench

ACE= Annual Chance of Exceedance; LOP = Level of Protection;

Topics to be Analyzed in the Draft EIR

Based on the proposed project's potential for significant impacts on the environment, the District with the Corps will prepare a joint EIR/S. The EIR/S will serve to further assess the proposed project's effects on the environment, to identify significant impacts, and to identify feasible mitigation measures to reduce or eliminate potentially significant environmental impacts. An

analysis of alternatives to the proposed project will also be included in the document. Topics to be analyzed in the EIR/S, include but are necessarily limited to the following: aesthetics, air quality, biological resources, cultural and paleontological resources, soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use, noise, recreation, transportation and traffic, and utilities. Responses received to this NOP may modify or add to the preliminary assessment of potential issues addressed in the EIR/S.

Environmental Procedures

This NOP initiates the CEQA process through which the District in conjunction with the Corps and the USFWS will refine the range of issues and project alternatives to be addressed in the EIR/S. Comments are invited on the proposal to prepare the EIR/S and on the scope of issues to be included.

Please submit any comments within 30 days of receipt of this notice to Michael Martin, the District's environmental planner for the South San Francisco Bay Shoreline Phase I Study, at the Santa Clara Valley Water District (see *Contact Information* below). After the 30-day review period for the NOP is complete, a draft EIR/S will be prepared in accordance with CEQA, as amended (Public Resources Code §21000 et seq.), the State Guidelines for Implementation of CEQA (CCR §15000 et seq.), and NEPA.

Once the draft EIR/S is completed, it will be made available for a minimum 45-day public review and comment period. Copies of the draft EIR/S will be sent directly to those agencies commenting on the NOP, and will also be made available to the public at a number of locations, including the District headquarters and public libraries in the area. Information about availability of the draft EIR/S will also be posted on the District's website (http://www.valleywater.org) and at the Shoreline Study's website (http://www.southbayshoreline.org).

Contact Information

For further information, contact the following:

Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3686
(408) 630-3095
Michaelmartin@valleywater.org

Additional information relevant to the project and the EIR/S can also be found at http://www.valleywater.org and http://www.southbayshoreline.org

Figure 1: Location Map

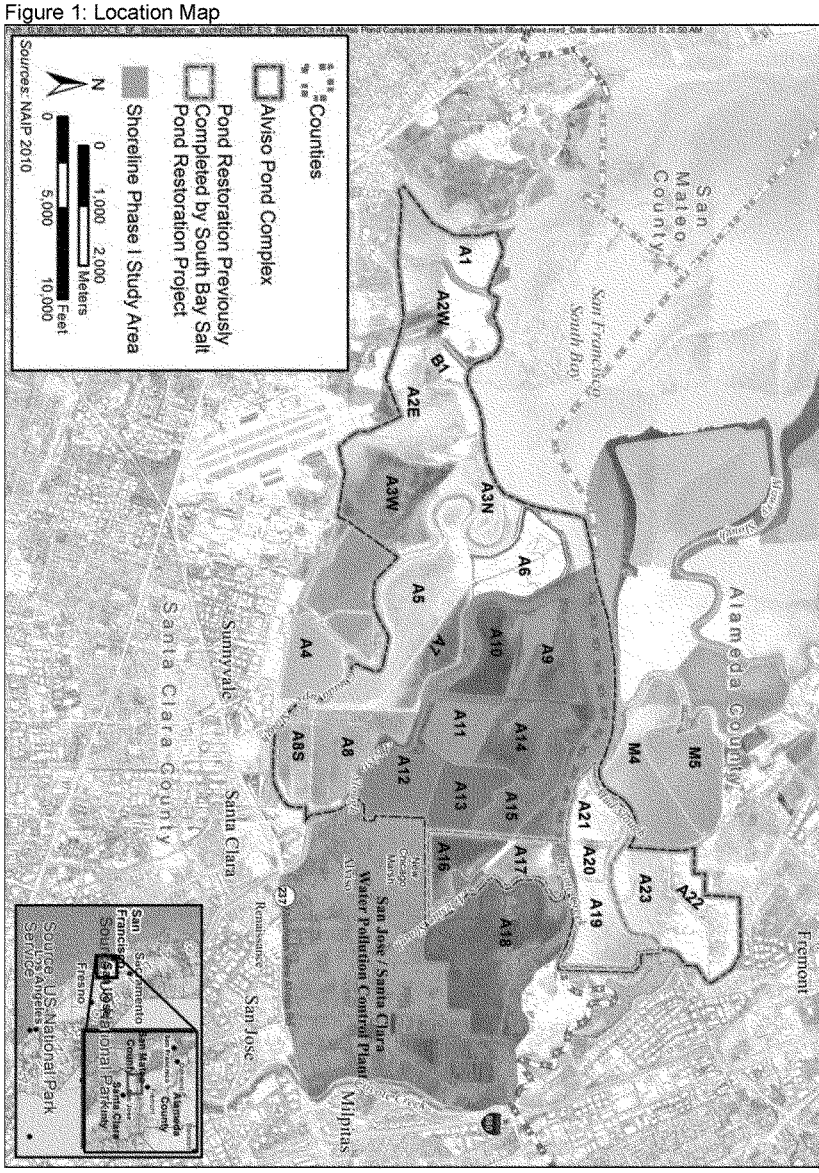


Figure 2: Alviso Levee Segment Alternatives

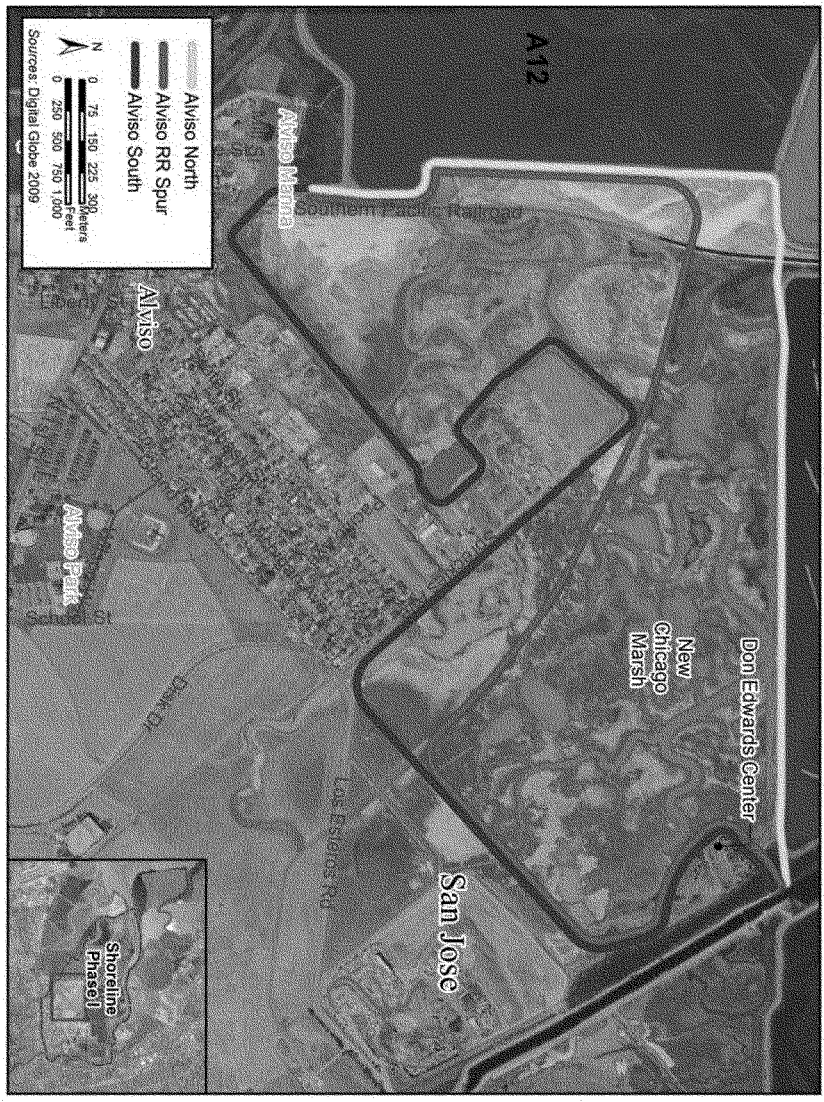
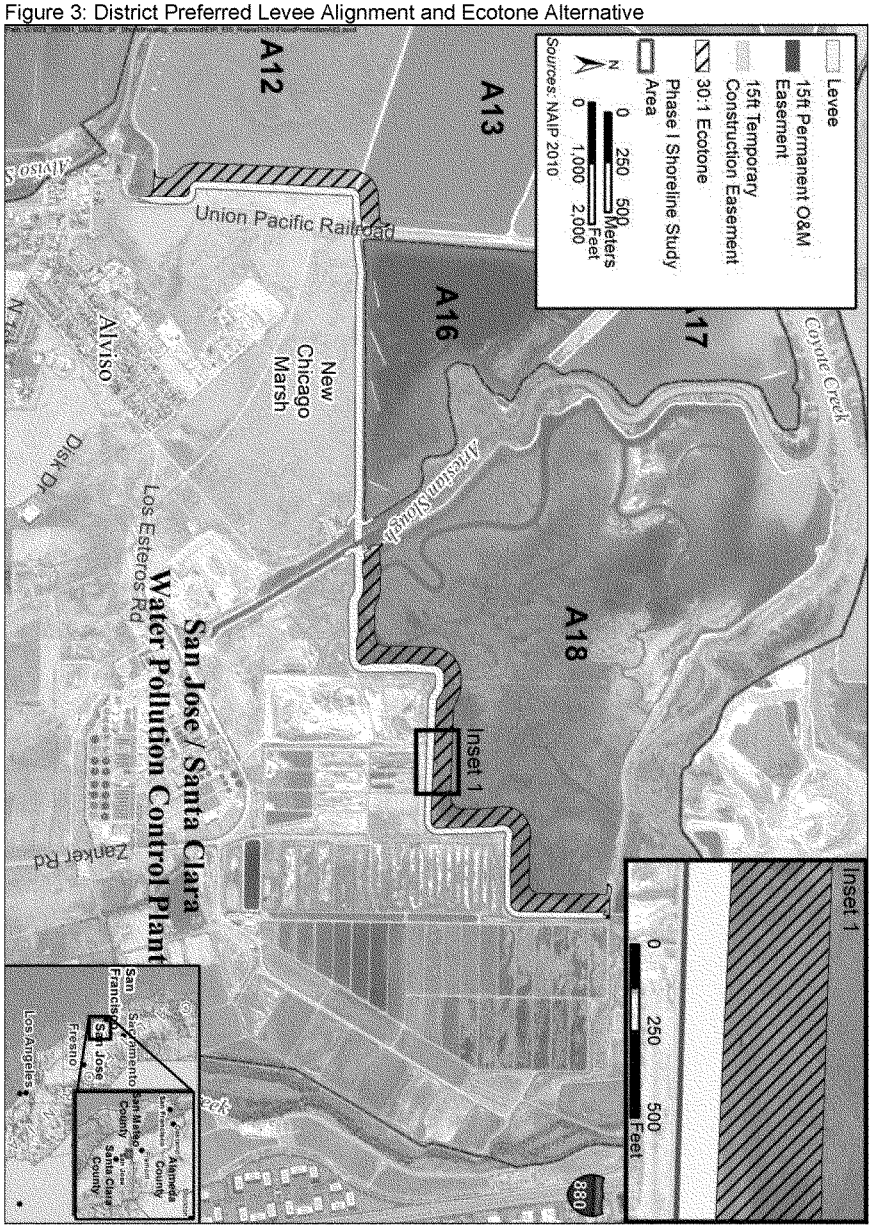


Figure 3: District Preferred Levee Alignment and Ecotone Alternative



NOTICE OF PREPARATION/NOTICE OF INTENT

Subject: Notice of Preparation/Notice of Intent of a Draft Environmental Impact Statement/ Environmental Impact Report/Feasibility Report for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study

The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, Lead Agencies under NEPA, and the California Coastal Conservancy, Lead Agency under CEQA, will prepare a joint project-level Environmental Impact Statement (EIS)/Environmental Impact Report (EIR)/Feasibility Report, hereafter called the Report, for the first Interim Feasibility Study component of the South San Francisco Bay Shoreline Study. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use the Report when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but not later than 30 days after receipt of this notice. A public scoping meeting is scheduled. It will be held on Wednesday, January 25, 2006, from 5:30-8:30 p.m, at 40 North Milpitas Blvd., Milpitas, CA 95035.

Please send your response, and the name of a contact person in your agency, to:

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California, 94612

Date: 1/06/06 Signature: Brenda Buxton

Title: Project Manager

Telephone: (510) 286-1015

SUMMARY

Pursuant to the National Environmental Policy Act of 1969, as amended (NEPA), and the California Environmental Quality Act of 1970, as amended (CEQA), the U.S. Army Corps of Engineers (Corps), the U.S. Fish and Wildlife Service (USFWS), and the California Coastal Conservancy (CCC) intend to prepare a joint project level Environmental Impact Statement / Environmental Impact Report / Feasibility Report (Report) to address the potential impacts of the first Interim Feasibility Study component of the South San Francisco Bay Shoreline Study, San Francisco Bay, California. This study is closely interrelated with the ongoing South Bay Salt Ponds Restoration Project, discussed in the Notice of Intent dated November 9, 2004. It will function as a project-level EIS/EIR tiered under that programmatic EIS/EIR and will be issued subsequently to the programmatic document. The Corps and the USFWS will serve as Joint Lead Agencies under NEPA, and CCC will be the Lead Agency under CEQA.

Lead Agencies Proposed and Connected Actions

The Corps, in cooperation with the USFWS, and the CCC are proposing to study flood protection and ecosystem restoration for the Alviso portion of the South San Francisco Bay (South Bay) Salt Ponds and adjacent areas to determine whether there is a federal interest in constructing a project with flood protection and/or ecosystem restoration components in this area, and if so, to determine the optimum project to recommend to Congress for authorization. The Report will recommend a plan which will provide for long-term restoration for these salt ponds and adjacent areas as well as flood protection and recreation components, if these actions are justified under Federal criteria. The Report and its alternatives will be tiered to the programmatic EIS/EIR for the South Bay Salt Ponds Restoration Project.

SCOPING PROCESS

Public participation in the environmental scoping process is an important step in determining the full scope of issues to be addressed in the Report. The Corps, the USFWS, and the CCC request your comments on the scope and content of the draft joint Report.

A public scoping meeting will be held to solicit comments on the environmental effects of the range of potential projects and the appropriate scope of the Report. The public is invited to comment on environmental issues to be addressed in the Report during this meeting.

Dates

Written comments from all interested parties are encouraged and must be received no later than 30 days after receipt of this notice. A public scoping meeting will be held on Wednesday, January 25, 2006, from 5:30-8:30 p.m. at 40 North Milpitas Blvd., Milpitas, California, 95035. Persons needing reasonable accommodations in order to attend and participate in the public scoping meetings should contact Bill DeJager at (415) 977-8670 at least a week in advance of the meeting to allow time to process the request.

Addresses

Written comments should be sent to Yvonne LeTellier, Project Manager, U.S. Army Corps of Engineers, 333 Market Street, 8th Floor, San Francisco, California, 94105-2197, or Brenda Buxton, Project Manager, California Coastal Conservancy, 1330 Broadway, 11th Floor, Oakland, CA, 94612. Written comments may also be sent by facsimile to (415) 977-8695, or via email through the public comments link on the South Bay Salt Ponds Restoration Project website, at

www.southbayrestoration.org/Question_Comment.html. All comments received, including names and addresses, will become part of the administrative record and available to the public.

SUPPLEMENTARY INFORMATION

On November 9, 2004, the USFWS and the Corps issued a Notice of Intent for the proposed South Bay Salt Ponds Restoration Project programmatic EIS/EIR. The Corps and the USFWS propose to integrate the planning process for the Alviso Pond and Santa Clara County Interim Feasibility Study component of the South San Francisco Bay Shoreline Study with the planning process for the South Bay Salt Ponds Restoration Project. The two projects include ecosystem restoration, flood protection, and public access components. However, the current Interim Feasibility Study is a project-level component of the South Bay Salt Pond Restoration Study and it will be tiered to the above-mentioned programmatic EIS/EIR. This Interim Feasibility Study and the Report to be prepared will only cover a portion of the larger geographic area addressed in the South Bay Salt Ponds programmatic EIS/EIR.

Project Description.
South Bay Salt Ponds Restoration Project.
Project Location: The South Bay Salt Ponds Restoration Project area comprises 15,100 acres of salt ponds and adjacent habitats in South San Francisco Bay that USFWS and California Department of Fish and Game (CDFG) acquired from the Cargill Salt Company in 2003. USFWS owns and manages the 8,000-acre Alviso pond complex and the 1,600-acre Ravenswood pond complex. CDFG owns and manages the 5,500-acre Eden Landing pond complex.

The overarching goal of the South Bay Salt Ponds Restoration Project is to restore and enhance wetlands in the South San Francisco Bay while providing for flood protection and wildlife-oriented public access and recreation. The following project objectives were adopted by the South Bay Salt Ponds Restoration Project's Stakeholder Forum which includes representatives of local governments, environmental organizations, neighboring landowners, businesses, and community organizations:

1. Create, restore, or enhance habitats of sufficient size, function, and appropriate structure to:
   a. 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.
   b. Maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees.
   c. 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.
2. Maintain or improve existing levels of flood protection in the South Bay area.
3. Provide public access and recreational opportunities compatible with wildlife and habitat goals.
4. Protect or improve existing levels of water and sediment quality in the South Bay, and fully evaluate ecological risks that could be caused by restoration.
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 species.
6. Protect the services provided by existing infrastructure (e.g., power lines, railroads).

USFWS and CDFG reviewed the proposed project objectives to ensure compliance with legal mandates, such as compatibility of wildlife with public access. Two additional evaluation factors were identified in the Alternatives Development Framework for comparative analysis:

7. Cost Effectiveness: Consider costs of implementation, management, and monitoring so that planned activities can be effectively executed with available funding.
8. Environmental Impact: Promote environmental benefit and reduce impacts to the human environment.

The South Bay salt ponds are now being managed by the U.S. Fish and Wildlife Service and the California Department of Fish and Game under an Initial Stewardship Plan which was evaluated in a March 2004 Final EIS/EIR. The long-term restoration plan currently under evaluation in the ongoing programmatic NEPA/CEQA process may include general plans for the entire project area as well as detailed design plans for a specific Phase I project.

South San Francisco Bay Shoreline Study.
The Corps plans to prepare a Feasibility Report integrated with an EIS/EIR for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study, pursuant to the following resolution by the U.S. House of Representatives Transportation and Infrastructure Committee, adopted July 24, 2002:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that the Secretary of the Army is requested to review the Final Letter Report for the San Francisco Bay Shoreline Study, California, dated July 1992, and all related interims and other pertinent reports to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of tidal and fluvial flood damage reduction, environmental restoration and protection and related purposes along the South San Francisco Bay shoreline for the counties of San Mateo, Santa Clara and Alameda, California."

Project Location: The South San Francisco Bay Shoreline Study area extends along South San Francisco Bay and includes the Alviso, Ravenswood, and Eden Landing pond complexes which are described above, as well as additional shoreline and floodplain areas in the counties of Alameda, San Mateo, and Santa Clara. The Report referenced in this Notice of Intent would propose implementation of the findings of the first Interim Feasibility Study component of the Shoreline Study. The area to be examined in the first Interim Study consists of 25 ponds in the Alviso pond complex on the shores of the South Bay in Fremont, San Jose, Sunnyvale and Mountain View, located in Santa Clara and Alameda counties, plus substantial adjacent areas which may need flood protection or which may be affected by flood protection or ecosystem restoration measures. The study area is bordered by San Francisco Bay and the operational salt ponds of Alameda County to the north and San Francisquito Creek on the west. To the south and east, the study area extends beyond the salt ponds to include all lands subject to inundation from a 100-year tidal flooding event. These additional lands are primarily urbanized areas in Palo Alto, Mountain View, Sunnyvale, and San Jose to the south, and urbanized lands in Milpitas and Fremont to the east. These lands are generally delineated on maps which are on file with the Corps of Engineers, San Francisco District. During the course of the study the exact delineation of which lands are subject to tidal inundation may be modified based on technical studies.

The Corps proposes to conduct the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study in coordination with the South Bay Salt Ponds Restoration Project and in partnership with the USFWS, the CCC, CDFG, and the Santa Clara Valley Water District (SCVWD). It is expected that the Corps's Report for the first Interim Feasibility Study component of the Shoreline Study will be released after the completion of the South Bay Salt Ponds Restoration Project programmatic EIS/EIR, so the EIS/EIR components of the Report for the Shoreline Study will tier off from the joint programmatic South Bay Salt Ponds EIS/EIR.

Alternatives

The Report will consider a range of alternatives and their impacts, including the No Action Alternative. Scoping will be an early and open process designed to determine the issues and alternatives to be addressed in the Report. For example, the range of alternatives may include varying mixes of managed ponds and tidal marsh habitat as well as varying levels and means of flood management and recreation and public access components which respond to the project objectives.

Content of the Report

The Report will identify the anticipated effects of the project alternatives (negative and beneficial) and describe and analyze direct, indirect, and cumulative potential environmental impacts of the project alternatives, including the No Action Alternative, in accordance with NEPA(40 CFR 1500-1508) and CEQA. For each issue listed below, the Report will include a discussion of the parameters used in evaluating the impacts as well as recommended mitigation, indicating the effectiveness of mitigation measures proposed to be implemented and what, if any, additional measures would be required to reduce the impacts to a less-than-significant level. The list of issues presented below is preliminary both in scope and number. These issues are presented to facilitate public comment on the scope of the Report, and are not intended to be all-inclusive or to be a predetermination of impact topics to be considered.

Biological Resources.
The Report will address the following issues and potential detrimental and beneficial impacts related to biological resources:

- effects on population sizes of endangered species and other species of concern, including California clapper rail, snowy plover, California least tern, salt marsh harvest mouse, Chinook salmon and steelhead trout.
- shifts in populations and effects on population sizes of migratory waterfowl and shorebirds
- increased habitat connectivity for all organisms that use multiple marsh and/or aquatic habitats, including birds, mammals, and fish
- potential for improved habitat connectivity with adjacent upland habitats
- potential loss of hypersaline wetlands and their unique communities
- reduction in predation for species of concern with larger habitat blocks
- increased nursery habitat in wetlands for fish
- potential for salmonid entrainment into managed ponds
- effects of *Spartina alterniflora* and the hybrids of this species, and other invasive species
- effects of flood control structures on existing ecosystem attributes and functions including aquatic and terrestrial species.
- effects of public access and recreation on aquatic and terrestrial species.

Hydrology and Flood Protection.
The Report will address the following issues and potential detrimental and beneficial impacts related to hydrology and flood protection:

- existing and future without-project tidal flood hazards as affected by fluvial inputs
- effects on the tidal regime and tidal mixing from project components, and related effects on salinity of Bay waters
- effects on high-tide water levels and resulting effects on flood hazards
- changes in tidal hydrodynamics, including tidal prism and tidal range in tidal sloughs, resulting changes in channel geometry and changes in tidal flood risks (including during project implementation)

- effects on flood flow conveyance as a result of converting salt ponds to tidal marsh
- potential decrease in wave energy associated with tidal marsh restoration and reduced erosion of flood protection levees
- Impacts on tidal flooding frequency and extent, and flood protection due to breaches in salt pond levees, improvement of existing levees, and construction of new levees
- Impacts on groundwater quality

Water and Sediment Quality.
The Report will address the following issues and potential detrimental and beneficial impacts related to water and sediment quality:

- effects of salt pond levee breaches, including changes in salinity, turbidity, dissolved oxygen, biochemical and biological oxygen demand, metals, polychlorinated biphenyls (PCBs), and other pollutants of concern.
- changes in residence time of water in the South Bay and related effects on water quality.
- changes in mercury and/or methyl mercury concentrations, and other pollutants of concern, in Bay and slough waters.
- potential to mobilize existing sediment contaminants, including mercury, PCBs, and other pollutants of concern.
- potential contamination from outside sources, including urban runoff, wastewater discharges, imported sediment and atmospheric deposition.

Recreation and Public Access.
The Report will address the project's effects on existing recreation facilities and their use as well as the potential effects of expansion or creation of new facilities. The benefits and impacts of increased or decreased public access on biological resources and achievement of other project objectives will also be addressed.

Economics.
The Report will evaluate the economic effects of the alternatives, including costs and benefits of flood protection, recreation, and effects on commercial fishing.

Cumulative Impacts.
The Report will examine the cumulative impacts of past, ongoing, and reasonably foreseeable future projects affecting tidal marsh and estuarine habitats in the South Bay, as well as effects on adjacent urban and rural lands and communities.

Environmental Analysis Process

The Report will be prepared in compliance with NEPA and Council on Environmental Quality Regulations, contained in 40 CFR parts 1500 - 1508; and with CEQA, Public Resources Code Sec 21000 et seq., and the CEQA Guidelines as amended. Because requirements for NEPA and CEQA are somewhat different, the document must be prepared to comply with whichever requirements are more stringent. The Corps and the USFWS will be Joint Lead Agencies for the NEPA process and the CCC will be the Lead Agency for the CEQA process. In accordance with both CEQA and NEPA, these Lead Agencies are responsible for the scope, content, and legal adequacy of the document. The SCVWD will be a Responsible Agency under the provisions of CEQA. Therefore, all aspects of the Report scope and process will be fully coordinated between these four agencies.

The scoping process will include the opportunity for public input during a public meeting and by written comments submitted during the 30-day scoping period.

The draft Report will incorporate public concerns associated with the project alternatives identified in the scoping process and will be distributed for at least a 45-day public review and comment period. During this time, both written and verbal comments will be solicited on the adequacy of the document. The final Report will address the comments received on the draft during public review and will be made available to all commenters on the draft Report. Copies of the draft and final reports will be posted on the Internet as part of the public review process.

The final step in the Federal EIS process is the preparation of a Record of Decision (ROD), a concise summary of the decisions made by the Corps and the USFWS. The ROD will identify the alternative selected by the agencies and other alternatives that were considered. It also will discuss the mitigation measures that were adopted. Because there are two lead agencies, it is possible that each agency will prepare its own ROD. The Record, or Records, of Decision may be published no earlier than 30 days after publication of the Notice of Availability of the final EIS. The final step in the State EIR process is certification of the EIR, which includes preparation of a Mitigation Monitoring and Reporting Plan and adoption of its findings, should the project be approved.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay National Wildlife Refuge Complex
1 Marshlands Road
Fremont, California 94555

May 28, 2015

Caleb Conn
Project Manager
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, CA 94103

Re: South San Francisco Bay Shoreline Study Phase 1 Project – Refuge coordination in the study's planning process

Dear Mr. Conn,

This letter serves as documentation of the United States Fish and Wildlife Service's (USFWS) Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) participation in the South San Francisco Bay Shoreline Study Phase 1 Project (South Bay Project), in response to comments from the USACE headquarters on the Draft Interim Environmental Impact Statement/ Environmental Impact Report/Feasibility Report (Integrated Document), specifically: "*Lastly, there does not appear to be any correspondence or affirmation from the USFWS' Don Edwards National Wildlife Refuge acknowledging or providing input into the planning process. Has nothing been received from the Refuge or was it just not included in the draft report?*"

The USFWS has been engaged in the Shoreline Study at least since 2003 with the acquisition of the large complex of former commercial salt ponds from Cargill and its addition to the Refuge to be managed for wildlife and habitat conservation. Following the acquisition, the Corps concluded that there was a Federal interest in a South Bay Project, given that USFWS would not be able to provide flood risk management, and that the public benefits of a large scale multipurpose flood protection/ ecosystem restoration project could only be realized with the Corps assistance.

The Refuge Manager, with technical assistance from Refuge staff and the Department of the Interior San Francisco Field Office of the Solicitor's legal counsel, actively participated in crafting early supporting documents such as Issue Resolution Conference White Papers on future-without project assumptions and land access policy. Pursuant to NEPA, the USFWS joined the Corps as a Federal Co-Lead and jointly issued a Notice of Intent to Prepare an Integrated Environmental Impact Statement/Environmental Impact Report/Feasibility Report for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study, published on January 6, 2006 (Federal Register Vol. 71, No. 4). Further, the USFWS is an integral partner in the multi-agency collaborative South Bay Salt Pond Restoration Project, which is closely interrelated with the South Bay Project.

The Project Leader for the San Francisco Bay National Wildlife Refuge Complex (of which the Don Edwards Refuge is one of seven units) has participated as a Principal on the South Bay Project Executive Team for the past several years (both I and my predecessor, Mendel Stewart). Additionally, the Refuge Manager and /or his staff have participated on the Shoreline Management Team for at least the past few

years. Several Refuge staff reviewed and provided edits as well as supporting references to the Draft Integrated Document; however, the Refuge was inadvertently left off of the List of Preparers in Chapter 7.0. A list of names is enclosed for incorporation into the Final Integrated Document.

I and my staff will continue to provide technical assistance to completing the Final Integrated Document and its associated responses to comments, as necessary, as well as the Implementation Guidance submittal package and other supporting materials necessary for reaching a final Chief's Report and ultimately project authorization and implementation. Please let me know if you have any further questions.

Sincerely,

Anne E. Morkill
Project Leader
San Francisco Bay National Wildlife Refuge Complex
Pacific Southwest Region
U.S. Fish and Wildlife Service

Addendum to List of Preparers (Chapter 7.0), Integrated Environmental Impact Statement/Environmental Impact Report/Feasibility Report for the South San Francisco Bay Shoreline Study

USFWS Don Edwards San Francisco Bay National Wildlife Refuge (USFWS)

Name	Discipline	Role in Preparing Report
Anne Morkill	Refuge Complex Manager	Exec Team representative for Refuge; general document QC
Eric Mruz	Refuge Manager	PDT representative for Refuge; general document QC
Melisa Amato	Wildlife Refuge Specialist	PDT representative for Refuge; general document QC
Cheryl Strong	Wildlife Biologist	General review and updates of text in Integrated Document
Rachel Tertes	Wildlife Biologist	General review and updates of text in Integrated Document
Jennifer Heroux	Visitor Services Specialist	General review and updates of text in Integrated Document
Patricia Roberson	Planner/NEPA Coordinator	General review and updates of text in Integrated Document; environmental NEPA support

Rev 5/28/2015

Draft Integrated Document Distribution (copy of document)

United States Environmental Protection Agency, Region IX

U.S. Fish and Wildlife Service, California Fish and Wildlife Office

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Alameda County Mosquito Abatement District
Alameda County Public Works Agency
Alameda County Water District
Alameda Creek Alliance
Alcalde & Fay
Alviso Water Task Force
ALZA Corporation
AMEC Earth and Environmental
American Canyon Eagle/Napa Valley Register
American River College
American Rivers
A-N West, Inc.
ANG Newspapers
Applied Marine Sciences
Applied Materials Inc.

Aquarium of the Bay
Aquarium of the Pacific
Archibald & Wallberg Consultants
Art Anderson Associates
Asian Week
Aspen Environmental Group
Assoc. General Contractors of California
Association of Bay Area Governments (ABAG)
Audubon Society (Sequoia Chapter)
Avian Research Associates
Avocet Research Associates
AWTF
BART-Capitol Corridor Planning Group
Bay Area Air Quality Management District
Bay Area Open Space Council
Bay Area Ridge Trail
Bay Area Sea Kayakers
Bay Institute
Bay Nature
Bay Nature Magazine
Bay Planning Coalition
BayCrossings
Baykeeper
Beyond Searsville Dam
Biggs Cardosa Associates
Biodiversity Resources Center
Bio-Integral Resource Center
Boston University, Marine Biological Program
Boy Scouts
Brown & Caldwell
California Air National Guard
California Coastal Commission
California Department of Conservation
California Department of Fish and Wildlife
California Department of Health Services

California Department of Pesticide Regulation
California Department of Toxic Substances Control
California Department of Transportation, District 4
California Department of Water Resources
California Department of Water Resources, Bay Delta Office
California Emergency Management Agency
California Marine Affairs Navigation Conference (CMANC)
California Native Plant Society - SC Chapter
California Native Plant Society- Marin Chapter
California Natural Resources Agency
California Office of Historic Preservation
California Recreational Boaters of California
California Resources Agency
California State Coastal Conservancy
California State Governor's Office
California State Lands Commission
California State Parks Division of Boating and Waterways
California State University, Stanislaus
California Trout Inc.
California Waterfowl Association
California Wildlife Conservation Board
California Wildlife Foundation
Cardinal Photo
Cargill Salt
Carollo Engineers
Castro Valley Sanitary District
CCCR/Ohlone Audubon
CDFG
Center for Collaborative Policy
Center for Development of Recycling
Center for Ecosystem Management and Restoration
Center for Public Oversight
CH2M Hill
Children's Discovery Museum BioSITE
Citizens Committee to Complete the Refuge
City of Alameda Health Care District

City of Berkeley Shorebird Nature Center
City of Concord
City of Cupertino
City of East Palo Alto
City of Foster City
City of Fremont
City of Hayward
City of Los Altos, Public Works Dept.
City of Menlo Park
City of Milpitas
City of Monte Sereno
City of Mountain View
City of Newark
City of Oakland, Environmental Service Division
City of Palo Alto
City of Petaluma
City of Redwood City
City of San Francisco, PUC
City of San Jose
City of San Jose, City Facilities Architectural Services Public Works
City of San Jose, Dept. of Parks, Recreation & Neighborhood Services
City of San Jose, Environmental Services
City of San Jose, Planning Department
City of San Mateo
City of Santa Clara
City of Saratoga
City of Sunnyvale
City of Union City
CLEAN South Bay
Clean Water Fund
Coast & Harbor Engineering, LLC
Coastal Conservancy
College of the Redwoods Honors Program
Committee for Green Foothills
Concept Marine Associates

Contra Costa County Community Development
Contra Costa Flood Control District -Public Works Dept.
Contra Costa Times
Contra Costa Vector and Mosquito Control District
Cooper Crane
Crissy Field Wetlands Project
CSU Hayward
CSU-East Bay
CWA
Dall & Associates
Danish Hydraulic Institute
De Anza College
Defenders of Wildlife
Department of Fish and Game
Department of the Interior
DFG
DFG -Project Wild
Diane Renshaw Consulting Ecologist
Dinwiddie & Associates
DIO/OEPC
DOE Joint Genome Institute
Don Edwards SF Bay National Wildlife Refuge
DTSC
Dublin-San Ramon Services District
Ducks Unlimited
Earth, Air, & Space Educational Foundation
Earthwatch Institute
East Bay Bicycle Coalition
East Bay Conservation Corps
East Bay Dischargers Authority
East Bay Regional Park District
EBMUD
EBRPD
ECORP Consulting, Inc.
EDAW, Inc.

Eden Shores Community

EIP Associates

Eisenberg, Olivieri & Associates Inc. (EOA)

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Estuarine Engineering Branch

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Fishing in the City

Floating Islands West

Foothill College

Fresno Audubon Society

Friend of Alameda NWR

Friends of Adobe Creek

Friends of Bayfront Park

Friends of Calabazas Creek

Friends of Corte Madera Creek Watershed

Friends of Five Creeks

Friends of Novato Creek

Friends of Sausal Creek

Friends of Stevens Creek Trail

Fugro West, Inc.

Gahagan & Bryant Associates, Inc.

GAIA Consulting, Inc.

Geomatrix Consultants

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Great Eastern Ecologyy, Inc.
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HAN-PADRON ASSOCIATES, LLP
Hanson Environmental, Inc.
HASPA Citizens Advisory Committee
Hayward Area Recreation and Park District
HDR Engineering Inc.
Hidden Villa
High School Programs/Leadership Corp.
Hispanic Chamber of Commerce
HMH Inc.
Home Builders Association, South Bay
Huffman-Broadway Group, Inc
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Hydro Science
Hydroikos Associates
Hydroscience Engineers, Inc.
Jasper Ridge Biological Preserve
Jensen Corp./Jensen Landscape Services Inc.
Johnson & Johnson
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K&AES, INC.
Kamman Hydrology & Engineering
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Kleinfelder
KQED
KTEH
Lake Merritt Breakfast Club

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Los Angeles Times
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LWV for Fremont/Newark/Union City & LWVBay Area Nat.Res/Water Board Chair
Malcolm Pirnie, Inc.
Marin Audubon
Marin County Public Works Dept.
Marin Independent Journal
Marine Mammal Center
Marine Science Institute
Math Science Nucleus
Mayne Elementary School
McGuire and Hester Construction
McNeese State University
MEC Analytical Systems Inc.
Menlo High School
Menlo Park Environmental Commission
Menlo Park Planning Commission
Metropolitan Transportation Commission
Midpeninsula Regional Open Space District
Moffatt & Nichol Engineers
More Fishing
Morgan Hill Chamber of Commerce
MPBTA

Mt. Pleasant High School
Murray Engineering & Consulting
Museum of Local History
MWH
Napa County Flood Control Dist.
Napa County Mosquito Abatement District
Napa County RCD
NASA
NASA Ames Research Center
NASA-JPL
National Fish & Wildlife Foundation
National Park Service
Native American Heritage Commission
Natural Heritage Institute
Newscolor, LLC
NOAA
NOAA
NOAA -National Marine Fisheries Service
NOAA -National Marine Fisheries Service, Habitat Conservation Branch
NOAA -National Ocean Service
NOAA Restoration Center
North Salinas Valley Mosquito Abatement District
Northwest Hydraulics
Novo Nordisk
NRDC
Ocean Sciences
Office of Supervisor Rose Jacobs Gibson
Ohlone Audubon Society
Oklawaha Farms, Inc.
One-to-One Tutoring Service
Our City Forest
Pacific EcoRisk
Pacific Gas & Electric Co.
Pacific Inter-Club Yacht Association
Pacific Sun

Palo Alto Baylands Nature Center
Palo Alto Daily News
Palo Verde Residents Association
Pelican Media
Peninsula Open Space Trust
People for Livable and Affordable Neighborhoods (P.L.A.N.)
PM Strauss & Associates
Point Reyes Bird Observatory
Point Reyes National Seashore
Port of Oakland
Port of Redwood City
Port of San Francisco
Presidio Trust
PWA
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Questa Engineering Corporation
RanaResources
Refuge EEC
Regional Water Quality Control Board
Rep. Mike Honda's office
Resources Law Group
Resources Legacy Fund
Restore Coyote Creek
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Riparian Habitat Joint Venture
River of Words
Romberg Tiburon Center
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S.S. Papadopulos & Associates
Sacramento Bee
Salmon & Trout Enhancement Program
Salt River Construction
San Francisco Bay Area Water Transit Authority
San Francisco Bay Bird Observatory
San Francisco Bay Brands

San Francisco Bay Conservation and Development Commission
San Francisco Bay Joint Venture
San Francisco Bay National Wildlife Refuge
San Francisco Bay Regional Water Quality Control Board
San Francisco Baylands Ecosystem Habitat Goals
San Francisco Boardsailing Association
San Francisco Conservation Corps
San Francisco Invasive Spartina Project
San Francisco Planning Department
San Francisco Public Utilities Commission
San Francisco State University
San Francisco State University, Biology Dept.
San Joaquin Regional Rail Commission
San Jose Conservation Corps & Charter School
San Jose Mercury News
San Jose Public Library- Alviso Branch
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San Jose Public Library- Seventrees Branch
San Jose Public Library- Willow Glen Branch
San Jose State University
San Jose State University, Dept. of Biological Sciences
San Mateo County
San Mateo County Board of Supervisors
San Mateo County Bridge Trails Committee
San Mateo County Clerk-Recorder's Office
San Mateo County Env. Health
San Mateo County Harbor District
San Mateo County Mosquito Abatement District
San Mateo County MVCD

San Mateo County Planning Commission
San Mateo County Resource Conservation District
San Mateo County Trails Committee
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Santa Clara County Parks & Recreation Department
Santa Clara County Planning Office
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Santa Clara County, Office of Supervisor Dave Cortese
Santa Clara Open Space Authority
Santa Clara University
Santa Clara Valley Audubon Society
Santa Clara Valley Urban Runoff PPP
Santa Clara Valley Water District
Santa Cruz County Mosquito Abatement District
Santa Monica Bay Restoration Commission
Save Bayfront Park
Save Our South Bay Wetlands
Save The Bay
Save the Wetlands in Mayhews
SBYC/ANG
Schaaf & Wheeler
SCVAS
SEEDS
Semiconductor Industry Association
Senator Dianne Fienstein's Office
Sequoia Analytical Laboratory
SF Bay Trail

SFEI

SFO

SFPUC

SFSU Recreation and Leisure Studies

Shaw Environmental & Infrastructure

Shaw Environmental, Inc.

Shoreline Park in Mountain View

Sierra Club, Loma Prieta Chapter

Sierra Club, SF Bay Chapter

Silicon Valley Association of Realtors

Silicon Valley Bicycle Coalition

Silicon Valley Engineering Council

Silicon Valley Land Conservancy

Silicon Valley Leadership Group

SLR International

Solano County Mosquito Abatement District

Sonoma County Water Agency

Sonoma Ecology Center

Sonoma Land Trust

Sound Watershed

Southbrook Homeowners Association

Southern California Coastal Water Research Project

Southern Illinois University in Carbondale

Southern Sonoma RCD

SRI International

Stanford University

State Assemblyman, 22th District

State Coastal Conservancy

State Lands Commission

Student Conservation Association

SVLG

Sycamore Associates

Tahoe Research Group

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University of Nevada
University of New Orleans
University of San Francisco, Biology Department
University of Twente
University of Virginia
University of Washington, School of Aquatic and Fishery Sciences
University of Western Australia
Urban Creeks Council
URS Corporation
U.S. Army Corps of Engineers
U.S. Army Corps of Engineers HQ

U.S. Army Corps of Engineers S. Pacific Div.
U.S. Army Corps of Engineers Sacramento District
U.S. Army Corps of Engineers SF District
U.S. Coast Guard
U.S. Department of Agriculture Natural Resources Conservation Service
U.S. Department of the Interior, Office of Environmental Policy and Compliance
U.S. Environmental Protection Agency, Office of Clean Water Act Compliance
U.S. Environmental Protection Agency, Region 9
U.S. Fish & Wildlife Service
U.S. Fish & Wildlife Service - Don Edwards SF Bay National Wildlife Refuge
U.S. Senator Diane Feinstein
U.S. Geological Survey
U.S. Geological Survey, Pacific Science Center
U.S. Geological Survey, Western Ecological Research Center
U.S. Geological Survey, Western Fisheries Research Center
U.S. Geological Survey /Humboldt State
U.S. Geological Survey /WERC
Vali Cooper & Associates, Inc.
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Valley & Mountain Consulting
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Watershed Sciences
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West Valley Sanitation District
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Wildlife Stewards

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Wolfe Mason Associates

WRA, Inc.

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www.earthandbeauty.com

Zentner and Zentner

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Seth	Adams
William	Ahern
Christina	Ahlers
Ariel	Ambruster
Sioux	Ammerman
Gavin	Archbald
Jim	Armstrong
Grant	Ballard
Robert	Bamford
Megha	Bansal
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Cesent	Calimpong
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Jackie	Cohen
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David	Cook

Katharine	Cook
Terry	Cooke
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Wilson	Doctor
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Linda	Gass
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Matthew	Greuel
Salena	Grewal
Marty	Grimes
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Cristina	Grosso
Jon	Hallberg
Srinivas	Hanabe
Katrina	Harrison
Dennis	Haussler
John S.	Haydon
Dan	Heimann
Jerry	Heinrichs
Michael	Henderson
Mark	Hendren
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Yolanda	Hernandez
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Gregory	Hoffman
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Joshua	Hoyt

Joshua	Huber
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Kelly	Jost
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Erin	Justice
Zach	Katz
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Aaron	Lee
Therese	Lee
Bea	Leija
Don	Lepley
Bill	Lev
Joyce	Lewis
Dan	Liddell
Sally	Lieber
Mike	Linden
Cynthia	Lipford
Jane Braxton	Little
Sally	Liu
Bill	Lock
Vicki	Logan
Jeremy	Lowe
Libby	Lucas
John	Lukas

John	Luongo
Joseph	Lutzweit
Tom	Madalena
Alberta	Maged
John	Magee
Julianna	Mandler
John	Margowski
Herb	Masters
Regina	Maurantonio
Olivier	Mazeas
Tripp	McCandlish
Jim	McDermott
Theresa	McDermott
Joanne	McFarlin
Nancy	McKown
Caitlin	McLaughlin
Jim	Meyers
Michael	Millar
Mike	Miller
Gaurav	Misra
Kevan	Moffett
Karen	Monahan
Genie	Moore
Jennifer	Moore
Maritza	Mullen
Angus	Mullins
Stacia	Mumm
Dan	Murphy
Seamus	Murphy
Jim	Murray
John	Neibel
Denis	Newman
Daisy	Nguyen
Wes	Nichols
Angela	Obando
Davinna	Ohlson
Jorge	Ordonez
Mary	Pakenham-Walsh
Beth	Pardieck
Dave	Paullin
Heidi	Peirce
Alan	Pobanz
Eric	Polson

Matt	Polvorosa Kline
Roger	Potash
Brian	Potter
Roy	Powers
Paul	Prange
Jonah	Probell
Evan	Raymond
Bill	Reddy
Jeff	Reese
Paul	Reisentz
Christian	Reyes
Sarah	Richmond
Marijke	Rijsberman
John	Roselli
Susan	Rosenthal
Wayne	Roth
Pati	Rouzer
Ariel	Rowan
Homa	Rozan
Mike	Rugg
Carol	Runge
Steve	Rutledge
David	Salinero
Edgar	Salire
Noelani	Sallings
Rolane	Santos
Red	Schlichting
Ann	Schneider
Kristin	Schuster
Rob	Schusteritsch
Clysta	Seney
Drew	Seutter
	seutter
Andrea	Shea
Judy	Sheen
Danny	Shewey
Jeff	Sicklesteel
Jack	Smith
K	Smith
Kyle	Smith
Carolyn	Smyth
Kimberly	Snyder
Jana	Sokale

Jacqueline	Solomon
Joie	Spooner
Pam	Squyres
Dan	Stammerjohn
James	Stattion
Vince	Staub
Hugo	Steemers
Richard	Stovel
Carolyn	Strange
Anne	Sturm
Dennis	Sugar
Terrence	Sullins
Barbara	Sulser
Karen	Sundback
Lisa	Sy
Jan	Talbert
Joshua	Tallis
Nancy	Teater
Frank	Teng
Joe	Thomas
David	Thomson
Gabriel	Thoumi
Julie	Thrower
Ralph	Toloski
Lindsey	Tong
Rosario	Torres
Harriet	Trezevant
Ashutosh	Tripathi
Kazuya	Tsurushita
Mari	Tusten
Carol	Tyler
Claire	Tyler
Robert	Venticinque
Amber	Vierling
Josh	Wallaert
Michael	Wasmann
Jeff	Watanabe
Jennifer	Watson
Wendy	Webster
Don	Weden
Sabrina	West
Jason	Wiener
Christina	Williams

Mary	Wisnewski
J	Wood
Claire	Woolf
Katherine	Wright
Rose	Wright
Yungnane	Yang
Greg	Yarris
Jake	Young
Annie	Zacanti

San Francisco Bay Conservation and Development Commission
455 Golden Gate Avenue, Suite 10600, San Francisco, California 94102 tel 415 352 3600 fax 415 352 3606

September 4, 2015

Mr. Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
1455 Market Street, 16th Floor
San Francisco, CA 94103

SUBJECT: BCDC Support for the South San Francisco Bay Shoreline Study, Phase 1

Dear Mr. Kendall Tom

Thank you for the request by the San Francisco District of the U.S. Army Corps of Engineers (USACE) that the San Francisco Bay Conservation and Development Commission (BCDC) support the flood risk management and ecosystem restoration work proposed by USACE's South San Francisco Bay Shoreline Study, Phase 1. The project is described in the draft Integrated Report released on December 19, 2014, and with additional detail provided in subsequent meetings with the project proponent.

As the proposed project would be constructed by the federal government, with some local and state funding, BCDC will require USACE to prepare and submit a Consistency Determination for review by BCDC under the federal Coastal Zone Management Act (CZMA). Based on decades of past practice and experience, we believe that it would be most prudent for USACE to submit its Consistency Determination during the project's Pre-Construction Engineering & Design phase.

In general, the BCDC staff supports the purpose of this project and looks forward to taking it before the Commission for its review and action under the CZMA when enough information is gathered and analyzed to ensure that it will both comply with the enforceable policies of the Coastal Management Program (CMP), as contained in the McAteer-Petris Act and in the San Francisco Bay Plan ("Bay Plan"), and benefit the region. Both the staff and Commissioners can better provide USACE with practical suggestions if USACE is willing to provide the Commission with an initial briefing on the project. As such, we have reserved time for a USACE presentation at our next Commission meeting on September 17, 2015.

It is worthwhile to note that the Commission previously has unanimously approved at least two horizontal levees to create transition zones, upland habitat, and areas where marsh can move inland with rising sea level rise at Sonoma Creek (Consistency Determination No. C2014.004) and Max Keech Properties (BCDC Permit No. 2007.005). That being said, the project's south bay shoreline levee would require much larger amounts of fill than either of the two above-referenced projects, although the fill is proposed to be placed within salt ponds, as opposed to within the Bay. While BCDC's criteria for evaluating fill in salt ponds are different than its criteria used to analyze fill proposed in the Bay, any fill proposed within BCDC's

jurisdiction must be justified. Also, the Commission will analyze this project in light of its efforts to make the Bay's shoreline more resilient to expected rising sea level; it has consistently supported appropriate efforts to do so in the past, and I am sure that USACE will receive many questions from the staff and Commissioners about the project's design and purpose in light of the ramifications of climate change and the need to protect the Bay's existing natural resources.

Based on the draft Integrated Report, BCDC-USACE staff-level coordination, and USACE's responses to BCDC's comment letter of February 23, 2015, the BCDC staff can indicate now that the proposed project is generally consistent with the Bay Plan's policies, or can be amended to be so, with additional documentation and a series of changes. The Bay Plan encourages converting salt ponds to tidal and subtidal habitats and designing ecosystem restoration and flood risk management features that provide for, and are adaptable to, projected rising sea level. The USACE proposal incorporates these attributes and its proposed ecotone would provide important habitat and ecosystem resilience. The Bay Plan requires that the public have access to the Bay shoreline, and the project would promote such access by filling a gap in the Bay Trail. I am happy that discussions among the Corps, BCDC, and other project-related staff indicate that the federal agencies are willing to work with Commission staff to ensure that the project design will be fully consistent with the Commission's policies as it is brought to a more detailed level.

Finally, please note that BCDC is open to the concept of phased consistency review, as authorized by section 930.36(d) of the CZMA regulations, should USACE elect to pursue this approach. Using this approach, BCDC generally requires up to 75 days to conclude our process and provide a federal agency with a phased Consistency Concurrence following the submission of a phased Consistency Determination. As stated above, however, we believe that a better process would be to expedite a Commission briefing on the overall goals of the project now, and review a USACE Consistency Determination later at the Pre-Construction Engineering & Design phase.

I hope this letter clarifies our position and please be assured that we very much look forward to working with you to complete this very important project.

If you have any further questions, please contact Bob Batha of our staff at 415-352-3612, or by email at bob.batha@bcdc.ca.gov; or me directly.

Sincerely,

LAWRENCE J. GOLDZBAND
Executive Director

References:

BCDC (1979). Management Program for San Francisco Bay. San Francisco Bay Conservation and Development Commission (prepared with financial assistance from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provisions of the Federal Coastal Zone Management Act of 1972, as amended).

BCDC (2008). San Francisco Bay Plan. San Francisco Bay Conservation and Development Commission.

U.S. Department
of Transportation
Federal Aviation Administration

Western-Pacific Region
Airports Division

San Francisco Airports District Office
1000 Marina Boulevard, Suite 220
Brisbane, CA 94005

May 21, 2015

Mr. Thomas R. Kendall
Chief, Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers - San Francisco District
1455 Market St. San Francisco, CA 94103
ATTN: William DeJager
Environmental Section A -

Subject: FAA Comments on the Draft Interim Feasibility Report and Draft Environmental Impact Statement/Environmental Impact Statement/Report – South San Francisco Bay Shoreline Phase I Study, Santa Clara County, California

Dear Mr. Kendall:

Mr. Dejager of your staff contacted our office in April 2015 regarding whether we had any comments or concerns regarding aviation issues and the Draft Interim Feasibility Report and Draft Environmental Impact Statement (EIS)/Environmental Impact Statement/Report – South San Francisco Bay Shoreline Phase I Study, which is proposing a flood protection and environmental enhancement project approximately 5 miles north of Norman Y. Mineta San Jose International Airport. We appreciate that Mr. Dejager made this effort as we were not aware of the Draft EIS. We have the following comments.

Any wildlife or environmental enhancement project has the potential, if located in an inappropriate location, to increase the potential for wildlife to collide with aircraft. Our Federal Aviation Administration Advisory Circular (A/C) 150-5200-33B *Hazardous Wildlife Attractants on or Near Airports*, which is available on the www.faa.gov website, recommends a separation distance of at least 5,000 feet between potential hazardous wildlife attractants and airports serving piston-powered aircraft, and a separation distance of at least 10,000 feet between such hazards and airports serving turbine-powered (jet) aircraft. Hazardous wildlife attractants can include marsh and wetland areas, which would be enhanced as part of your proposed project. FAA AC 150-5200-33B also recommends a separation distance of 5 miles between the farthest edges of an airport's Air Operations Area (AOA) (i.e. runway) and a hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across approach or departure airspace. The AC also identifies which types of wildlife have the greatest potential to strike and damage aircraft.

Both Norman Y. Mineta San Jose International Airport, and Moffett Federal Airfield at the National Aeronautics and Space Administration, Ames Research Center, are in the vicinity of the project alternatives described in the Draft EIS. Both airports service turbine-powered aircraft. While it appears both airports are beyond 10,000 feet from your proposed project alternatives, it also appears they may be within 5 miles of your project alternatives. We recommend that you disclose in the Final EIS the separation distances between the Air

Operations Areas (nearest point of the runway) of these airports and the proposed habitat improvements for each alternative described in the EIS.

Also, for any of your project alternatives that are within 5 miles of these airports, we recommend that the EIS evaluate whether the proposed habitat improvements could cause wildlife hazardous aircraft operations such as waterfowl, shorebirds, gulls, or raptors to move into or across approach or departure airspace (i.e. the areas beyond the ends of the runway where aircraft climb immediately after takeoff, or line up to land). We recommend that if such habitat improvements are included in your Final EIS, that you modify the habitat restoration plan in that area so it would not create any attractants that could encourage hazardous wildlife movements into or across approach or departure airspace within 5 miles of the either airport.

If your Final EIS does propose to create or enhance habitat that could attract wildlife hazardous to aircraft operations to within 10,000 feet of either airport, or cause hazardous wildlife movement into or across approach or departure airspace, this should be identified as a significant environmental impact, and that condition disclosed to the Federal official responsible for signing the Record of Decision for the EIS.

The FAA does not support the creation of new wildlife hazards to aircraft. While there are methods to discourage wildlife from areas where they represent a wildlife-aircraft strike hazard, such methods are time consuming and expensive to implement, and are not a substitute for advance planning that avoids attracting wildlife hazardous to an airport or an airport's approach or departure airspace in the first place.

Thank you for consideration of these comments. If you have questions regarding these comments you may contact me at telephone 650-827-7601 or e-mail maverick.douglas@faa.gov, or contact Mr. Douglas Pomeroy of my staff at telephone 650-827-7612 or e-mail douglas.pomeroy@faa.gov.

Sincerely,

Maverick Douglas
Acting Manager

cc:
Director of Aviation, Norman Mineta San Jose International Airport
Chief Executive Officer, Santa Clara Valley Water District
Center Director, NASA Ames Research Center
Refuge Manager, Don Edwards San Francisco Bay National Wildlife Refuge

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Francisco Bay Regional Water Quality Control Board

Sent via e-mail – no hard copy to follow

July 13, 2015
CIWQS Place ID 813084

U.S. Army Corps of Engineers
San Francisco District
Attn.: Thomas R. Kendall
1455 Market St.
San Francisco, CA 94103

Subject: Letter of support for the South San Francisco Bay Shoreline Project

Dear Mr. Kendall:

This letter is in response to your request for a letter supporting the flood risk management and ecosystem restoration project (Project) proposed in the December 2014 *Draft South San Francisco Bay Shoreline Phase I Study*, Integrated Document, *Draft Integrated Interim Feasibility Report and Environmental Impact Statement / Report* (Shoreline Study). Water quality certification (Certification) pursuant to section 401 of the federal Clean Water Act will be required to authorize construction of the Project. The San Francisco Bay Regional Water Quality Control Board (Water Board) usually reviews applications for Certification during the detailed, final design process that occurs after completion of a final environmental document. Therefore, we plan to consider issuing Certification for the Project following completion of Project review in compliance with the requirements of the California Environmental Quality Act (CEQA) and after review of near-final Project designs. At this time the Water Board has not been requested to take formal action on any requirements related to the Project. However, as is described below, the Project appears to be consistent with the intent of the *San Francisco Bay Basin Water Quality Control Plan* (Basin Plan), the Water Board's primary regulatory document, and, therefore, appears to be eligible for Certification. This letter provides Water Board staff's assessment of the proposed Project.

Project Description

The proposed Project is identified as Alternative 3 in the Shoreline Study. The Project's components include an Alviso North levee alignment, San José–Santa Clara Regional Wastewater Facility (WPCP) South levee alignment, a 30:1 (1 foot of elevation rise for each 30 feet of horizontal distance) ecotone adjacent to ponds A12/13 and A18, restoration of ponds A9-15 and A18, a flood gate across the Union Pacific Railroad tracks near ponds A12/13, and a tidal flood gate at Artesian Slough. The Project includes an engineered levee, approximately 15.2 feet high, along existing salt pond berms, the eastern border of Pond A12, and the southern borders of

DR. TERRY F. YOUNG, CHAIR | BRUCE H. WOLFE, EXECUTIVE OFFICER

1515 Clay St., Suite 1400, Oakland, CA 94612 | www.waterboards.ca.gov/sanfranciscobay

ponds A16 and A18. The Project would allow for continued Federal Emergency Management Agency (FEMA) accreditation at the end of the study's period of analysis (2017-2067).

Water Board Comments

Water Board staff supports the Project and recognizes that it is needed both for flood protection and to enable the restoration of salt marsh and related habitats in about 2,800 acres of historically diked salt ponds in South San Francisco Bay, in the former Alviso Salt Pond Complex ponds A9 through A15 and A18. Since the current salt pond levees provide flood protection to the Alviso area, the Project will facilitate salt marsh restoration by allowing the outer salt pond levees to be breached after the Project has replaced flood protection provided by these levees. Project implementation is also part of a long-term adaptive management strategy to address the potential impacts of sea level rise in the Bay.

Reviewed in isolation, the flood control element of the Project, with adjacent ecotone fill, would place fill into about 137 acres of waters of the State, consisting of 16.8 acres of wetlands and 120.8 acres of open water. This impact is large for a single project and would require significant mitigation to be consistent with the Basin Plan, which incorporates the State of California's no net loss policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28). However, the Basin Plan also directs the Water Board to use the *Baylands Ecosystem Habitat Goals* (1999) (*Habitat Goals*), and the *Baylands Ecosystem Species and Community Profiles* (2000) (referred to collectively as the "Habitat Goals Reports") as guides for wetland restoration to protect beneficial uses of waters in San Francisco Bay. The *Habitat Goals* contains the following recommendation for the shoreline in the vicinity of Alviso Slough:

> Restore tidal marsh throughout most of the segment, providing a continuous corridor of tidal marsh along the bayshore… . Restoration should emphasize reestablishing a natural transition between tidal marsh and adjacent wetlands and upland habitats, as well as transitions between salt and brackish tidal marsh.

One of the significant beneficial uses that the Basin Plan assigns to waters of the State in South San Francisco Bay is the preservation of rare and endangered species. The proposed habitat enhancement activities in the Alviso Salt Pond Complex ponds will enhance this beneficial use. The Habitat Goals and the *USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan) (USFWS, August 27, 2013), which include recovery actions for the California Ridgway rail (formerly California Clapper Rail) and salt marsh harvest mouse (SMHM), support both the restoration of as many acres of tidal marsh as feasible and the creation of ecotones between marsh habitats and upland high water refuges.

The ecotones will contribute to the value of the marsh and the future success of special status species using the marsh by providing an important transition zone. This type of upland transitional habitat is not well represented in the South San Francisco Bay due to the historic severe loss of habitat and the typically abrupt transitions between remaining middle marsh habitat and steep-sided levees. The ecotones will provide high tide cover and escape habitat for the California Ridgway Rail and SMHM, as well as providing some opportunity for landward migration of wetland habitat in the face of sea level change.

The Project's inclusion of tidal marsh restoration, along with the habitat enhancement provided by the ecotones in the proposed Project, supports the Water Board's ability to issue Certification for the Project.

As is noted in the Shoreline Study, South San Francisco Bay appears to be on the verge of becoming a sediment sink, rather than a sediment source. With increasing sea level and decreasing sediment supply, restoration practitioners and researchers in San Francisco Bay are encouraging all stakeholders to proceed with a sense of urgency to create sustainable marshes. Since the uncertainties related to sediment supply will increase over time, we encourage the U.S. Army Corps of Engineers to commence work on the Project as soon as possible.

Conclusion

In summary, Water Board staff is supportive of the Project, which will provide the integrated flood risk management and tidal habitat restoration that is necessary to support the preservation of rare and endangered species and to enhance habitat resilience to sea level rise. We look forward to continuing to work with the Project sponsors to complete the Certification process as further design details are provided.

If you have questions regarding the Certification process, please contact me at (510) 622-2314 or via email to bwolfe@waterboards.ca.gov.

Sincerely,

Digitally signed by Bruce H. Wolfe
DN: cn=Bruce H. Wolfe, o=SWRCB, ou=Region 2, email=bwolfe@waterboards.ca.gov, c=US
Date: 2015.07.13 12:20:27 -07'00'

Bruce H. Wolfe
Executive Officer

Cc:
John Bourgeois, California Coastal Conservancy – John.Bourgeois@scc.ca.gov
Melanie Richardson, Santa Clara Valley Water District – mrichardson@valleywater.org

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1398

July 16, 2015

Carole Roland-Nawi
State Historic Preservation Officer
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, California 95816

Dear Ms. Roland-Nawi:

The U.S. Army Corps of Engineers San Francisco District (USACE) has conducted a feasibility study entitled South San Francisco Bay Phase I Shoreline Study (Shoreline Study). The Shoreline Study project area comprises the industrial solar salt pond complex known as the Alviso Unit, which is situated at the southern end of San Francisco Bay near the town of Alviso (City of San Jose), Santa Clara County, California. The results of the Shoreline Study identified a dual-purpose project, which the USACE is undertaking: (1) ecosystem restoration that will convert the salt ponds into tidal salt marsh and (2) flood risk management that will involve levee construction across the salt ponds north of the town of Alviso. The Shoreline Study has incorporated a public-recreation component into the plans as well.

We initiated consultation in writing with you in December 2014, pursuant to 36 C.F.R. § 800, the implementing regulations of Section 106, National Historic Preservation Act, as amended. The USACE received a response letter in January 2015; however, you elected not to comment at that time because the submitted materials for the undertaking did not indicate that USACE had identified historic properties or assessed effects consistent with the standards of 36 C.F.R. § 800.4 through § 800.5.

Over the past two weeks, my staff and I have coordinated with Jessica Tudor through email and telephone conversations to rectify the data gaps by submitting materials (July 14th) that we believe sufficiently document USACE efforts to identify and evaluate historic properties, and to assess potential effects to identified properties. The USACE has identified two historic properties, the Alviso Historic District (in the town of Alviso) and the Alviso Salt Pond Historic Landscape per 36 C.F.R. § 800.4(b). In our opinion, implementing the ecosystem restoration would cause an adverse effect only to the Salt Pond Historic Landscape (36 C.F.R. § 800.5(a)).

In addition, we are confident that the submitted materials address other concerns in your letter, such as the delineation of the Area of Potential Effects in accordance with 36 C.F.R. § 800.4(a)(1) and clarifying the previous ecosystem restoration project in the Alviso Unit by the U.S. Fish and Wildlife Service, who satisfied the requirements of Section 106 and executed a Memorandum of Agreement (MOA). We feel that the measures contained in this MOA largely address the character of effect created by our project. We would like to reach agreement on how

best to address our project's effects to historic properties, if any, beyond those specifically addressed in the U.S. Fish and Wildlife Service agreement document.

If you have questions, please contact Kathy Ungvarsky, Archaeologist, at (415) 503-6842 or (email: kathleen.ungvarsky@usace.army.mil). I look forward to continuing the Section 106 process and receiving your comments.

Sincerely,

Thomas R. Kendall, P.E.
Chief, Planning Branch

AMENDMENT TO

MEMORANDUM OF AGREEMENT

AMONG THE U.S. FISH AND WILDLIFE SERVICE,
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER, AND
THE U.S. ARMY CORPS OF ENGINEERS
REGARDING
THE SOUTH BAY SALT POND RESTORATION PROJECT
INCLUDING RESTORATION OF FORMER INDUSTRIAL SALT PONDS TO TIDAL SALT MARSH AND OTHER WETLAND HABITATS,
INCLUDING THE FORMER SALT WORKS WITHIN THE ALVISO UNIT OF THE DON EDWARDS SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE AND THE CALIFORNIA DEPARTMENT OF FISH AND GAME'S EDEN LANDING ECOLOGICAL RESERVE, ALAMEDA AND SANTA CLARA COUNTIES, CALIFORNIA

(HEREAFTER "Agreement")

WHEREAS, the Agreement was executed in June, 2012;

WHEREAS, the U.S. Fish and Wildlife Service (USFWS) is proposing to amend this Agreement because of a beneficial and necessary activity described in "the San Francisco Bay Phase I Shoreline Survey" that recommends the U.S. Army Corps of Engineers San Francisco District (USACE) restore salt ponds to tidal salt marsh and repair levees adjacent to the U.S. Fish and Wildlife Service's (USFWS) property and encompassing a portion of the Alviso Salt Ponds within the Don Edwards National Wildlife Refuge (NWR) that are covered by the Agreement; and

WHEREAS, the Alviso Salt Ponds were determined to be eligible for the National Register of Historic Places (with SHPO concurrence dated 10/12/2010) and have been documented to Historic American Landscape Survey standards (HALS CA-92) and submitted to the Library of Congress (2013) as mitigation for the salt pond restoration activities as per this Agreement; and

WHEREAS, the USFWS is inviting the USACE to be a signatory party on the Agreement because they are proposing similar restoration activities in Alviso Ponds A9-18, along with critical levee flood control repairs bordering Alviso Ponds A18, A16, A-13, and A12 that will ensure the viability of the entire Alviso Salt Pond restoration project (undertaking); and

WHEREAS, the Area of Potential Effects (APE) for the Agreement is being expanded to include Alviso Pond A18 and the bordering levee (Expanded-APE) (Amendment Attachment-1); and

WHEREAS, the USACE will complete identification and evaluation of historic properties within the Expanded-APE prior to beginning restoration activities in Pond A18 and levee construction; and

WHEREAS, changing the function and appearance (character defining features) by restoring Pond A18 to salt marsh is a potential adverse effect, similar to the adverse effects determined in the Agreement for the other Alviso Salt Works ponds; and

WHEREAS, converting Pond A18 to tidal salt marsh is similar to the other Alviso Salt Works Historic District ponds which are the subject of the Agreement; therefore the HALS documentation for the Alviso Salt Works Historic District is sufficiently comprehensive to embrace Pond A18; and

WHEREAS, the USACE has provided written information on the Shoreline Study findings to the Native American tribes listed with the California Native American Heritage Commission, and has invited the tribes in writing to comment, but has not received any comments; and

WHEREAS, the USACE will send a copy of this executed amendment to the Advisory Council on Historic Preservation; and

NOW, THEREFORE, in accordance with Stipulation I and Stipulation II. C. of the Agreement, the USFWS, USACE, and SHPO agree to amend the Agreement as follows:

Amend Stipulation I. Area of Potential Effect by inserting the following text as paragraph C:

> "Specifically, the APE is extended to also include existing waterways (Alviso Slough to the west and Coyote Creek to the north) that could be impacted by pond restoration or levee construction (sewage treatment ponds north and east of the proposed levee). All project actions would occur within Ponds A9–A15 and A18, all south of Coyote Creek. In addition, the entire Alviso Marina (at the southernmost point of Pond A12 along Alviso Slough) has been included because the proposed levee would tie in at the existing levee just east of the marina. No other actions are proposed for the marina property.
>
> Along the southern edge, the area has been defined by applying a 100-foot buffer to the southernmost levee option. This area includes land that would be available for use during construction for activities such as materials and equipment staging and temporary roads for transporting equipment, materials, and personnel along the levee construction route. All ground-disturbing construction activities would occur within this boundary."

Amend Stipulation II. A by inserting a second paragraph with the following text:

> "The USACE will complete the identification and evaluation of historic properties within the Expanded-APE prior to beginning restoration activities. All draft historic property identifications and determinations of eligibility (DOE) will be submitted to SHPO and USFWS for a 30-day review and comment period. The USACE will address

the comments and resubmit the final DOE to the USFWS and SHPO for concurrence. The SHPO will have 30 days to respond.

If Pond A18 is found to be a contributing property, the USACE will revise the Alviso Salt Works Historic District DPR-523 form to include a description of the pond, a map(s), historical background, and photographs. A draft of the revised DPR-523 form will be transmitted to SHPO and USFWS for 30-day review and comment period. The USACE will address comments, submit a revised document, and request concurrence from SHPO on the Pond A18 DOE. The SHPO will have 30 days to review the revised document. The final revised DPR-523 form will then be transmitted to the USFWS, the SHPO, and the Northwest Information Center, prior to June 2019."

Amend Stipulation II.C. to insert the following text:

"The same procedures outlined by the USFWS in their Historic Properties Treatment Plan to manage new archaeological discoveries during restoration of the NWR ponds will apply to Pond A18 and the levee (Expanded-APE). The USACE will also be responsible for managing inadvertent discoveries in the Expanded-APE."

Amend the Signatory Block to include the USACE as follows:

SIGNATORY PARTIES

U.S. FISH and WILDLIFE SERVICE

By: _____ Date: 3 Sept 2015

Anne Morkill, Refuge Complex Manager
Don Edwards San Francisco Bay National Wildlife Refuge

CALIFORNIA STATE HISTORIC PRESERVATION OFFICER

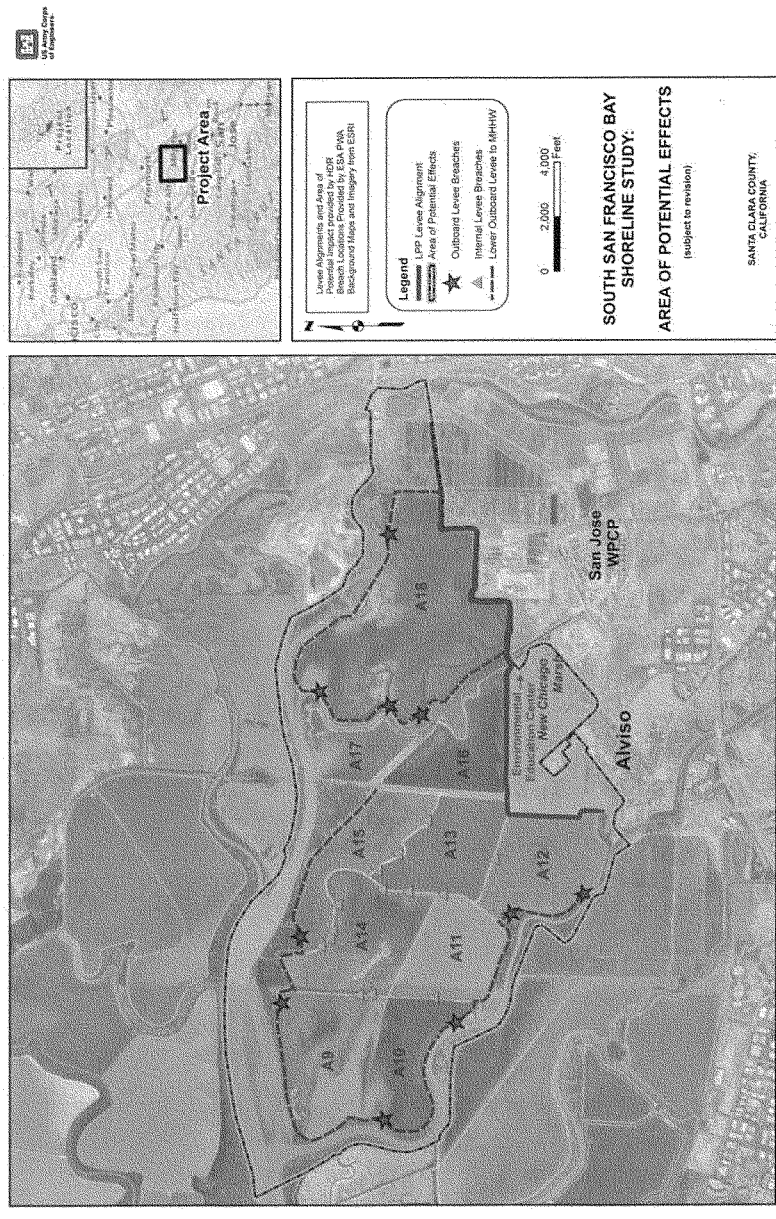
By: _____ Date: 8 Sept 2015

Julianne Polanco
State Historic Preservation Officer

U.S. ARMY CORPS of ENGINEERS

By: _____ Date: 3 Sep 15

John C. Morrow, P.E. Lieutenant Colonel
San Francisco District Engineer



Amendment Attachment-1. Expanded-APE includes A18 and levee.

4 FWS040721A South Bay Salt Pond Restoration Project (SBSPRP) **Amendment to MOA (9/3/2015)** Don Edwards San Francisco Bay NWR and U.S. Corps of Engineers (USACE).

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1398

July 16, 2015

Ms. Rosemary Cambra, Chairperson
Muwekma Ohlone Indian Tribe
of the San Francisco Bay Area
P. O. Box 360791
Milpitas, CA 95036

Dear Ms. Cambra,

The U.S. Army Corps of Engineers, San Francisco District (USACE) has conducted a study entitled South San Francisco Bay Shoreline (Shoreline), and is proposing a two-part project: ecosystem restoration that will convert the Alviso salt ponds into tidal salt marsh and flood risk management that will involve levee construction outside and north of the town of Alviso across the salt ponds. The project has incorporated a public recreation component into the plans as well.

The USACE has prepared a draft Environmental Impact Report/Statement (EIR/S), published December 2014. Since then, we have initiated consultation with the State Historic Preservation Officer pursuant to the Section 106 implementing regulations at 36 C.F.R. § 800. As part of that process, I request your comment on the USACE undertaking.

Please find enclosed two documents: (1) the Cultural Resources section of the USACE draft EIR/S and (2) a Memorandum for Record that summarizes the USACE Shoreline project, highlights the historic properties identified and consideration of effects, and provides background information on the previous U.S. Fish and Wildlife Service Section 106 efforts for tidal marsh restoration in south San Francisco Bay and how it relates to the USACE undertaking.

If you would like to receive the entire EIR/S or any other documents, we would provide hard copies or electronic files on a CD. Please contact Kathleen Ungvarsky, Archaeologist, at (415) 503-6842 (email: kathleen.ungvarsky@usace.army.mil) for additional information.

Sincerely,

Thomas R. Kendall
Chief, Planning Division

Enclosures

Mr. Valentin Lopez
Chairman, Amah Mutsun Tribal Band
PO Box 5272
Galt, CA. 95632

Ms. Katherine Erolinda Perez
Ohlone/Costanoan Indian Tribe
P.O. Box 717
Linden, CA 95236

Ms. Jakki Kehl
Ohlone Indian Tribe
720 North 2nd Street
Patterson, CA 94363

Ms. Michelle Zimmer
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94026

Representative Ramona Garibay
Ohlone/Costanoan Indian Tribe
Trina Marine Ruano Family
30940 Watkins Street
Union City, CA 94587

Ms. Ann Marie Sayers
Indian Canyon Mutsun Band of Costanoan
P. O. Box 28
Hollister, CA 95024

Irene Zwierlein
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94062

Mr. Andrew Galvan
The Ohlone Indian Tribe
Mission San Jose
PO Box 3152
Fremont, CA 94539

Memorandum for Record July 2015

Subject: San Francisco Bay Phase I Shoreline Study

1. This MFR includes a project description of the ecosystem restoration measures and flood risk management levee currently proposed by the U.S. Army Corps of Engineers San Francisco District (USACE) for the salt pond complex known as the Alviso Unit. It also includes background information on the U.S. Fish and Wildlife Service (USFWS) restoration program in the Alviso Unit and its relationship to the USACE project.

2. USACE Project Description and APE. The USACE proposed action, referred to as the San Francisco Bay Phase I Shoreline Study (Phase I Project), would involve an area of 13 salt ponds located in the eastern half of the Alviso Unit, which has a total of 25 salt ponds (Figure 1). All but one salt pond in the APE are situated within the USFWS Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) administered by the USFWS. The one pond added to USACE Phase I Project APE (A18) is owned by the City of San Jose. In the APE, restoration activities will focus on converting the salt ponds to naturally functioning, tidally influenced salt marsh, which will require breeching levees and opening ponds to the tides, building levees between the newly restored tidal marsh areas and local communities, and restoring habitat features.

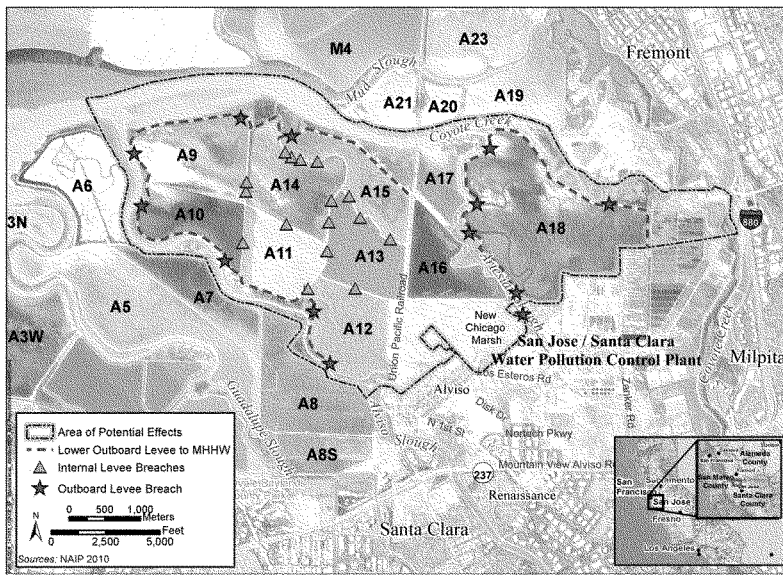


Figure 1: San Francisco Bay Phase I Shoreline Project Area of Potential Effects

3. The Phase I Project is a dual-purpose project, closely associated with the USFWS restoration program: the conversion of industrial salt ponds into tidally influenced salt marsh, and the construction of a flood risk management levee that is critical to the function of the

restoration measures. The Phase I Project is related to an extensive, multiagency program in San Francisco Bay, entitled the South Bay Salt Pond Restoration Project (SBSPRP), which has identified approximately 20,000 acres of former industrial salt-pond complexes stretching across the South Bay shoreline between Fremont and Palo Alto that would be restored to tidal salt marsh and other wetland habitats. Under the SBSPRP, the USFWS identified three major historic salt pond complexes in the South Bay and outlined restoration plans: Eden Landing Unit near Hayward, Ravenswood Unit near Palo Alto, and Alviso Unit in north San Jose.

4. USFWS Section 106. In 2012, the USFWS consulted with the California State Historic Preservation Office (SHPO) regarding the restoration program for the entire Alviso Unit, and consequently, satisfied the requirements of Section 106 of the National Historic Preservation Act (NHPA), pursuant to 36 C.F.R. § 800, by executing a Memorandum of Agreement (MOA) that included a Historic Property Treatment Plan (HPTP). Information from the USFWS Section 106 compliance is highlighted below; it has direct impact on the current USACE effort to comply with Section 106

5. Alviso Unit National Register. The USFWS evaluated the Alviso Unit, concluded that it was eligible for inclusion in the National Register of Historic Places (National Register), and received concurrence from the California State Historic Preservation Officer (SHPO) that the *Alviso Salt Pond Historic Landscape (Historic Landscape)* is a Historic Property under Criterion A of the National Register. The USFWS technical report discussing the National Register evaluation of the Alviso Unit is entitled "Appendix E: Identification and Evaluation of the South San Francisco Bay Solar Salt Industry Landscape," a copy of which is available from USACE.

The Alviso Unit APE was surveyed by the USFWS, which consisted of walking the outboard and inboard salt pond levees, recording archaeological features on and next to the levees as well as documenting features in the ponds through visual observations and GPS recording. The USACE technical report, which is entitled "Cultural Resource Assessment: South San Francisco Shoreline Interim Feasibility," presents the results of its research and survey effort; it is available from USACE.

6. USFWS Adverse Effects. The USFWS determined that restoration would cause adverse effects to the *Historic Landscape* as a result of converting salt ponds into tidal marsh, because the project will change the character-defining elements of the property by affecting their function and appearance. Under the terms of HPTP, the USFWS prepared a report on the *Historic Landscape* that meets the requirements of the *Historic American Landscape Survey*. The report was submitted to the Library of Congress through the National Park Service. The determination of adverse effect to the *Historic Landscape* is consistent with USACE finding. Even with the addition of pond A18 to the USACE undertaking, USACE suggests that additional mitigation measures beyond the USFWS report may not be needed, an issue that will be part of USACE Section 106 consultation with SHPO for the tidal marsh restoration project component.

7. USACE Levee Contribution. Although the USFWS restoration program included the concept of new levees in the Alviso Unit, USACE has explicitly outlined the design and siting of the levee, and evaluated the visual impacts, the results of which were presented in the USACE draft Environmental Impact Report/Statement (EIS/R). The USACE considered alternatives to a new levee, including a no-action alternative, and selected the least environmentally damaging levee alternative (out of three possible alternatives) in consideration of the wishes of Alviso

residents (Figure 2). The new levee alignment follows the alignment of an existing, non-engineered levee; however, the new levee will have engineered dimensions and will be larger. The new Alviso North levee is situated far from the town to reduce the level of adverse visual effects. The EIR/S includes simulation photos that show the view of the new levee from different points around Alviso.

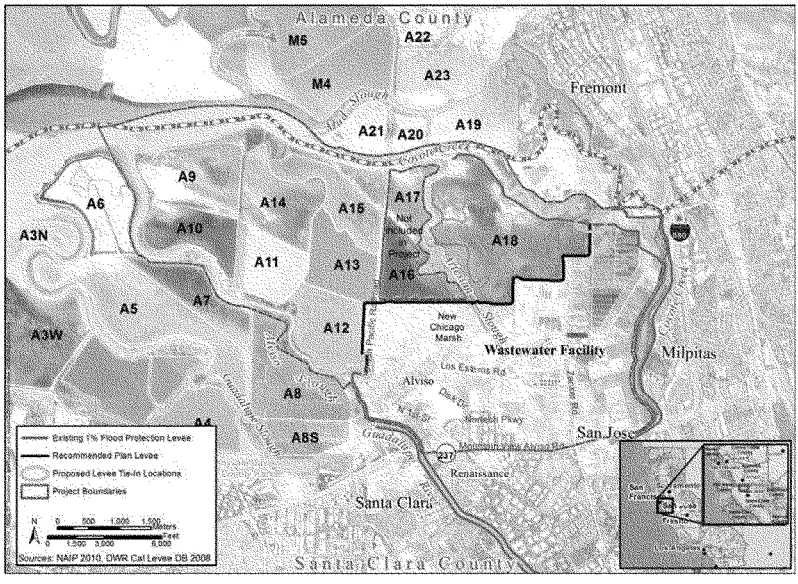


Figure 2: Study Area Map Showing Levee Location

8. <u>USACE Levee and Alviso Historic District</u>. In addition to the salt pond *Historic Landscape,* the other historic property of importance for the USACE Section 106 consultation is the Alviso Historic District. Alviso, known as "Port of Alviso (San José)," was listed in the National Register in 1973 as a District. The Alviso Historic District comprises eleven buildings on ninety acres. The Port of Alviso is also a State of California Point of Historical Interest (SHPI SCL-061) and listed in the California History Plan and California Inventory of Historic Resources.

Alviso is situated adjacent to, and overlooks, the vast salt pond complex. The northwest boundary of the Historic District is adjacent to the part of the APE where the western end of the flood levee will tie into to the existing levee at the Alviso Marina. This construction would require work near and possibly in the Historic District. The addition of a new levee would not cause an adverse effect to any of the contributing elements of the Historic District, or to any non-contributing buildings. The introduction of a larger levee would cause a minor change in the character and setting; however, constructing this feature would not diminish the integrity of the District's significant historic features. USACE has therefore determined that the undertaking will not cause an adverse effect to the Alviso Historic District.

9. USACE Cultural Resource Inventory. The USACE Phase I research identified several other historic sites and prehistoric cultural resources situated near but outside the USACE APE. They were nonetheless visited during archaeological surveys and updated site information recorded. One archaeological site (CA-ALA-338) is of particular interest, because it is recorded as the disturbed remnants of a shell deposit situated in the bottom of a salt pond. Archaeologists have observed ALA-338 for decades, and most recently both USACE and the USFWS have reported on this site in their cultural resource documents noted above. The site appears to be situated east of the Alviso Unit APE, i.e., east of Pond A19, but this ancillary salt pond area may be under the USFWS jurisdiction. If it is Refuge lands, the USFWS monitoring and management measures in their HPTP (attached to the MOA) would be applicable. The USACE will follow up on this matter.

10. The USACE understands that the USFWS consulted local Native American tribal representatives and invited them to comment on the SBSPRP restoration measures for the Alviso Unit. To date, the USACE has not offered the tribes an opportunity to comment. USACE will engage the tribes through written correspondence and request their comment and recommendations.

MEMORANDUM OF AGREEMENT BETWEEN THE U.S. FISH & WILDLIFE SERVICE AND THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER REGARDING THE SOUTH BAY SALT POND RESTORATION PROJECT INCLUDING RESTORATION OF FORMER INDUSTRIAL SALT PONDS TO TIDAL SALT MARSH AND OTHER WETLAND HABITATS, INCLUDING THE FORMER SALT WORKS SITES WITHIN THE ALVISO UNIT ON THE DON EDWARDS SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE AND CALIFORNIA DEPARTMENT OF FISH AND GAME'S, EDEN LANDING ECOLOGICAL RESERVE; ALAMEDA AND SANTA CLARA, COUNTIES, CALIFORNIA

WHEREAS, the South Bay Salt Pond Restoration Project (SBSPRP) is an extensive project that includes approximately 20,000 acres of former industrial salt pond complexes along the shoreline of the San Francisco Bay, south of the San Mateo Bridge. The salt ponds were part of a vast system of salt ponds previously operated by Cargill Salt. In 2003 the Alviso and West Bay salt pond complexes were transferred to the U.S. Fish and Wildlife Service and included in the Don Edwards San Francisco Bay National Wildlife Refuge (DESFBNWR). The Baumberg salt pond complex, now knows as the Eden Landing Ecological Reserve, is owned and managed by the California Department of Fish and Game (CDFG). The SBSPRP is partially on federal property, will require a federal permit, and will use federal funding. Restoration activities will change the salt ponds to salt marsh which alters their function and open water appearance, both of which are contributing characteristics of the historic landscape and has the potential to affect a historic property (Undertaking) (Figure 1 in Attachment 1); and

WHEREAS, the U.S. Fish and Wildlife Service (USFWS) has determined, in consultation with the California State Historic Preservation Officer (SHPO), that the former salt works and evaporative salt industry ponds associated with the Alviso Unit of the DESFBNWR and property owned and managed by the CDFG known as the Eden Landing Ecological Reserve (ELER) are eligible for inclusion in the National Register of Historic Places under Criteria A (historic property) as historic landscapes, including the six eligible archaeological sites identified within the ELER as defined in 36 CFR Part 800, the regulation implementing Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470f). The SHPO concurred with the evaluation on October 12, 2010; and

WHEREAS, the USFWS has determined that altering the former industrial salt ponds in the Alviso and ELER complexes by replacing the controlled flow of water with a tidally influenced marsh environment will adversely affect the character defining elements of the ponds by affecting their function and appearance and may adversely affect the archaeological sites by changing the water system (Adverse Effect); and

WHEREAS, the USFWS has consulted with the SHPO pursuant to 36 CFR Part 800 regarding the Undertaking's adverse effects on historic properties and the USFWS has notified the Advisory Council on Historic Preservation (Council) of the adverse effect pursuant to 36 CFR 800, implementing Section 106 of the National Historic Preservation Act, as amended, 16 U.S.C. 470f (NHPA). The Council has declined to participate in a letter dated December 3, 2010; and

WHEREAS, a portion of the project is on land owned by the CDFG. The USFWS and CDFG have consulted regarding this project and have executed a Memorandum of Understanding (MOU) that determines that the USFWS is the lead agency and defines the relationship and responsibilities of each agency. The CDFG is a consulting party with obligations that are associated with the resolution of the adverse effect, thus they have been invited to concur in this MOA (800.6(c)(3); and

WHEREAS, the USFWS has consulted with interested parties and tribes. The SBSPRP includes a wide variety of partners and agencies. Communication with and input from stakeholders in the community and interested organizations continues to be achieved using public meetings and workshops, a website, a newsletter, press releases, and presentations, to ensure that the public remains informed about the project status and is involved in the planning and implementation process. The USFWS consulted with tribes and tribal members provided by the California Native American Heritage Commission. Consultation was also accomplished through contacts during the public outreach efforts. The Hayward County Historical Society and parties that expressed an interest will continue to be updated as the project is implemented; and

NOW, THEREFORE, the USFWS and the SHPO agree that if the Undertaking proceeds, the Undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the Undertaking on a historic property and to satisfy the requirements of Sections 106 and 110(b) of the NHPA, and further agree that these stipulations shall govern the Undertaking and all of its parts until this Memorandum of Agreement (MOA) expires or is terminated.

STIPULATIONS

The USFWS and by extension through the MOU, CDFG shall ensure that the following stipulations are implemented:

I. Area of Potential Effect

A. The Area of Potential Effect (APE) is depicted in Figures 2 and 3 (Attachment 1) and includes the Alviso Historic District and ELER Historic District that are located in the southern end of San Francisco Bay. The ELER encompasses 6612 acres divided into 23 ponds. The Alviso Unit encompasses 9677 acres divided into 28 ponds. Within the APE, activities will focus on restoring the salt ponds to naturally functioning, tidally influenced salt marsh which requires breeching levees and opening ponds to the tides, building levees between the newly restored

tidal marsh areas and local communities, and restoring habitat features. Additionally, archaeological resources within the ELER Historic Landscape that are contributing elements of the landscape may be affected by fluctuating water levels

B. If modifications to the Undertaking take place subsequent to the execution of this MOA that necessitate the revision of the APE, USFWS will consult with the SHPO to facilitate mutual agreement on the subject revisions. If USFWS and SHPO cannot reach an agreement, then the parties will resolve the dispute in accordance with Stipulation III.B of this document. Should the USFWS and SHPO reach mutual agreement on the proposed revisions the USFWS will submit a final map of the revision no later than 30 days following such an agreement.

II. Mitigation of Project Effects to Historic Properties

The USFWS has consulted with the SHPO and has developed a historic properties treatment plan (Attachment 2) that will be implemented, prior to and during the SBSPRP. The mitigation plan follows the *Secretary of the Interior's Standards for the Treatment of Historic Properties* and includes the following elements:

A. Recordation of Historic Properties: The Alviso and ELER salt pond complexes are considered historic landscape districts. The USFWS consulted with the Regional Coordinator for the HALS program at the National Park Service regarding the requirements for photo documentation and recordation of the landscape that is commensurate with the level of adverse effect. NPS-HALS program staff responded with guidance on the requirements for recordation, therefore all recordation and photography documentation requirements will be in accordance with this guidance. The HALS documentation will be submitted to the NPS for transmittal to the Library of Congress. Copies of the HALS documentation will also be maintained at the DESFBNWR, USFWS Cultural Resources Team office, CDFG, and the Hayward County Historical Society.

B. Interpretation of Solar Salt Industry: Interpretive materials will be developed, including at least one interpretive panel and pamphlet that describes the solar salt industry process and landscape features that were associated with the evaporative salt industry. A draft of the interpretive materials will be shared with SHPO and interested parties for review and comment. The panel will be installed within the ELER. The timeline for completing the interpretive materials is based on the pace of the restoration project but is estimated to be within 5 years of the date of this agreement

C. Archaeological Resources: Archaeological resources within the ELER that are contributing elements of the historic landscape will be treated according to the Treatment Plan (Attachment 2). Generally, sites will be protected *in situ*.

However, sites that are affected by fluctuating water levels will be documented with photography, GPS mapping, and limited subsurface testing of features and selective surface collection. The sites will then be monitored once a year at a low tide event or summer dry season for five consecutive years from the signing of this MOA. Monitoring will continue until the restoration work is completed. No additional affects are anticipated from the restoration work once the salt marsh habitat has been reestablished, at that point monitoring will cease. If any site appears to be accessible to vandals or the structure of the site changes due to vandalism, then a more substantial data collection procedure will be instituted. There is also the potential for new discoveries to occur and these will be managed by recordation and data collection procedures outlined in the Historic Properties Treatment Plan (Attachment 2).

III. Administrative Provisions

A. Standards

1. Professional Qualifications: All activities prescribed in Stipulations I and II of this MOA shall be carried out under the authority of USFWS by or under the direct supervision of a person or persons meeting at a minimum the *Secretary of the Interior's Professional Qualifications Standards* (48 FR 44738-3, September 29, 1983) in the appropriate disciplines.

B. Dispute Resolution

1. Should the SHPO object to the manner in which the terms of this MOA are implemented, to any action carried out or proposed with respect to implementation of the MOA, or to any documentation prepared in accordance with and subject to the terms of this MOA, the USFWS shall immediately consult with the SHPO for no more than 30 days to resolve the objection. If the objection is resolved through such consultation, the action subject to dispute may proceed in accordance with the terms of that resolution. If, after initiating such consultation, the USFWS determines that the objection cannot be resolved through consultation, the USFWS shall forward all documentation relevant to the objection to the Council, including the USFWS proposed response to the objection, with the expectation that the Council will within 45 days after receipt of such documentation:

    a. Advise the USFWS that the Council concurs in the proposed response to the objection, whereupon the USFWS will respond to the objection accordingly; or

b. Provide the USFWS with recommendations, which the USFWS will take into account in reaching a final decision regarding its response to the objection; or

c. Notify the USFWS that the objection will be referred for comment to the Council pursuant to 36 CFR 800.7, and proceed to refer the objection and comment. The USFWS shall take the resulting comment into account in accordance with 36 CFR 800.7(c)(4) and Section 110 (1) of the NHPA.

2. Should the Council not exercise one of the above options within 45 days after receipt of all pertinent documentation, the USFWS may assume the Council's concurrence in its proposed response to the objection.

3. The USFWS shall take into account any Council recommendation or comment provided in accordance with this stipulation with reference only to the subject of the objection. The USFWS responsibility to carry out all actions under this MOA that are not the subjects of the objection will remain unchanged.

4. At any time during implementation of the measures stipulated in this MOA should an objection pertaining to such implementation be raised by a member of the public, the USFWS shall notify the SHPO and take the objection into account, consulting with the objector and, should the objector so request, with the SHPO to address the objection. The time frame for such consultation shall be reasonably determined by the USFWS.

5. The USFWS shall provide to the SHPO, the Council when Council comments have been issued hereunder, and any parties that have objected pursuant to paragraph B.4., above, with a copy of its final written decision regarding any objection addressed pursuant to this stipulation.

6. The USFWS may authorize any action subject to objection under this stipulation to proceed after the objection has been resolved in accordance with the terms of this stipulation.

C. Amendments

Either signatory may propose that this MOA be amended, whereupon the signatories will consult for no more than 30 days to consider such amendment. The amendment process shall comply with 36 CFR 800.6(c)(1) and 800.6(c)(7). This MOA may be amended only upon the written agreement of the signatories. If it is not amended, this MOA may be terminated by either signatory in accordance with Stipulation D., below.

D. Termination

1. If this MOA is not amended as provided for in paragraph C. of this stipulation, or if

either signatory proposes termination of this MOA for other reasons, the signatory proposing termination shall in writing notify the other signatory, explain the reasons for proposing termination, and consult with the other signatory for at least 30 days to seek alternatives to termination. Should such consultation result in an agreement on an alternative to termination, then, the signatories shall proceed in accordance with the terms of that agreement.

2. Should such consultation fail, the signatory proposing termination may terminate this MOA by promptly notifying the other signatory in writing. Termination hereunder shall render this MOA null and void. If this MOA is terminated hereunder and if the USFWS determines that the Undertaking will nonetheless proceed, then the USFWS shall either consult in accordance with 36 CFR 800.6 to develop a new MOA or request the comments of the Council pursuant to 36 CFR Part 800.

E. Duration of the MOA

Unless terminated pursuant to paragraph D. of this MOA, or unless it is superseded by an amended MOA, this MOA will be in effect until the USFWS, in consultation with the SHPO, determines that all of its stipulations have been satisfactorily fulfilled. The duration of this MOA will not exceed seven (7) years, because of the restoration phases that require up to five years to complete, unless the signatory parties agree to an extension. Upon a determination by USFWS that all of the terms of this MOA have been satisfactorily fulfilled, this MOA will terminate and have no further force or effect. The USFWS will promptly provide the SHPO and CDFG with written notice of its determination and of the termination of the MOA. Following provision of such notice, this MOA will be null and void.

F. Effective Date

This MOA will take effect when it has been executed by both the USFWS and the SHPO. Execution of this MOA by the USFWS and the SHPO, its transmittal by the USFWS to the Council in accordance with 36 CFR 800.6(b)(1)(iv) and subsequent implementation of its terms, shall evince pursuant to 36 CFR 800.6(c), that this MOA is an agreement with the Council for purposes of Section 110(1) of the NHPA, and shall further evince that the USFWS has afforded the Council an opportunity to comment on the Undertaking and its effects on historic properties, and that the USFWS has taken into account the effects of the Undertaking on historic properties. The CDFG is a concurring party to the MOA as represented by their signature.

U.S. FISH and WILDLIFE SERVICE

By: _____ Date: 5/25/12

Mendel Stewart, Project Leader, San Francisco Bay NWR Complex, Region 8

CALIFORNIA STATE HISTORIC PRESERVATION OFFICER

By: _____ Date: 28 JUN 2012

Mr. Milford Wayne Donaldson, FAIA: California State Historic Preservation Officer

Concurring Party
CALIFORNIA DEPARTMENT OF FISH AND GAME

By: _____ Date: 6/12/12

Mr. Scott Wilson, Acting Regional Manager, Bay Delta Region

Attachments:
Attachment 1: Figure 1. Project Location Map.
Figure 2. Alviso Unit APE.
Figure 3. ELER APE.

Attachment 2: Historic Properties Treatment Plan

ATTACHMENT 1.

South Bay Salt Pond Restoration Project

Project Overview and APE Map

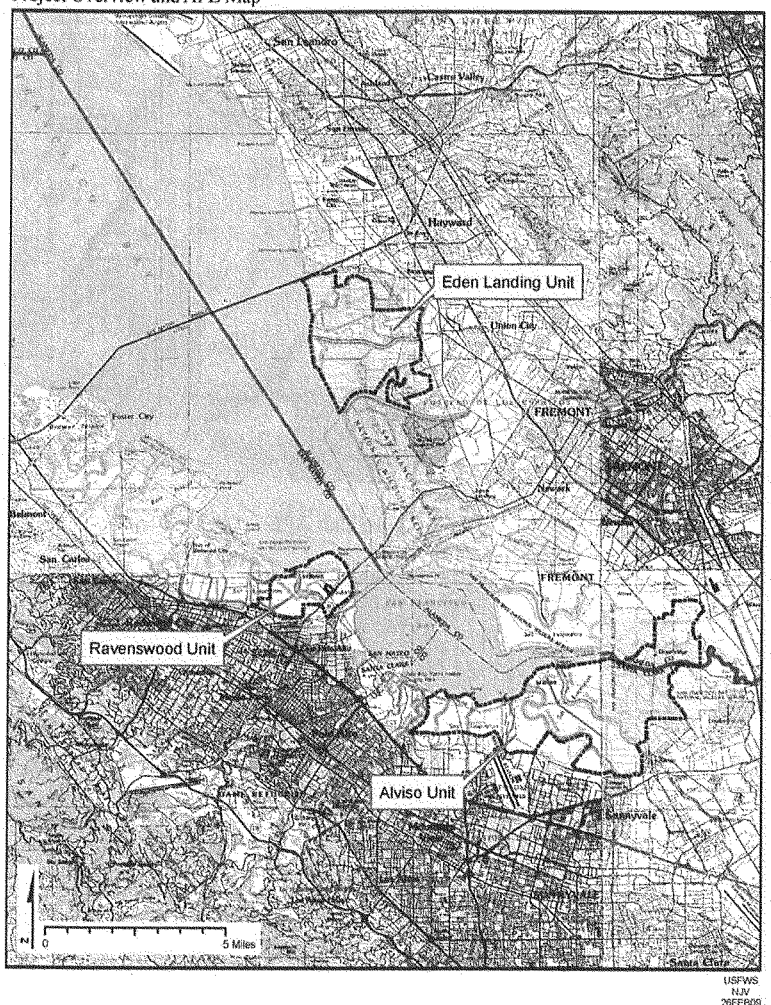


Figure 1. Project location map.

South Bay Salt Pond Restoration Project

Alviso Unit APE Map

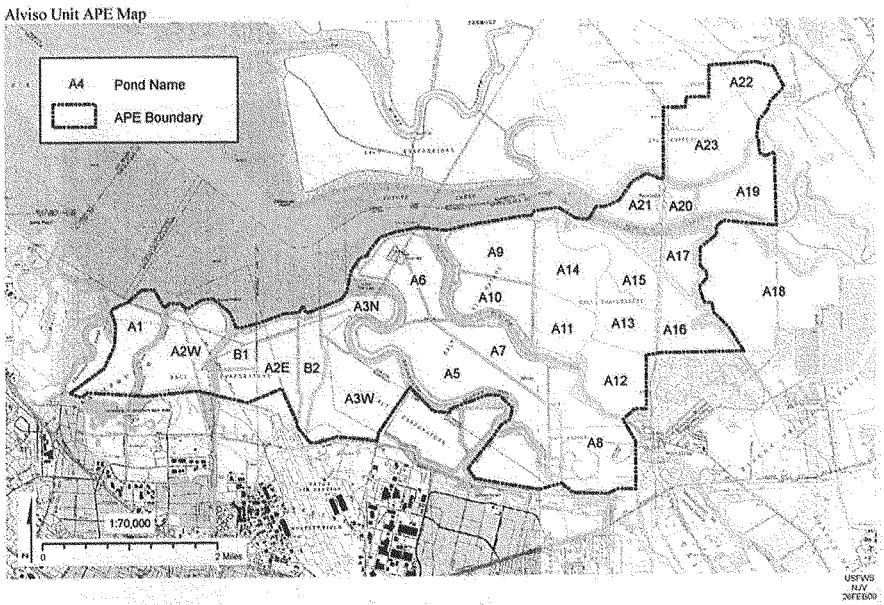


Figure 2. Alviso Unit APE.

South Bay Salt Pond Restoration Project
Eden Landing Unit APE Map

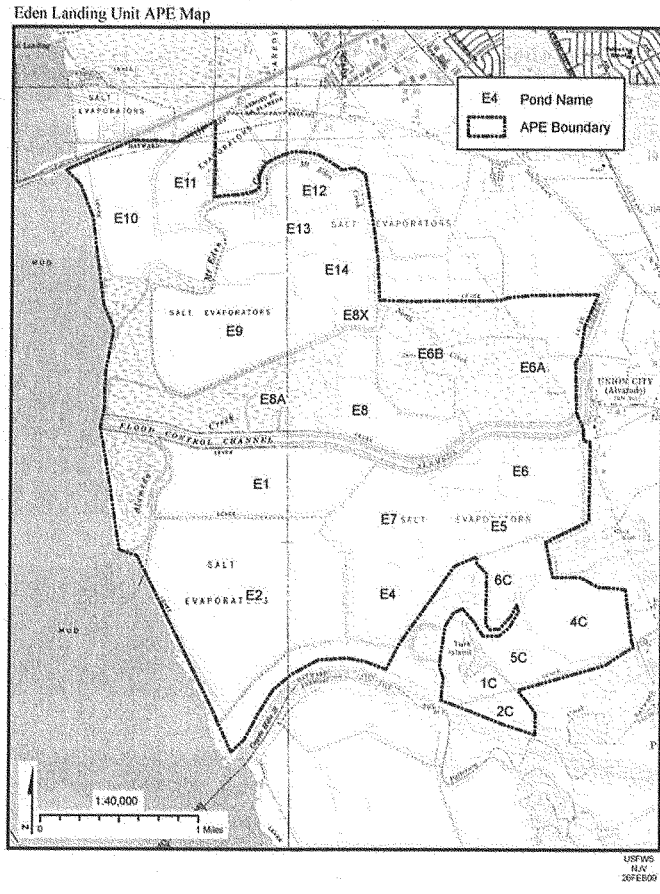


Figure 3. ELER APE.

ATTACHMENT 2.

U.S. Fish and Wildlife Service Project #FWS040721A
Historic Properties Treatment Plan
for the
Salt Works within the South Bay Salt Pond Restoration Project at the
Alviso Unit, Don Edwards San Francisco Bay National Wildlife Refuge,
and the
Eden Landing Ecological Reserve, California Department of Fish and Game
Alameda and Santa Clara counties, California
January 14, 2011/revised May 4, 2012

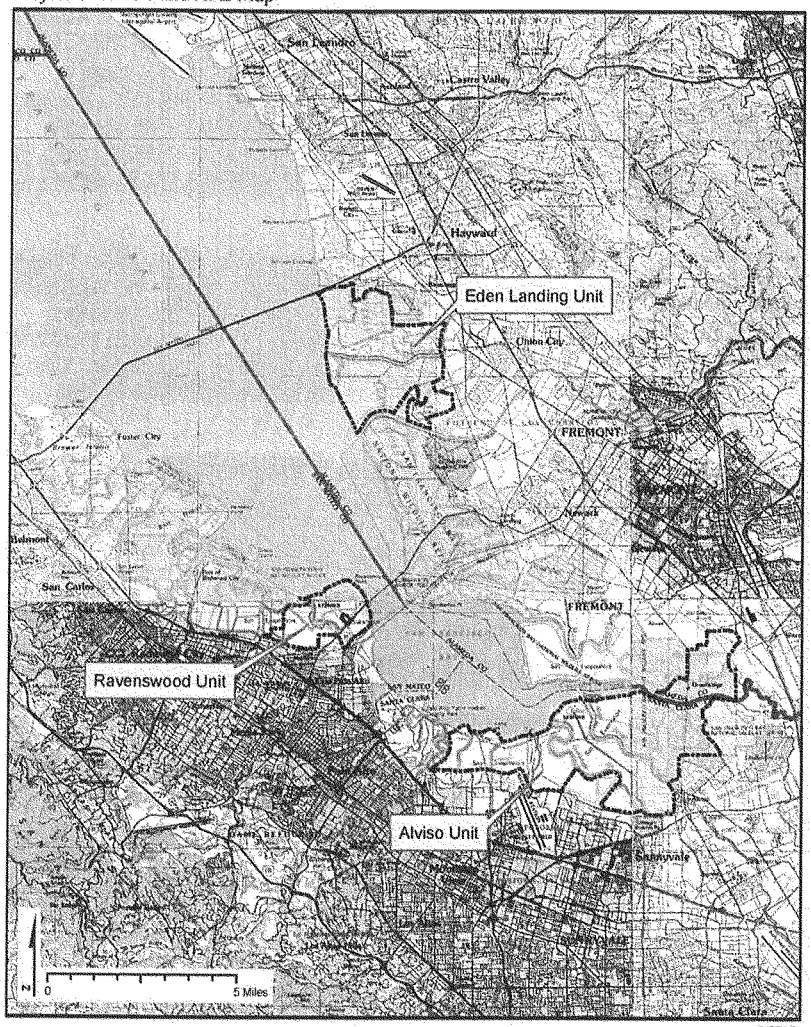
Introduction
The South Bay Salt Pond Restoration Project (SBSPRP) will restore the former industrial salt production ponds in South San Francisco Bay to a more natural mix of tidal wetland habitats and managed ponds. The restoration comprises former salt ponds located at the southern end of San Francisco Bay. The SBSPRP encompasses property managed by the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG). The agencies are working together along with the California State Coastal Conservancy (Conservancy) and U.S. Army Corps of Engineers (USACE) and other project partners. The SBSPRP is composed of three noncontiguous units, including the Eden Landing Ecological Reserve (ELER or Eden Landing) on the east side of the Bay near the San Mateo bridge; the Alviso unit at the southern end of the bay; and the West Bay-Ravenswood unit located on the west side of the Bay near the Dumbarton Bridge (Figure 1).

In 2010 the salt works at the Alviso Unit and ELER were evaluated and determined to be eligible to the National Register of Historic Places (NRHP) as historic landscapes that encompass a range of condensing ponds, archaeological resources, and features associated with solar salt production and processing. This historic properties treatment plan has been developed to mitigate for the adverse effects associated with converting the salt ponds back to a native salt marsh habitat.

Undertaking
The SBSPRP is an extensive project that includes nearly 20,000 acres of former industrial salt ponds that were part of a vast system of salt ponds previously operated by Cargill Salt. The USFWS is the lead agency for complying with the National Historic Preservation Act. The Alviso Unit is managed by the USFWS and the ELER salt ponds are owned and managed by the CDFG. The SBSPRP is partially on federal property, will require a federal permit, and will use federal funding. Restoration activities will change the salt ponds to salt marsh which alters their function and open water appearance, both of which are contributing characteristics of the historic landscape and has the potential to affect a historic property

South Bay Salt Pond Restoration Project

Project Overview and APE Map



USFWS
NJV
26FEB09

Figure 1. Project location map.

Area of Potential Effects
The Area of Potential Effect (APE) is depicted on Figure 1 and includes the Alviso Historic District and ELER Historic District that are located in the southern end of San Francisco Bay (See Figures 2 and 3). The ELER encompasses 6612 acres divided into 23 ponds, in Alameda County. The Alviso Unit encompasses 9677 acres divided into 28 ponds, within Alameda and Santa Clara counties. Within the APE, activities will focus on restoring the salt ponds to naturally functioning, tidally influenced salt marsh which requires breeching levees and opening ponds to the tides, building levees between the newly restored tidal marsh areas and local communities, and restoring habitat features. Additionally, archaeological resources within the ELER Historic Landscape that are contributing elements of the landscape may be affected by fluctuating water levels

The Alviso Unit is drained, from east to west, by Mud Slough, Coyote Creek, Alviso Slough, Guadalupe Slough, Stevens Creek, Mtn View Creek, and Charleston Slough. The boundaries of the Alviso Salt Works Historic Landscape are established by legal ownership and natural features. The Eden Landing Unit is drained by Mt. Eden, North, and Old Alameda Creeks, the Alameda Federal Flood Control Channel marks the southern boundary of the district. The boundaries of the Eden Landing Salt Works Historic Landscape are established by legal ownership and natural features.

Alviso Salt Works Eligibility to the National Register of Historic Places:
The Alviso Salt Works Historic Landscape meets eligibility standards under criterion A because it is associated with the twentieth century period of industrialization when one operator created a vast network of evaporation ponds to produce the large amount of brine necessary to meet production demands. The SHPO has concurred with the eligibility determination (Donaldson to Mruz, October 12, 2010). Interpreting the Alviso Salt Works landscape offers a different view of the salt industry than the Eden Landing area. The Alviso Salt Works clearly reflects the industrial zenith and development of huge tracks of salt marsh for salt brine production. The large exterior levees and vast ponds are the signature features of the Alviso Unit solar salt landscape.

Alviso Salt Works Historic Properties Description
The history of solar salt production in Alviso dates from the 1920s. In Alviso, the salt industry did not develop from small, family-owned salt farms, but rather, began as an industrial-level enterprise. Only two salt companies, the Alviso Salt Company (that included Continental Salt and Chemical Company) and Schilling's Arden Salt Company are associated with the Alviso unit. Both companies appear to have built levees, developed salt ponds, and harvested salt from these lands during the 1920s. Arden acquired Alviso Salt in 1929, including its plant near the town of Alviso. Leslie Salt became the sole operator after 1936, until Cargill's acquisition in 1978 (EDAW 2005:14).

The Alviso Salt Works is characterized by vast evaporation ponds, large levees, and robust water control devices. The pattern of spatial organization has changed only slightly from the 1950s when the operation was controlled by the Leslie Salt Company. The Alviso Unit was developed for brine production there were no crystallizing ponds or processing plants within the unit.

One archaeological site, one townsite, and a bridge have been recorded within the Alviso Salt Works, none of which are related to salt production (Table 1). Only two of the three resources within the Alviso Salt Works are potentially eligible properties but they do not contribute to the Alviso Salt Works Historic Landscape. The town of Drawbridge (P-01-003291) and site CA-ALA-338 (P-01-002057) have been reviewed but no formal determination of eligibility has been completed. Site CA-ALA-338 was originally noted in 1909 by Nels C. Nelson as a shell-midden mound site. The site location has been re-visited, but no evidence of the site was identified (Busby 2008; Valentine 2009). Site CA-ALA-338 appears to have been completely destroyed by salt pond development.

The town of Drawbridge (P-01-003291) was a small community of cabins that were used for duck hunting and weekend retreats. The isolated location also attracted bootleggers, gamblers, and prostitution in the 1920s and 1930s. Leslie's salt plant diked off parts of the east and west marshes at the southern end of San Francisco Bay, leaving Drawbridge in isolation and causing the ground to subside (Morrow 1984; EIS/EIR 2007 Report). Environmental conditions for the island have not improved since the 1940s and most of the cabins are in serious decline, are threatened by vandalism, or are sinking into the marsh. The community was essentially abandoned by the 1950s with the last resident staying until 1978 when the Don Edwards San Francisco Bay NWR was established. Drawbridge is within the refuge boundaries but a corridor through the center of the island and town is on land owned by the Southern Pacific Railroad and private entities. Access to the island requires permission from the Southern Pacific Railroad to cross on their tracks. Because the Service does not own or manage the primary corridor of the town which is within 50 ft of the tracks along with safety concerns with the access on an active railroad track, the deteriorated condition of the buildings, and the problem of continued subsidence of the island have sidelined a proactive preservation approach and implementation of a 1980s plan to open the site to visitors (Morrow 1984:136-137).

The Coyote Slough bridge was constructed in 2001 as a replacement of an earlier bridge and is ineligible to the NRHP.

Table 1. Recorded cultural resources within the Alviso Salt Works Historic Landscape.

Trinomial Site No.	Primary Site No.	Treatment	Eligibility To the NRHP	Description
CA-ALA-338	P-01-002057	N/A	Unevaluated	Disturbed remnants of shell midden; no surface evidence.
	P-01-003291	Monitor	Unevaluated	Drawbridge townsite
	P-01-010205/P-43-001578	N/A	No	Coyote Slough Bridge-installed in 2001.

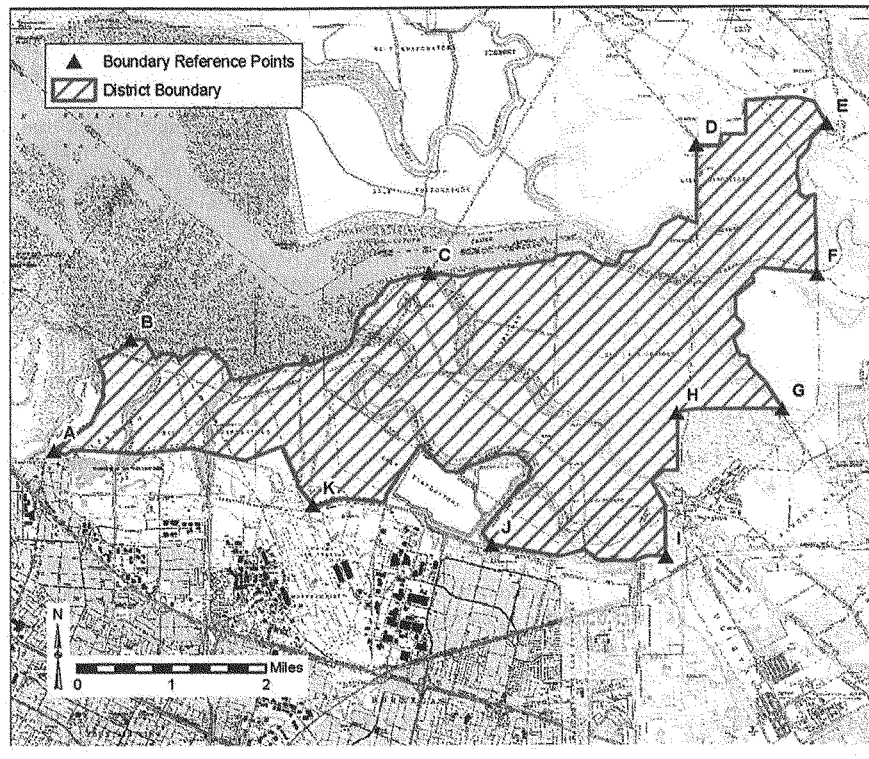


Figure 2. Alviso Salt Works Historic Landscape – Project APE.

Eden Landing Salt Works Eligibility to the National Register of Historic Places:
The Eden Landing Salt Works meets eligibility criteria A and D as defined by the National Register of Historic Places (NRHP) as a historic landscape. The SHPO has concurred with the eligibility determination (Donaldson to Mruz, October 12, 2010). Character defining elements of the historic landscape are the perimeter levees, interior pond divisions, archaeological sites associated with the family-owned processing plants and landings, and the Archimedes screw pumps. The overall Eden Landing Salt Works Historic Landscape provides an opportunity to interpret the evolution of the solar salt industry.

Eden Landing Historic Properties Description
The San Francisco Bay solar salt industry had its beginnings in the Eden Landing area. The initial salt production operations were small, family-owned parcels of less than 50 acres. There were nearly 30 different salt works located within the Eden Landing area between 1850 and 1910. One of the largest salt operations was the Union Pacific Salt Company which was in continuous production from 1872 to 1927. The Oliver Salt Company was among the few nineteenth century salt producers that continued operation into the 1920s. Between 1910 and 1930 the industry began consolidating as the market demand for salt increased beyond the capacity of the small producers. In 1930 the number of operators dropped from 28 to only five; and by the 1940s Leslie became the only major operator (EDAW 2005:14). "The Leslie-California Salt Company purchased the Oliver Salt works in 1931" (Ver Planck 1958:110). The small ponds have been altered to meet modern large-scale production needs.

Eleven cultural resources have been recorded within the Eden Landing Salt Works Historic Landscape, all of which are related to the historic period of salt manufacturing (Table 2). Four sites have been determined eligible, five sites have been determined ineligible, and one site is unevaluated. And, one architectural resource, the Archimedes Screw Windmills has been determined to be a contributing element of the Eden Landing Salt Works historic landscape.

Table 2. Recorded cultural resources within the Eden Landing Salt Pond Historic Landscape.

Trinomial Site No.	Primary Site No.	Treat ment	Eligibility To the NRHP	Description
CA-ALA-489H, -501H	P-01-000217	Monitor and data collection	Yes	Eden Landing historic shipping station (warehouses, wharves, associated developments)
CA-ALA-494H	P-01-000210	Interpret, monitor	Yes	Oliver Salt Co. piling and foundations
-	P-01-010740	Interpret, monitor	Yes	Archimedes Screw Windmills
CA-ALA-495H	P-01-000211	N/AA	No	Location of former Rocky Point Saltworks – no surface remains.
CA-ALA-496H	P-01-000212	Monitor	Yes	Pilings and foundation of former Union Pacific Salt (ca. 1872-1927)
CA-ALA-497H	-	N/A	No	Peterman's Salt Works -- no surface remains
CA-ALA-498H	P-01-214	N/A	No	Salt works, not relocated
CA-ALA-499H	P-01-215	N/A	No	Modern refuse scatter
-	PF-1	Monitor	Yes	Whisby Salt Works refuse scatter
-	P-01-010834	N/A	No	Union City Alvarado Salt Ponds
-	FWS-07-12-1	Monitor, data collection	Yes	J. Quigely Alvarado Salt Works, domestic refuse scatter

Figure 3. Eden Landing Salt Works Historic Landscape – Project APE.

Character Defining Features of the Alviso and Eden Landing Salt Works Historic Landscape
Character defining features of the Salt Works includes the landscape of levees, open-water ponds, water control structures, roads, and remnant wooden features, and archaeological sites. The initial evaporation ponds were built adjacent to the bay while secondary ponds were larger and protected from inundation from open bay water. Pickling and crystallizing ponds are relatively small and close to the salt processing plant and transportation corridor. The landscape features are engineered but lack distinctive qualities of individual workmanship or materials. The features are important because of their interrelationship and function as an evaporative salt factory. The ponds appearance of open water surrounded by earthen levees is a character defining feature.

The ELER encompasses some of the earliest salt ponds developed for salt production from the naturally suitable tidal salt marsh lands. Remnant features of the salt works of the Oliver family, the Barton family's Union Pacific Salt Works, and J. Quigley's Alvarado Salt Works are represented by archaeological sites that are historic properties. Overprinting by the modern solar salt industry has altered the nineteenth century landscape, raising levees, combining small ponds into much larger evaporation ponds, and changing the flow of water. The levees, water control structures, intakes, and pump stations have all been altered over the years to accommodate the increased production capacity, yet the distinctive pond landscape and remnant features reflect the evolving solar salt production industry.

Assessment of Effects to the Alviso and Eden Landing Salt Works Historic Landscape
The assessment of effects is determined by applying the criteria of adverse effects as provided in 36 CFR 800.5(ii).

> *Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization,. . . that is not consistent with the Secretary's standards for the treatment of historic properties and applicable guidelines.* The *Secretary's Standards* suggest that changes to historic properties should be minimal, follow the original plan, and should be compatible with existing materials or function.

The proposed modifications to remove salt works ponds from salt production will change their function and open water appearance, which are contributing characteristics of the historic landscape. The proposed restoration activities will alter these character defining features of the property which contributes to its eligibility and is an adverse effect as per 36 CFR 800.5(2)(iv). Additionally, altering the water flow from a controlled level to a tidally influenced dynamic flow may affect the six eligible sites within the Eden Landing Salt Works. Only the salt pond landscape will be affected by the restoration activities in the Alviso Salt Works.

Mitigation to resolve the adverse effects of the project activities is directed toward the salt pond landscape and six sites in the ELER.

Treatment Plan Actions
This Historic Properties Treatment Plan will affectively mitigate the effects of the SBSPRP. The USFWS and CDFG will ensure implementation of the treatment plan to include:

1) Documenting the salt works landscape based on consultation with the NPS Regional Coordinator for the Historic American Landscapes Survey (HALS);

2) Submitting the HALS documentation to NPS who will transmit it to the Library of Congress. Additionally, copies of the HALS documentation will be maintained at the DESFBNWR, USFWS Cultural Resources Team office, CDFG, and the Hayward Historical Society;

3) Protecting archaeological resources *in situ* within the ELER that are contributing elements of the historic landscape. Sites that are affected by fluctuating water levels will be documented with photography, GPS mapping, and limited subsurface testing of features and selective surface collection. The sites will then be monitored once a year at a low tide event or summer dry season for five consecutive years from the signing of this MOA. Monitoring will continue until the restoration work is completed. No additional affects are anticipated from the restoration work once the salt marsh habitat has been reestablished, at that point monitoring will cease. If any site appears to be accessible to vandals or the structure of the site changes due to vandalism, then a more substantial data collection procedure will be instituted.

4) Monitoring sites will include a site visit by a qualified archaeologist who will prepare a brief condition assessment report with photo-documentation of each site. Photographs will be taken from set photo points, each year, in order to trace any changes to the sites. Photographs will be maintained by the USFWS Cultural Resources Team (CRT). The CRT will evaluate the photographic record annually to provide site protection recommendations to the land managing agency. Reports will be archived with project materials at the CRT office.

5) Developing interpretive materials to be installed within the ELER that introduces the story of evaporative salt production in the San Francisco Bay region, including a boardwalk and interpretive panel at the Oliver Salt Works and Archimedes Screw Windmills.

Summary and Resolution of Adverse Effect
The mitigation measures presented in this Historic Properties Treatment Plan and stipulated in the Memorandum of Agreement will resolve the adverse effect of the South Bay Salt Pond Restoration Project.

References Cited

Busby, Colin I.
2008 *Cultural Resources Assessment: South San Francisco Bay Shoreline Interim Feasibility Study, Task Order 3*. Report prepared for U.S. Army Corps of Engineers, San Francisco. Report prepared by Basin Research Associates, Inc., San Leandro.

Donaldson, Milford Wayne
2010 October 12, 2010. Letter to Eric Mruz, Refuge Manager, Don Edwards San Francisco Bay National Refuge.

EDAW
2005 *South Bay Salt Pond Restoration Project: Salt Works Historic Context*. Submitted to U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and California Department of Fish and Game.

Morrow, Patrice
1984 *Drawbridge: Cause and Effect in the Development of a Unique Life Style*. Master's thesis from the California State University, Hayward.

Nelson, Nels C.
1909 Shellmounds of the San Francisco Bay Region. *University of California Publications in American Archaeology and Ethnology* 7(4):309-356.

Speulda-Drews, Lou Ann and Nick Valentine
2009 *Appendix E: Identification and Evaluation of the South San Francisco Bay Solar Salt Industry Landscape*. Report prepared for Don Edwards San Francisco Bay NWR, San Francisco. Report prepared by USFWS Cultural Resources Team, Sherwood, Oregon.

Valentine, Nick
2009 Personal Communication.

Ver Planck, William E.
1958 *Salt in California*. California Division of Mines Bulletin 175.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1398

July 16, 2015

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The Ohlone Indian Tribe
Mission San Jose
PO Box 3152
Fremont, CA 94539

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The USACE has prepared a draft Environmental Impact Report/Statement (EIR/S), published December 2014. Since then, we have initiated consultation with the State Historic Preservation Officer pursuant to the Section 106 implementing regulations at 36 C.F.R. § 800. As part of that process, I request your comment on the USACE undertaking.

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Sincerely,

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PO Box 5272
Galt, CA. 95632

Ms. Katherine Erolinda Perez
Ohlone/Costanoan Indian Tribe
P.O. Box 717
Linden, CA 95236

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Sincerely,

Thomas R. Kendall
Chief, Planning Division

Enclosures

Mr. Valentin Lopez
Chairman, Amah Mutsun Tribal Band
PO Box 5272
Galt, CA. 95632

Ms. Katherine Erolinda Perez
Ohlone/Costanoan Indian Tribe
P.O. Box 717
Linden, CA 95236

Ms. Jakki Kehl
Ohlone Indian Tribe
720 North 2nd Street
Patterson, CA 94363

Ms. Rosemary Cambra, Chairperson
Muwekma Ohlone Indian Tribe
of the San Francisco Bay Area
P. O. Box 360791
Milpitas, CA 95036

Representative Ramona Garibay
Ohlone/Costanoan Indian Tribe
Trina Marine Ruano Family
30940 Watkins Street
Union City, CA 94587

Ms. Ann Marie Sayers
Indian Canyon Mutsun Band of Costanoan
P. O. Box 28
Hollister, CA 95024

Irene Zwierlein
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94062

Mr. Andrew Galvan
The Ohlone Indian Tribe
Mission San Jose
PO Box 3152
Fremont, CA 94539

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1398

July 16, 2015

Irene Zwierlein
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94062

Dear Ms. Zwierlein,

The U.S. Army Corps of Engineers, San Francisco District (USACE) has conducted a study entitled South San Francisco Bay Shoreline (Shoreline), and is proposing a two-part project: ecosystem restoration that will convert the Alviso salt ponds into tidal salt marsh and flood risk management that will involve levee construction outside and north of the town of Alviso across the salt ponds. The project has incorporated a public recreation component into the plans as well.

The USACE has prepared a draft Environmental Impact Report/Statement (EIR/S), published December 2014. Since then, we have initiated consultation with the State Historic Preservation Officer pursuant to the Section 106 implementing regulations at 36 C.F.R. § 800. As part of that process, I request your comment on the USACE undertaking.

Please find enclosed two documents: (1) the Cultural Resources section of the USACE draft EIR/S and (2) a Memorandum for Record that summarizes the USACE Shoreline project, highlights the historic properties identified and consideration of effects, and provides background information on the previous U.S. Fish and Wildlife Service Section 106 efforts for tidal marsh restoration in south San Francisco Bay and how it relates to the USACE undertaking.

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Ohlone/Costanoan Indian Tribe
P.O. Box 717
Linden, CA 95236

Ms. Jakki Kehl
Ohlone Indian Tribe
720 North 2nd Street
Patterson, CA 94363

Ms. Michelle Zimmer
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94026

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of the San Francisco Bay Area
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PO Box 3152
Fremont, CA 94539

Appendix B10

Clean Water Act Section 404(b)(1) Determination

Clean Water Act Section 404(b)(1) Determination

South San Francisco Bay Shoreline Phase I Study

Santa Clara County, California

July 1, 2015

CLEAN WATER ACT SECTION 404(B)(1) EVALUATION

1.0 PROJECT DESCRIPTION

The Shoreline Study Integrated Document fully analyzes alternatives and their effects to the environment within the National Environmental Policy Act Requirements. The alternative discussed in this 404(b)(1) evaluation is the Recommended Plan, which is also the Least Environmentally Damaging Practicable Alternative. This is discussed further in the "Attachment 1. LEDPA Analysis for All Alternatives" and also Chapter 3.9.3 of the Integrated Document.

1.1 PROJECT LOCATION

The study area for Shoreline Phase 1 encompasses a portion of the South Bay shoreline between Alviso Slough and Coyote Creek, along with adjacent managed ponds, tidal waters and marshes, and upland areas in the vicinity of Alviso (Figure 1). Land areas include the community of Alviso, nearby light industrial areas, and a wastewater facility. The study area covers about 7,400 acres in Santa Clara County and consists of the area between the mouth of the Guadalupe River (to the west) and the mouth of Coyote Creek (to the east) and extends south to include both the community of Alviso and the San José–Santa Clara Regional Wastewater Facility (Wastewater Facility). The Study Area includes areas where restoration and FRM action may be implemented and former Salt Ponds A9–A15 and A18.

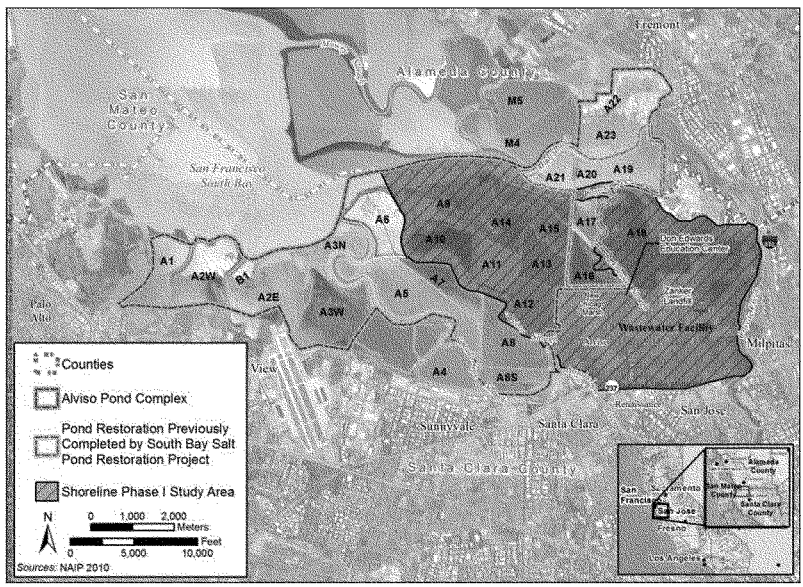

Figure 1. Alviso Pond Complex and Shoreline Phase I Study Area

1.2 GENERAL DESCRIPTION

The U.S. Army Corps of Engineers, San Francisco District, is proposing to construct levees bayward of the community of Alviso and the adjacent Wastewater Facility, restore Ponds A9-15 and A18 from existing managed ponds to allow tidal flow between adjacent sloughs and the existing ponds, allowing for restoration of tidal marsh habitat, and provide recreation features in line with the project objectives. The proposed plan includes: Basic ecosystem restoration of Ponds A9–A15 and Pond A18 with a 30:1 ecotone adjacent to Ponds A12/13 and A18. The tidal marsh restoration approach would be consistent with the approach taken by the South Bay Salt Pond (SBSP) Restoration Project, as follows: modifications would include breaching of outboard levees, modification of internal levees, construction of ditch blocks along existing levee-adjacent channels, and construction of pilot channels along historical contours. The ecotone will provide transitional habitat between the tidal marsh and the upland levee, providing refugia for wildlife during flooding and wave attenuation. The flood risk management levee will be earthen with a height of 15.2 feet NAVD 88 and would tie into existing 1-percent ACE flood risk management features in the study area. Landside areas would have a 15-foot-wide permanent easement (for operation and maintenance) and an additional 15-foot-wide temporary easement for the construction period along the full length of the levee. The new levees would be at least partially on land managed by the USFWS.

In addition to the flood risk management and ecosystem restoration, recreation features will include educational and interpretive signs, seating areas with benches, multi-use trails, wildlife viewing platforms, and a pedestrian bridge over Artesian Slough and the Union Pacific Railroad.

1.3 AUTHORITY AND PURPOSE

1.3.1 Project Authority

This report was prepared as an interim response to USACE Study Authorizations contained in multiple congressional actions, including Section 142 of the Water Resources Development Act of 1976 (WRDA), Public Law 94-94-587, a resolution adopted by the U.S. House of Representatives' Committee on Transportation and Infrastructure in 2002, and further guidance adopted through the WRDA of 2007, Section 4027:

> *".—In accordance with section 221 of the Flood Control Act of 1970 (42 U.S.C. 1962d–5b), and subject to paragraph (2), the Secretary shall credit toward the non-Federal share of the cost of any project authorized by law as a result of the South San Francisco Bay shoreline study—*
>
> *(A) the cost of work performed by the non-Federal interest in preparation of the feasibility study that is conducted before the date of the feasibility cost sharing agreement; and (B) the funds expended by the non-Federal interest for acquisition costs of land that constitutes a part of such a project and that is owned by the United States Fish and Wildlife Service. (2) CONDITIONS.—The Secretary may provide credit under paragraph (1) if— (A) the value of all or any portion of land referred to in paragraph (1)(B) that would be subject to the credit has not previously been credited to the non-Federal interest for a project; and (B) the land was not acquired to meet any mitigation requirement of the non-Federal interest."*

The most recent Water Resources Reform and Development Act (WRRDA) 2014 Section 1025 provides discretionary authority to the ASA(CW) to approve the USACE's implementation of a project on other Federal Lands (specifically in cases where the non-Federal interest originally purchased those lands). However, the "Secretary may carry out a project [on such lands] only after the non-Federal interest has entered into a memorandum of understanding (MOU) with the Federal agency that includes such terms and conditions as the Secretary determines to be necessary."

For the South San Francisco Bay Shoreline project, this provision applies to all project elements on USFWS lands. Although prior to WRRDA 2014, the USACE was proposing to ask Congress for authorization to construct FRM features on USFWS lands, WRRDA 2014 does apply to the whole project. Any project features that reside on USFWS lands will need a MOU between the non-Federal sponsor and the USFWS to be completed that includes such terms and conditions that the ASA(CW) deems necessary.

1.3.2 Project Purpose

Much of the portion of the study area that is not currently subject to tidal action historically consisted of tidal marsh and slough prior to diking efforts in the 20th century. Loss of these tidal habitats has greatly compromised biological and water quality functions in the study area. In addition, most of the study area is potentially vulnerable to sea level change over the course of the study's evaluation period of 50 years due to its topographic position at the extreme downstream end of the Santa Clara Valley where the valley adjoins San Francisco Bay.

As a result of severe subsidence in the Study Area, many areas landward of the former salt ponds became potentially vulnerable to tidal flooding. The non-engineered dikes protecting these areas were created as early as the 1920s and generally maintained to protect the ponds from tidal flooding when they were being used for salt production. These dikes were not engineered nor intended to reduce flood risk for urban areas. These lands are now substantially urbanized and have high-value development and include much of the well-known Silicon Valley as well as transportation corridors, wastewater plants, and other critical infrastructure. In addition, a substantial sea level change (SLC) is expected during the planning horizon for this study (2017–2067), exacerbating problems from tidal flooding.

The former management of the study area ponds by Cargill provided incidental flood risk reduction to the South Bay area. The transfer of pond ownership to the U.S. Fish and Wildlife Service (USFWS) and the City of San José created an opportunity to restore tidal marsh habitat by breaching these non-engineered pond dikes. However, breaching the non-engineered pond dikes would increase flood risk to inland areas that are currently separated from San Francisco Bay by these ponds. Therefore, the Shoreline Study purpose is to provide flood risk management to the Community of Alviso and the larger Silicon Valley, along with providing ecosystem restoration and maintaining recreational opportunities. Please see Chapter 2 of the Integrated Document for a more in depth discussion of the Purpose and Need of this project.

2.0 GENERAL DESCRIPTION OF DREDGED OR FILL MATERIAL

2.1 GENERAL CHARACTERISTICS OF MATERIAL

The imported fill will come primarily from the channel excavation of three other FRM projects in the county; Upper Llagas Creek (31 miles away), Upper Guadalupe River (11 miles away) and Permanente Creek (9 miles away). The materials are predominantly clays and silts with some sand. There is no gravel or bedrock at the sites indentified for borrow.

Technically, there could be fill associated with raising the inner levees to prepare for ponds being breached, leading to loss of jurisdictional waters. This would be temporary as these levees would be graded down later when remaining ponds are breached. Any islands retained on these inner levees would be only in locations where there is substantial existing levee width, such as some of the levee intersections and the Pond A14/A15 levee. Islands formed in these areas would be on solid, well-established, consolidated fill. Any temporary fill needed to widen an inner levee (should widening be needed in some areas) would be graded down at a later date and would return to being jurisdictional. Because the restoration will be occurring in phases between 2020 and 2030, additional analysis will be provided during the plans and engineering design phase of this project.

2.2 QUANTITY OF MATERIAL (CUBIC YARDS)

There will be approximately 940,000 cubic yards of fill with the Recommended Plan's FRM levee.

2.3 SOURCE OF MATERIAL

The imported fill will come primarily from the channel excavation of three other FRM projects in the county; Upper Llagas Creek (31 miles away), Upper Guadalupe River (11 miles away) and Permanente Creek (9 miles away). The materials are predominantly clays and silts with some sand. There is no gravel or bedrock at the sites indentified for borrow.

2.4 DESCRIPTION OF THE PROPOSED DISCHARGE SITE

The spoil from the existing levee (36.3 acres of non-engineered dikes) excavation will be used in the construction of the proposed FRM levee (50%) and the bench or ecotone (50%).

2.4.1 Location

The FRM levee location and footprint is described in detail in Chapter 9.2 of the Integrated Document, Plan Description.

2.4.2 Size

The Recommended Plan FRM levee includes the footprint of the existing levee, with the 15.2 foot levee being 110 feet wide, at 49.9 acres, and the ecotone being 345 feet wide, at 116.3 acres.

2.4.3 Type of site and size

The type of habitat includes the existing levee footprint and open water and wetlands within a managed pond.

2.4.4 Timing and Duration of Discharge

It is anticipated that the duration of construction would occur approximately 3 years between June 2018 and March 2021. The construction schedule for the timing and duration of the project is located in Chapter 3. 7.3 of the Integrated Document.

2.4.5 Description of Disposal Method

Fill will be mechanically placed and shaped in controlled lifts with ground based equipment. Lifts will be rolled into a stable continuum resistant to sloughing and erosion. The surface of the completed fill will be tracked walked to provide stability and a reasonably substrate for vegetation.

2.5 FACTUAL DETERMINATIONS (SECTION 230.11)

2.5.1 Physical Substrate Determinations

The South Bay is a complex system, both geographically and hydrodynamically, with freshwater tributary inflows, tidal currents, and wind interacting to create complex circulation patterns that vary over time. The most obvious hydrodynamic response to these forcing mechanisms is the daily rise and fall of the tides, although much slower residual circulation patterns also influence the mixing and flushing processes of the South Bay.

The Alviso Complex ponds are operated to maintain continuous tidal circulation by management of tidal flow through water control structures. With breaching of the internal non-engineered dikes, the tidal flow will be restored to a more natural state, without the use of water control structures.

2.5.2 Substrate Elevation and Type

Material would be placed along the existing non-engineered dikes A12/A13 and A18, and further into the bay than the current footprint with a 30:1 ecotone.

2.5.3 Sediment Type

The materials are predominantly clays and silts with some sand. There is no gravel or bedrock at the sites indentified for borrow.

2.5.4 Dredge/Fill Material Movement

Material is expected to remain within the construction footprint since the levee will be built to the appropriate flood risk management standards. The ecotone will be gently sloping down from the upland area of the FRM levee and is not expected to move further into the bay.

2.5.5 Physical Effects on Benthos

No adverse impacts to benthic organisms are anticipated other than displacement of those organisms in the construction footprint of the proposed project. The benthos in the canals being filled would be buried under the fill material; however these highly prolific organisms are expected to quickly re-establish in the natural wetlands restored through improved hydrology. It is anticipated that no long-term adverse impacts would occur.

3.0 FACTUAL DETERMINATIONS

3.1 WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATION

3.1.1 Water column

During construction of the levee and breaching of the internal ponds, turbidity would increase temporarily in the water column adjacent to the project. The increased turbidity would be short-term; therefore the Recommended Plan would have no long-term or significant impacts, if any, on salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients or eutrophication

3.1.2 Current Patterns and Circulation

The flow of tidal waters into the ponds is currently controlled through structures. Removal of the internal berms will increase the natural tidal flow process.

Normal Water Level Fluctuations: For tidal areas, mean higher high water (MHHW) in the study area is currently at 7.81 feet NAVD 88, and ordinary high water (OHW) is 8.47 feet NAVD 88. Pond A16 is currently managed to be around 3.1 feet NAVD 88. Other ponds may be higher or lower, but they are all managed well below MHHW. All topography that could have a change in jurisdictional status is above current average water levels for MHHW and OHW.

3.1.3 Salinity Gradients

Salinity is that of oceanic water. Dredged material placement would not affect normal tide fluctuations or salinity.

3.1.4 Actions That Will Be Taken to Minimize Impacts

BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

3.2 SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

During project construction, a temporary short-term increase in suspended particulates may occur that are associated with levee removal and reconstruction. Best management practices would be used to minimize the suspension and transport of soils, levee materials, and roadway materials into water adjacent to or downstream of the construction area including use of sediment controls, turbidity screens, or sediment blockages for adjacent wetlands.

In general, any short-term impacts to water quality associated with construction of the project would be ameliorated by construction sequencing, best management practices for erosion and sedimentation control and monitoring during construction. Turbidity would be short-term and localized and no significant adverse impacts are expected. State water quality standards for turbidity outside an allowable mixing zone would not be exceeded.

3.2.1 Effects on Chemical and Physical Properties of the Water Column

The sea level elevation where the FRM levee will be constructed is characterized by a sandy/silt substrate. There would be little, if any, adverse effects to chemical and physical properties of the water as a result of placing sandy/silty material within the construction footprint.

3.2.1.3 Light Penetration

During construction operations there would be a temporary insignificant reduction in light penetration in the canals in the immediate vicinity of the activity. Once construction is complete, light penetration is expected to return to pre-construction levels.

3.2.1.4 Dissolved Oxygen

Dissolved oxygen levels would not be altered by this project due to the tidal energy wave environment and associated adequate reaeriation rates.

3.2.1.5 Toxic Metals, Organics, and Pathogens

No toxic metals, anthropogenic organics, or pathogens are anticipated at this time to be released by project construction. Several other ponds (A21/20/19, E8A/9/8X, Alviso: Pond A8 (includes 8S), A6 tidal restoration, A17 tidal restoration), in this area have been breached to restore managed ponds to tidal marsh habitat through the South Bay Salt Pond Restoration Project, with no releases of toxic metals, organics, or pathogens.

3.2.1.6 Aesthetics of the Water Column

During construction, visual aesthetics would be negatively impacted.

3.3 EFFECTS ON BIOTA

3.3.1 Primary Productivity and Photosynthesis

Disposal of excavated materials would adversely affect 17.4 acres of wetlands in the immediate vicinity of construction by destroying vegetation and smothering biota. However, restoration of 2,783 acres of salt ponds to tidal marsh habitat would improve the primary productivity and photosynthesis due to an increase in quantity and quality of wetland habitat within the Study Area.

3.3.2 Suspension/Filter Feeders

During construction operations there would be a temporary increase in turbidity and possibly a decrease in suspension/filter feeders due to construction activities. This temporary increase in turbidity would be short-term and should not have any long-term negative impact on these highly fecund organisms. The implantation of the project should benefit these organisms by creating a better quality wetland habitat.

3.3.2.3 Sight Feeders

During construction operations there would be a temporary increase in turbidity and possibly a decrease in sight feeders due to construction activities. No significant impacts on these

organisms are expected as the majority of sight feeders are highly mobile and can move outside the affected area. When the project is operational, sight feeders would benefit from the better quality wetland habitat.

3.4 CONTAMINATION DETERMINATIONS

The material that would be used for FRM levee construction would not introduce, relocate, or increase contaminants at the area. The fill material would consist of sandy material with some silt and is not expected to contain any hazardous materials. Construction activities will require the use of diesel powered standard and low-ground pressure equipment. All construction contracts will include basic and site specific requirements for safety and environmental protection. Typical requirements would require each Contractor to develop plans and strategies to implement best management practices (e.g. barriers, fueling locations, etc.) for preventing contamination as well as responding to accidental spills.

3.5 AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

No long-term adverse impacts on aquatic organisms are anticipated. Tidal marsh ecosystems are expected to greatly improve because of implementation of the Recommended Plan. The proposed project is not expected to cause or contribute to violations of State Water Quality Standards, jeopardize the existence of any federally endangered or threatened species, nor impact a marine sanctuary. No significant degradation is expected and all appropriate and practicable steps would be taken to minimize impacts. Removal of internal levees within the existing ponds is expected to restore tidal flow and re-establish tidal marsh habitat throughout the project footprint.

3.5.1 Effects on Plankton

No adverse impacts to plankton are anticipated.

3.5.2 Effects on Benthos

The extended footprint of the new FRM levee material would bury some benthic organisms. Benthic organisms found within the project area adapted for existence in an area with substrate movement, thus most would be able to burrow up through the disposed material. Recolonization is expected to occur within a year after construction activities cease. No adverse long-term impacts to non-motile or motile benthic invertebrates are anticipated.

3.5.3 Effects on Nekton

No adverse impacts to nektonic species are anticipated.

3.5.4 Effects on Aquatic Food Web

No adverse impacts to the aquatic food web are anticipated, other than minor temporary impacts within the construction footprint of the proposed spreader channels.

3.5.5 Effects on Special Aquatic Sites

There are no hardground or coral reef communities located in the immediate project area that would be impacted by the Recommended Plan.

3.5.6 Wetlands

The dominant vegetation community in the Project Area is pickleweed. There would be approximately 17.4 acres of wetland habitat loss with the construction of the FRM levee. However, this loss is considered minimal due to the increase in tidal marsh habitat to 2,783 acres and is not anticipated to have any adverse effects. The proposed project is anticipated to provide positive ecological benefits by reconnecting tidal flows to the Bay.

3.5.7 Threatened and Endangered Species

Federally listed species that are known to be present within the Study Area include the steelhead trout, salt marsh, harvest mouse, western snowy plover, California least tern, and California Ridgway rail. Appropriate measures to avoid, minimize, and reduce, and compensate for impacts to listed species have been fully coordinated with NMFS and USFWS. A Biological Opinion was received from the USFWS on April 27, 2015 and a Letter of Concurrence was received from NMFS on May 19, 2015. Please see Appendix B8 (ESA Compliance) of the FR/EIS/EIR for the Biological Assessment and Biological Opinion that detail the federally listed species within the project area.

3.5.8 Effects on Sanctuaries and Refuges

No adverse impacts to sanctuaries are anticipated as the site does not contain a sanctuary. Ponds A9-15 are located on Don Edwards San Francisco Bay National Wildlife Refuge (USFWS Refuge) land for restoration, and the USFWS owned FRM levee along Ponds A12 and A13. The refuge will gain tidal wetland habitat over managed salt ponds, which are valuable habitat and is compatible with the Tidal Marsh Recovery Plan.

3.5.9 Effects on Mud Flats

The Recommended Plan would affect 0.6 acres of mud flats due to FRM and ecotone construction. This area will be converted into a transitional habitat for use by several species in regards to sea level rise.

3.5.10 Effects on Vegetated Shallows

There are no vegetated shallows located in the immediate project area that would be impacted by the Recommended Plan.

3.5.11 Effects on Other Wildlife

No adverse impacts to small foraging mammals, reptiles, or wading birds, or wildlife in general are expected. The ecotone and restored tidal marsh habitat is expected to improve habitat for wildlife in the Project Area.

3.6 PROPOSED DISPOSAL SITE DETERMINATIONS

3.6.1 Mixing Zone Determination

Material placed with regard to the FRM levee would meet requirements outlined in the Water Quality Certificate. Placement would not cause unacceptable changes in the mixing zone water quality requirements as specified by the State of California's Water Quality Certification permit procedures. No adverse impacts related to depth, current velocity,

direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents are expected from implementation of the project.

3.6.2 Determination of Compliance with Applicable Water Quality Standards

Because of the inert nature of the material to be to be disposed, Class III water quality standards would not be violated.

3.6.3 Potential Effects on Human Use Characteristics

3.6.3.3 Municipal and Private Water Supply

In the short term, water use would be limited to project construction for activity such as dust control; no long-term water use would be associated with the project, and the project would not affect the overall water supply. Water use during project construction would depend on weather conditions and would be primarily limited to earthwork operations. A project of this type and magnitude would typically use two water trucks per day during earthwork operations at 2,500 gallons per truck. Earthwork operations for this project are estimated at this feasibility level of development to be about 750 days, which equates to approximately 3.75 million gallons of construction water.

It should be noted that construction operations such as these often make use of recycled water. The Wastewater Facility is within the project boundary and produces high-quality, tertiary treated recycled water. The recycled water is distributed throughout the area for irrigation and other approved purposes as part of the discharge permit, and this would be a viable, available, conservation-minded source.

Because the project would not require any new, long-term sources of water, impacts on water supply would be less than significant.

3.6.3.4 Recreational and Commercial Fisheries

Fishing in the immediate construction area would be prohibited during construction. Otherwise, recreational and commercial fisheries would not be impacted by the implementation of the project.

3.6.3.5 Water Related Recreation

Water related recreation in the immediate vicinity of construction would be prohibited during construction activities. People are not allowed to use the current managed ponds for water activities and therefore there would be no impact on water related recreation.

3.6.3.6 Aesthetics

The Recommended Plan includes a 15.2 foot levee. This levee will impact the aesthetics of the area, however, recreational features such as pedestrian bridges, viewing platforms, and interpretive signs will be located along the trails. These impacts are not expected to adversely affect the aesthetic resources of the restored tidal marsh habitat.

3.6.3.7 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

No such designated sites are located within the project area.

3.7 DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

There would be no cumulative impacts that result in a major impairment in water quality of the existing aquatic ecosystem resulting from the placement of material at the project site.

3.8 DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

There would be no secondary impacts on the aquatic ecosystem as a result of the fill. During construction the sites would be contained with sedimentation barriers. Erosion would be controlled by appropriate erosion control techniques. Sedimentation would be controlled during construction.

4.0 FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

4.1 ADAPTATION OF SECTION 404(B)(1) GUIDELINES TO THIS EVALUATION

No significant adaptations of the guidelines were made relative to this evaluation.

4.2 EVALUATION OF AVAILABILITY OF PRACTICABLE ALTERNATIVES TO THE PROPOSED DISCHARGE SITE WHICH WOULD HAVE LESS ADVERSE IMPACT ON THE AQUATIC ECOSYSTEM

No practicable alternative exists which meets the study objectives as well as the non-Federal sponsors objectives that does not involve discharge of fill into waters of the United States. The 12.5 foot levee would require 17.2 acres of fill into existing wetlands, which is 0.02 acres less than the Recommended Plan. Impacts to Waters of the U.S. would be 57.1 acres under the 12.5 levee, and 136.6 acres under the Recommended Plan. The 136.6 acres includes the 30:1 sloping ecotone, which would provide transitional habitat for species, including listed species. Over time, the affected ponds and adjacent areas would have middle-term and long-term gains in waters of the United States as restoration areas transition. The 15.2 foot levee is requested by the non-Federal sponsor to meet FEMA requirements/accreditation at the end of the study period and provides more assurance of flood protection in the event of the USACE high SLC scenario (see Chapter 3 of the Integrated Document for a more robust discussion on SLC and levee heights. The no action alternative would not require fill of wetlands, however, the condition of the non-engineered dike would need replacement per USACE flood risk management standards in the face of sea level rise and also in order to restore tidal marsh habitat to the Bay Area.

4.3 COMPLIANCE WITH APPLICABLE STATE WATER QUALITY STANDARDS

After consideration of disposal site dilution and dispersion, the discharge of dredged materials would not cause or contribute to, violations of any applicable State water quality standards for Class III waters. In reconnecting the Bay with the tidal marsh habitat, water quality and habitat for species should improve.

4.4 COMPLIANCE WITH APPLICABLE TOXIC EFFLUENT STANDARD OR PROHIBITION UNDER SECTION 307 OF THE CLEAN WATER ACT

The discharge of fill materials is not anticipated to cause or contribute to violations of any applicable state water quality standards for Class III waters or Outstanding Florida Waters where applicable. The discharge operation is not anticipated to violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4.5 COMPLIANCE WITH ENDANGERED SPECIES ACT OF 1973

The placement of fill materials in the project area is not anticipated to jeopardize the continued existence of any species listed as threatened and endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended. A Biological Opinion was received from the USFWS on April 27, 2015 and a Letter of Concurrence was received from NMFS on May 19, 2015. No adverse effects are expected to any listed species.

4.6 COMPLIANCE WITH SPECIFIED PROTECTION MEASURES FOR MARINE SANCTUARIES DESIGNATED BY THE MARINE PROTECTION. RESEARCH, AND SANCTUARIES ACT OF 1972

No marine sanctuaries are located within the project area.

4.7 EVALUATION OF EXTENT OF DEGRADATION OF THE WATERS OF THE UNITED STATES

Waters of the United States impacts that would occur as a result of flood risk management implementation would occur at the time of construction. Levee and tide gate construction at Artesian Slough would result in the fill of waters of the United States. Ecosystem restoration impacts would occur in phases as the ecosystem restoration process takes place over time. Most adverse waters of the United States impacts (discharge of fill) would be from levee construction and installing transitional habitat, but lesser amounts of fill would occur due to breaching of ponds. Ecosystem restoration activity would result in beneficial effects by restoring or creating waters of the United States as the restoration process occurs over time. Impacts to wetlands from project construction would be offset over time due to restoration of large areas of tidal marsh.

The placement of fill material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife would not be adversely affected. Significant adverse effects on

aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values would not occur.

4.8 APPROPRIATE AND PRACTICABLE STEPS TAKEN TO MINIMIZE POTENTIAL ADVERSE IMPACTS OF THE DISCHARGE ON THE AQUATIC ECOSYSTEM

Appropriate steps have been taken to minimize the adverse environmental impact of the Recommended Plan. Turbidity would be monitored so that if levels exceed State water quality standards, the contractor would be required to cease work until conditions return to normal.

5.0 CONCLUSION

On the basis of the guidelines, the proposed dredging and disposal sites are specified as complying with the requirements of these guidelines.

Attachment 1. LEDPA Analysis for All Alternatives

Most adverse waters of the United States impacts (discharge of fill) would be from levee construction and installing transitional habitat, but lesser amounts of fill would occur due to breaching of ponds. Ecosystem restoration activity would result in beneficial effects by restoring or creating waters of the United States as the restoration process occurs over time. Impacts to wetlands from project construction would be offset over time due to restoration of large areas of tidal marsh.

Table 1 shows estimated construction-related impacts by type of waters of the United States for each of the action alternatives (see Chapter 3 in the Integrated Document for Alternatives). The table shows waters impacts associated with levee construction (including the different alignments), installing the Artesian Slough tide gate, and building transitional habitat.

Alternatives 2 and 3 would have similar wetland losses at 17.2 acres (1.13 percent of the total wetland area in the study area) and 17.4 acres (1.15 percent of wetland area in the study area), respectively. Alternative 4 would have the highest wetland loss at 37.1 acres, which is about 2.44 percent of the wetland area in the study area.

Alternative 3 would have the highest loss of other waters of the United States (120.2 acres or about 2.86 percent of the area of all non-wetland waters in the study area) because it would affect more area of circulation pond. Alternative 5 would have the smallest loss of other waters 0.82 percent of the area of all non-wetland waters in the study area.

Table 1. Flood Risk Management and Transitional Habitat Construction-Related Impacts by Type of Wetlands and Other Waters of the United States by Project Alternative

In acres and percentage of total acreage in the study area

Type of Water	Alternative 2 (NED/NER Plan)	Alternative 3 (Proposed Action and LPP)	Alternative 4	Alternative 5
Vegetated Wetland				
Salt Marsh				
Tidal	1.7 (0.53%)	1.7 (0.53%)	1.1 (0.34%)	0.0 (0.00%)
Non-tidal	8.1 (9.48%)	8.2 (9.60%)	8.3 (9.72%)	8.3 (9.72%)
Brackish Marsh	0.3 (0.07%)	0.3 (0.07%)	0.2 (0.05%)	0.2 (0.05%)
Muted Tidal/Diked Marsh [a]	1.8 (0.53%)	1.8 (0.53%)	22.0 (6.47%)	20.3 (5.97%)
Freshwater Marsh	1.0 (1.07%)	1.1 (1.18%)	0.9 (0.97%)	0.8 (0.86%)
Vegetated Wetland Subtotal	12.9 (1.0%)	13.1 (1.0%)	32.5 (2.6%)	29.6 (2.3%)
Unvegetated Wetland				
Seasonal Wetland	3.7 (14.12%)	3.7 (14.12%)	4.2 (16.03%)	0.0 (0.00%)
Mudflat	0.6 (0.27%)	0.6 (0.27%)	0.4 (0.18%)	0.4 (0.18%)
Unvegetated Wetland Subtotal	4.3 (1.7%)	4.3 (1.7%)	4.6 (1.9%)	0.4 (0.2%)
All Wetlands Total	17.2 (1.13%)	17.4 (1.15%)	37.1 (2.44%)	30.0 (1.97%)
Other Non-wetland Waters				
Open Water	9.4	9.4	9.7	9.6
Ponds				
Batch (high salinity)	7.9	32.6	9.2	7.3
Circulation	22.6	78.2	17.7	17.7
Sewage Treatment Ponds	0.0 (0.00%)	0.0 (0.00%)	0.0 (0.00%)	0.0 (0.00%)
Legacy Ponds	0.0 (0.00%)	0.0 (0.00%)	0.0 (0.00%)	0.0 (0.00%)
Other Water Subtotal	39.9 (0.95%)	120.2 (2.86%)	36.6 (0.87%)	34.6 (0.82%)
Grand Total	57.1 (1.00%)	137.6 (2.40%)	73.7 (1.29%)	64.6 (1.13%)

Note: Alternative 1 is the No Action Alternative and is therefore not included in this table or the following tables.
Key: NED/NER = National Economic Development/National Ecosystem Restoration; LPP = Locally Preferred Plan

Alternative 3 is the plan that is the least environmentally damaging practicable alternative. This LEDPA designation is based on the following considerations:

- Alternative 1, while it would have no immediate impacts to wetlands and other waters of the U.S., would not be resilient to SLC. Some existing non-tidal

wetlands would be lost in the long term. Marsh species listed under the Endangered Species Act would not recover within the study area due to needed habitat not being restored. Opportunities for increased wetland area and consequently improved water quality would be foregone. Breaching of existing managed ponds due to SLC would occur too late for sediment accumulation to form marshes in these areas.

- Alternatives 4 and 5 would have increased impacts to wetlands and other waters of the U.S. (relative to other alternatives) because of the levee alignment through New Chicago Marsh, with no offsetting improvements in aquatic resources.
- Alternative 2 would have the least short-term impacts to wetlands and other waters of the U.S. It would be less resilient to SLC, both in terms of the marsh transition zone adapting to rising sea levels and in the ability of the FRM levee to protect New Chicago Marsh from eventual drowning caused by its elevation being below mean sea level. The marsh transition zone would be much less useful for maintenance and recovery of listed marsh species.
- Alternative 3 would have slightly greater immediate impacts to wetlands and other waters of the U.S. because of the additional areas of fill for the wider levee and the ecotone. This alternative would provide tidal marsh ecotone with a much better ability to adapt to SLC and in doing so would provide additional assistance towards recovery of listed species. In addition, the increased FRM levee height would better protect New Chicago Marsh and its important population of salt marsh harvest mouse from risk of inundation due to SLC.

Appendix B11

Recovery Plan Criteria for Downlisting and Delisting for California Sea Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail

Table B11-1 *Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail in the Shoreline Phase I Study Area* summarizes the factors that affect recovery of and criteria that need to be met for downlisting and delisting of California sea-blite, salt marsh harvest mouse (SMHM), and California Ridgway's rail.

Table B11-1. Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail in the Shoreline Phase I Study Area

Criteria by Factors Affecting Recovery	Recovery Plan Species in the Central/South San Francisco Bay Recovery Unit		
	California Sea-Blite	Salt Marsh Harvest Mouse	California Ridgway's Rail
A. Present destruction, modification or curtailment of habitat or range			
Downlisting	Habitat supporting at least three populations must exist on land in conservation ownership or under conservation management.	Protect and manage historic and restored marsh complexes in the recovery unit at: • East Palo Alto–Guadalupe Slough, 1,000 or more acres in size, with viable habitat areas (VHAs) at (1) East Palo Alto–Cooley Landing–Palo Alto Nature–Mountain View to Stevens Creek and (2) Stevens Creek to Guadalupe Slough. • Guadalupe Slough–Warm Springs, 1,000 or more acres in size, with one VHA within the marsh complex. Habitat supporting all extant SMHM occurrences must be protected via habitat management. Each marsh complex must support VHAs that are connected by suitable habitat corridors with sufficiently deep pickleweed plains and/or sufficiently deep high marsh zones (and preferably both). Unless precluded by natural features or existing hardscape, the marsh complexes themselves must be connected to one another by marsh or restored tidal marsh of sufficient depth and complexity to allow for dispersal and recolonization. Marsh complexes must be 1,000 acres or more in size. VHAs must be 150 acres or more in size. Reduction in extant *Lepidium latifolium* populations to less than 10% cover (in and downgradient of the high marsh-upland ecotone) for 5 years in each marsh complex. Implement a system for early detection and control of future invasive plant infestations.	Protection and management of habitat sufficient to support a population of 500 rails in the recovery unit at East Palo Alto–Guadalupe Slough and Guadalupe Slough–Warm Springs marsh complexes. • The habitat for each population must have a minimum area of 1,111 acres (450 ha) of contiguous high-quality tidal marsh habitat with well-developed channel systems and high-tide refugia/escape cover at the high marsh/upland transition zone and/or inner-marsh. Reduction in extant *Lepidium latifolium* populations to less than 10% cover (in and downgradient of the high marsh-upland ecotone) for 5 years in each marsh complex. Implementation of a system for early detection and control of future invasive plant infestations. Implementation of site-specific management plans on lands owned by USFWS, CDFW, and Mid-Peninsula Open Space District to reduce human-caused disturbance to rails.
Delisting	Habitat supporting at least three populations must exist on land in conservation ownership or under conservation management for 10 generations.	Meet all criteria under downlisting item A. Develop a plan for early detection and control of *Lepidium latifolium* (in and downgradient of the high marsh-upland ecotone) to be implemented following any future increase beyond 10% cover; secure a source to fund such actions in perpetuity. Implement the South Bay Salt Pond Restoration Plan (USFWS 2009).	Meet all criteria under downlisting item A. Develop a plan for early detection and control of *Lepidium latifolium* (in and downgradient of the high marsh-upland ecotone) to be implemented following any future increase beyond 10% cover; secure a source to fund such actions in perpetuity. Implement the South Bay Salt Pond Restoration Plan (USFWS 2009).

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Table B11-1. Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail in the Shoreline Phase I Study Area

Criteria by Factors Affecting Recovery	Recovery Plan Species in the Central/South San Francisco Bay Recovery Unit		
	California Sea-Blite	Salt Marsh Harvest Mouse	California Ridgway's Rail
B: Overutilization for commercial, scientific, or educational purposes			
Downlisting Delisting	Overutilization is not known to be a threat to this species; no downlisting or delisting criteria developed.	Overutilization is not known to be a threat to this species; no downlisting or delisting criteria developed.	Overutilization was a major factor for this species at the turn of the 20th century but is not currently known to be a threat; no downlisting or delisting criteria developed.
C: Disease or predation			
Downlisting	Disease and predation are not known to be a major threat to this species; no downlisting or delisting criteria developed.	*Disease* is not known to be a major threat; no downlisting criteria developed. An unnaturally high level of *predation* is thought to exist in some marshes where SMHM are concentrated into narrow *Sarcocornia* zones due to surrounding habitat loss. Though little is known about death rates related to the resulting predation, it is presumed that restoration of deep marshes with ample high tide refugia, both high marsh and intermarsh, will result in a reduction of predation rates. Focus is on restoration of high quality marshes; no downlisting criteria developed for predation.	*Disease* is not known to be a major threat; no downlisting criteria developed. For *predation*, develop and implement a predator management plan at sites with significant predation issues.
Delisting		Disease and predation are not known to be a major threat to this species; no delisting criteria developed.	No delisting criteria developed for disease. Meet all downlisting criteria under item C. Predator monitoring indicates that, for 5 consecutive years, predation pressure on California Ridgway's rails falls below a level at which it negatively affects long-term population persistence.

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Table B11-1. Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail in the Shoreline Phase I Study Area

Criteria by Factors Affecting Recovery	Recovery Plan Species in the Central/South San Francisco Bay Recovery Unit		
	California Sea-Blite	Salt Marsh Harvest Mouse	California Ridgway's Rail
D: Inadequacy of existing regulatory mechanisms			
Downlisting Delisting	Existing regulatory mechanisms not identified as inadequate; no downlisting or delisting criteria developed.	Existing regulatory mechanisms not identified as inadequate; no downlisting or delisting criteria developed.	Existing regulatory mechanisms not identified as inadequate; no downlisting or delisting criteria developed.
E: Other natural or manmade factors affecting continued existence			
Downlisting	To provide sufficient resilience to stochastic events, meet downlisting conditions under item A and have at least: • A minimum of three populations.[a] • For 5 consecutive years of monitoring, the three populations must total a minimum of 1,500 individuals.	40% of the VHAs of each large marsh complex must have SMHM present at the capture efficiency level[a] of 5.0 or better and: • An additional 50% of the VHAs of each large marsh complex must have SMHM present at the capture efficiency level of 3.0 or better. • Each marsh complex must be monitored and found to meet the above criteria at least twice, with at least 5 years between surveys. After marsh complexes meet the criteria twice, there is no need to resurvey as long as no more than 20 years have passed and there has been no obvious negative change to habitat during that time. High marsh/upland transition lands must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to SLC. • This criterion will be met when SLC modeling shows sufficient uplands have been protected to accommodate landward migration while still allowing for acreage criteria to be met (see item A criteria).	To provide sufficient resilience to stochastic events, meet downlisting conditions under items A, B, and C and have an average number of at least 1,060 rails over a 10-year period, spread over a large geographic area. High marsh/upland transition lands must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to SLC. • This criterion will be met when SLC modeling shows sufficient uplands have been protected to accommodate landward migration while still allowing for acreage criteria to be met (see item A criteria).

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Table B11-1. Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and Ridgway's Rail in the Shoreline Phase I Study Area

Criteria by Factors Affecting Recovery	Recovery Plan Species in the Central/South San Francisco Bay Recovery Unit		
	California Sea-Blite	Salt Marsh Harvest Mouse	California Ridgway's Rail
Delisting	To provide sufficient resilience to stochastic events, meet delisting conditions under item A and have at least: • A minimum of three populations[a] • For 10 consecutive years of monitoring, the three populations must each support at least 500 individuals and the cumulative total of all San Francisco Bay populations must total a minimum of 8,000 individuals. High marsh/upland transition lands must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to SLC. • This criterion will be met when SLC modeling shows sufficient uplands have been protected to accommodate landward migration while still allowing for acreage criteria to be met. To minimize impacts sustained after oil spills occurring at or near populations of this species, the San Francisco Bay and Delta Area and Central Coast Area sections of the Sector San Francisco-Area Contingency Plan must be revised to place high priority on the emergency protection of this species.	75% of defined VHAs within each of the marsh complexes must have SMHM consistently present at the capture efficiency level of 5.0 or better. • Each marsh complex must be monitored and found to meet the above criteria at least twice, with at least 5 years between surveys. After marsh complexes meet the criteria twice, there is no need to resurvey as long as no more than 20 years have passed and there has been no obvious negative change to habitat during that time. High marsh/upland transition lands must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to SLC. • This criterion will be met when SLC modeling shows sufficient uplands have been protected to accommodate landward migration while still allowing for acreage criteria to be met. To minimize impacts sustained after oil spills occurring at or near rail populations, the San Francisco Bay and Delta Area section of the Sector San Francisco-Area Contingency Plan must be revised to place high priority on the emergency protection of this species.	To provide sufficient resilience to stochastic events, meet delisting conditions under items A, B, and C and have an average number of at least 3,180 rails over a 10-year period, spread over a large geographic area. High marsh/upland transition lands must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to SLC. • This criterion will be met when SLC modeling shows sufficient uplands have been protected to accommodate landward migration while still allowing for acreage criteria to be met (see item A criteria). To minimize impacts sustained after oil spills occurring at or near rail populations, the San Francisco Bay and Delta Area section of the Sector San Francisco-Area Contingency Plan must be revised to place high priority on the emergency protection of this species. Develop a map that identifies sources and extents of mercury exposure in rails; implement a plan to remediate the most significant point sources of mercury. Exposure of rails to mercury must be reduced such that the mean mercury concentration of all eggs sampled within a marsh complex must fall below 0.2 µg/g (fresh wet weight) for 5 consecutive years, the point above which it is believed developmental abnormalities and reproductive harm occur. • Only fail to hatch eggs will be sampled.

Source: USFWS 2013

km = kilometers; ha = hectares; USFWS = U.S. Fish and Wildlife Service; CDFW = California Department of Fish and Wildlife;

[a] For downlisting, a population is any concentration of plants separated by greater than 1.9 km (1.2 miles) from other such concentrations of plants, with no intervening locations observed over a period of 5 years.

[b] For delisting, a population is any concentration of plants separated by greater than 1.9 km (1.2 miles) from other such concentrations of plants, with no intervening locations observed over a period of 10 years.

[c] Viable habitat areas (VHAs) are defined as well-developed tidal marshes with (1) extensive *Sarcocornia* (pickleweed) on a mid to high marsh plain 200 meters (219 yards) or more deep (from shore to bay); (2) adjacent wide high marsh transition zone, wherever possible, that acts as a refugium for the mice during the highest tides with sufficient area and cover to minimize predation risks; and (3) stands of *Grindelia* or tall forms of *Sarcocornia*, interspersed among shorter forms of *Sarcocornia* to provide additional high tide refugia within the marsh and away from the upland edge.

[d] Capture level efficiency is the number of mice captured divided by effort in number of trap nights expended times 100.

Appendix B12

Environmental Justice Appendix

Environmental Justice Appendix

Regulatory Setting and Study Methodology

On February 11, 1994, President Bill Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. As the Federal sponsor of the Proposed Project, the U.S. Army Corps of Engineers (USACE) must consider how the project might affect minority and low-income populations.

Potential environmental justice populations were identified using American Community Survey 5-year estimates (2006–2010) and 2010 U.S. Census information..

In 2010, the Census blocks that make up the Alviso community supported a population of about 1,790 people (U.S. Census Bureau 2010). As of the late fall of 2012, 2010 Census data were available at the block level for race and ethnicity but not for income. For income and poverty, then, the following discussion relies on 5-year American Community Survey estimates for the census tract within which Alviso and the study area are located. This tract is much larger than the study area but is the best available information for the area.

Baseline Condition – Minority Populations

According to the Council on Environmental Quality's (CEQ) guidelines for environmental justice analyses (CEQ 1997):

> Minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the majority population percentage in the general population or other appropriate unit of geographic analysis. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

This study uses criterion (a) to identify minority communities. For the purpose of this study, a *minority* is a person who is Black, Asian, American Indian or Alaskan Native, or Native Hawaiian or other Pacific Islander, or is of Hispanic or Latino origin. People of Hispanic or Latino origin may be of any race and of more than one race.

Table 1 *General Racial and Ethnic Distribution of the Study Area* summarizes the racial and ethnic population distribution of cities in the study area. Table 1 *General Racial and Ethnic Distribution of the Study Area* shows that, in general, Santa Clara County and the cities in and around the study area have a higher proportion of minorities than the State as a whole. In San José, Santa Clara, and Sunnyvale, the percentage of Asian minorities is greater than the percentage of non-minorities (that is, white people who are not Hispanic). In general, the area is dominated by people who are Asian or white (both Hispanic and not Hispanic).

Table 1. General Racial and Ethnic Distribution of the Study Area

Area	Percentage of Total Population [a, b]									
	Total population	White, not Hispanic	White, Hispanic	Black or African American	AIAN[c]	Asian	HNOPI[d]	Some Other Race	Two or More Races	All Minorities
California	3,725,3956	40.1	17.4	6.2	0.9	13.0	0.3	16.9	4.9	59.6
Santa Clara County	1,781,642	35.2	11.8	2.6	0.7	32.0	0.4	12.4	4.9	64.8
San José	945,942	28.7	14.1	3.2	0.8	32.0	0.5	15.7	4.9	71.2
Santa Clara	116,468	36.1	8.9	2.7	0.5	37.7	0.5	8.3	5.3	63.9
Sunnyvale	140,081	34.5	8.5	1.9	0.5	40.9	0.4	8.7	4.6	65.5
Milpitas	66,790	14.6	5.9	2.9	0.5	62.1	0.5	8.7	4.7	85.3

Source: US Census Bureau 2010

[a] People of Hispanic or Latino origin can be one or more different races. These totals by race include people who might also be Hispanic or Latino.

[b] Percentages might not add up to 100 due to rounding.

[c] American Indian or Alaskan Native

[d] Native Hawaiian or other Pacific Islander

The study area supports two Census tracts (5046.02 and 5050.09) and several whole Census blocks. The Alviso area is made up of smaller blocks, but the study area also falls into parts of other much larger Census blocks that extend far outside of the study area boundary. Of the 54 individual blocks that are wholly or partially within the study area, 26 did not have any population in 2010 and were not considered in the analysis. These blocks include areas within the former salt pond complex and areas that support industrial/light industrial development only.

The remaining 28 blocks supported a population of 1,824 people in 2010; 88.3 percent of whom identified as minorities; only four blocks had a minority population that was less than 50 percent of the total population. See Appendix A6 *2010 Census Data – Racial and Ethnic Distribution of Study Area* for a detailed table of the racial and ethnic distribution by 2010 Census block. All but three of the blocks in the Alviso community had a 50 percent or greater proportion of minorities.

Figure 1 *Minority Distribution in the Study Area* shows the areas where minorities make up at least 50 percent of the total block population.

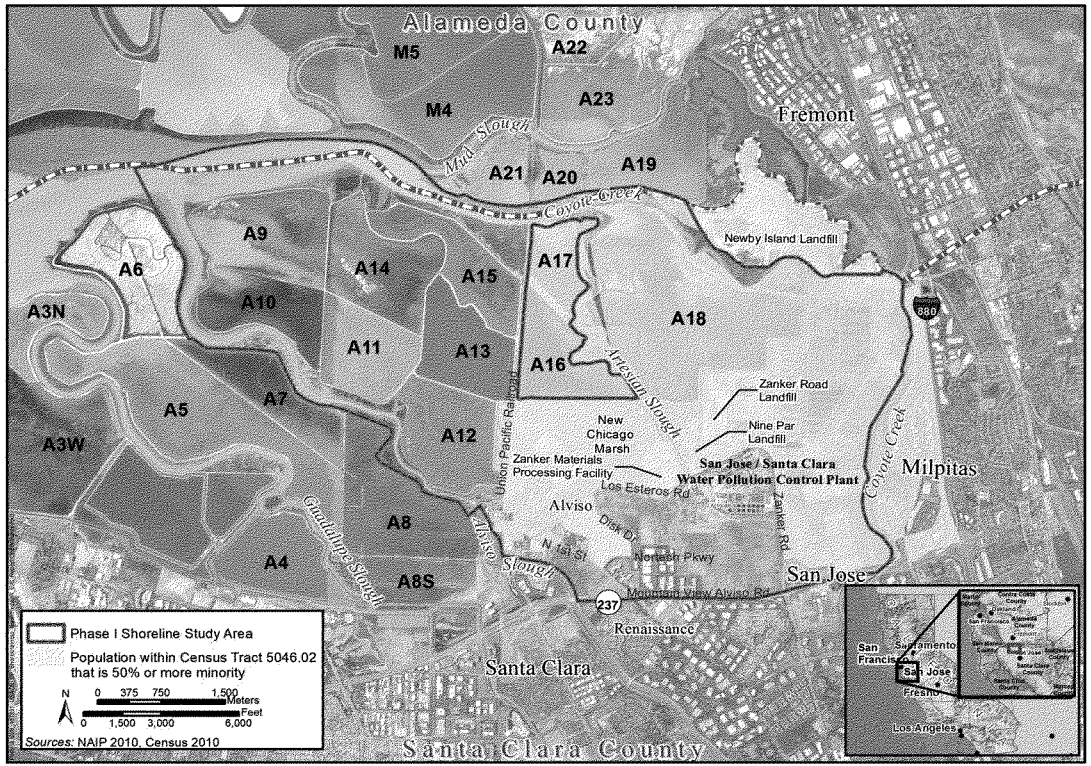

Figure 1. Minority Distribution in the Study Area

Baseline Condition – Low-Income Populations

To identify low-income populations, the CEQ's environmental justice guidance states the following (CEQ 1997):

> Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Note that the Census Bureau's current P-60 population report provides only general information about income trends nationwide and does not provide detailed information about the study area (DeNavas-Walt et al. 2012). Because of this, 2010 Census data are used to present more detailed information on income and poverty in the study area.

For the purpose of this study, a low-income population is persons who have a median income below the poverty thresholds defined by the U.S. Department of Health and Human Services. To identify low-income populations in the study area, this study identifies areas having a substantially higher percentage of people and households in poverty than the counties of Alameda and Santa Clara.

Table 2 *Income and Poverty Summary for Cities in the Study Area* summarizes the median income and poverty status of people living in cities in the study area.

Table 2. Income and Poverty Summary for Cities in the Study Area

Area	Median Household Income (2006–2010)	Percentage of Persons with Income below Poverty Level (2006–2010)
California	$60,883	13.7%
Santa Clara County	$86,850	8.9%
San José	$79,405	10.8%
Santa Clara	$85,294	8.6%
Sunnyvale	$90,174	6.2%
Milpitas	$92,694	5.8%

Source: U.S. Census Bureau 2012a, 2012b, 2012c, 2012d

Table 2 *Income and Poverty Summary for Cities in the Study Area* shows that, in general, people living in areas around the study area have a much higher median income than the rest of the residents of California as whole. To some degree, the higher incomes associated with each city reflect a higher cost of living in the Bay Area and are more meaningful when compared to the county incomes (and to each other) rather than to the State statistic.

The rates of people living in poverty in cities in the study area are lower than the State rate of 13.7 percent and range from a low of 5.8 percent in Milpitas to a high of 10.8 percent in San José.

Table 3 *Income and Poverty Summary for Census Tracts in the Study Area* summarizes income and poverty for the two Census tracts that include the study area. Census tract 5046.02 includes the community of Alviso but also includes large parts of the cities of Milpitas, Santa Clara, and Sunnyvale. Census tract 5050.09 is a much smaller tract that includes some developed areas south of State Route (SR) 237 between Coyote Creek and the Guadalupe River. 2010 Census data for poverty were not available at the time this report was written.

Table 3. Income and Poverty Summary for Census Tracts in the Study Area

Demographic Criterion	Census Tract	
	5046.02	5050.09
Median household income	$52,202	$75,082
Population for whom poverty status is determined	1,471	6,026
Percentage of population below poverty level	15.6%	10.7%
Poverty Status by Race: of the population, percentage that is below poverty level		
White alone	12.9%	15.5
Black or African American alone	100%	13.2
American Indian and Alaskan Native alone	NA[a]	NA
Asian alone	0%	3.5
Native Hawaiian and Other Pacific Islander alone	NA[a]	0
Some other race alone	20.7%	5.3
Two or more races	0%	18.8
Poverty Status by Ethnicity: of the population, percentage that is below poverty level		
Hispanic or Latino (of any race)	16.6%	13.5%
White alone (not Hispanic or Latino)	17.4%	12.9%

Source: U.S. Census Bureau 2012b

Note: The data presented here are estimates based on a sample of the population. See Appendix A6 *2010 Census Data – Racial and Ethnic Distribution of Study Area* for complete information about margins of error and data reliability.

[a] Either no sample observations were available or too few sample observations were available to compute an estimate.

The populated part of the study area is centered on the community of Alviso. Alviso is in Census tract 5046.02. As shown in Table 3 *Income and Poverty Summary for Census Tracts in the Study Area*, the 2006–2010 median income of this Census tract was substantially lower than the median income for Santa Clara County as a whole (which was $86,850 for the same period; see Table 2 *Income and Poverty Summary for Cities in the Study Area*) and for the city of San José (which was $79,405 for the same period; Alviso is within the city limits). This indicates that, in 2010, the median income of households in Census tract 5406.02 was lower than that of households in the surrounding areas. The median income of households in Census tract 5050.09, which is in the southeast corner of the study area, was $75,082. This income was also lower than the county and city median incomes. Please note that, in the case of Census tract

5046.02, the margin of error is quite large (±$35,786; see Appendix A7 *2010 Census Data – 5-Year Income Estimates for Study Area*) and the data might not represent the true income status of people living there.

The 2006–2010 American Community Survey data also provide Census tract–level information about poverty. As shown in Table 3 *Income and Poverty Summary for Census Tracts in the Study Area*, the overall proportion of people living in poverty (for that part of the population for whom poverty status has been defined) was 15.6 percent in Census tract 5046.02 and 10.7 percent in Census tract 5050.09. Both of these proportions are higher than the amount for Santa Clara County as a whole (8.9 percent below poverty level; see Table 2 *Income and Poverty Summary for Cities in the Study Area*). The percentage of people living below the poverty level in Census tract 5046.02, within which Alviso is located, was substantially higher than the county and city percentages. This indicates that poverty is more prevalent in this Census tract than in surrounding areas. However, as with the income data, the margin of error for poverty is quite high in this Census tract (±10.1 percent). The percentage of people living in poverty in Census tract 5050.09 was similar to the city percentage. The margin or error for Census tract 5050.09 was ±4.1 percent.

The American Community Survey also provides information about poverty based on race and ethnicity. As shown in Table 3 *Income and Poverty Summary for Census Tracts in the Study Area*, all (100 percent) of the black and African American people (23) living in Census Tract 5046.02 were living below the poverty level, and a high percentage (20.7 percent) of people who identify themselves as some other race (581) were living below the poverty level. When considered separate from race, the poverty rate of the Hispanic or Latino origin population (16.6 percent) in Census tract 5046.02 was lower than but not statistically different from the poverty rate of people who are white and not Hispanic or Latino (17.4 percent).

Considering all three measurements (median income, overall poverty, and poverty by race and ethnicity), the data suggest that the population of Census tract 5046.02, within which the community of Alviso is located, is generally lower income than surrounding areas. However, the margins of error for the data estimates presented in the American Community Survey introduce uncertainty. Therefore, the presence of a low-income population cannot be verified with the available data.

Summary

In summary, the 2010 Census information shows that the population of that part of the study area that includes the populated parts of Alviso supports a minority population. The American Community Survey estimates indicate that the same area is probably lower income. Section 0 *Potential Effects on Environmental Justice Populations* assumes that the area shown on Figure 1 *Minority Distribution in the Study Area* represents an environmental justice population in the study area.

Potential Effects on Environmental Justice Populations

Methodology for Determining Effects

Pursuant to Executive Order 12898, this section considers whether the project alternatives would:

- Cause disproportionately high adverse effects (such as noise, air quality, and access effects) on the identified population(s) during construction
- Cause disproportionately high adverse effects on the identified population(s) during operation and maintenance of the flood risk management (FRM) levee and restored areas

As defined in the 1997 CEQ guidance, the following factors are used to measure environmental justice effects:

- For *human health effects*, agencies are to consider the following factors to the extent practicable:
  - Whether the health effects, which may be measured in risks and rates, are significant (as the term is used by the NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death; and
  - Whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard is significant (as the term is used by the NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and
  - Whether health effects occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.
- For *environmental effects*, agencies are to consider the following:
  - Whether there is or will be an impact on the natural or physical environment that significantly (as the term is used by the NEPA) and adversely affects a minority population, low-income population, or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment; and
  - Whether environmental effects are significant (as the term is used by the NEPA) and are or may be having an adverse impact on minority populations, low-income populations, or Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and
  - Whether the environmental effects occur or would occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

In general, the part of Santa Clara County that includes the study area is racially and ethnically diverse. Racial and ethnic minorities make up 88.3 percent of the total population in Census blocks that are included, either wholly or partially, in the study area.

The community of Alviso, the area that generally supports the identified environmental justice populations, has long been located adjacent to the former salt ponds, the San José–Santa Clara Regional Wastewater Facility (Wastewater Facility), and industrial uses surrounding the plant. This analysis does not evaluate how these existing uses have affected the community in the past. The following discussion focuses on how this specific project might affect the environmental justice population.

Alternatives Evaluation

In general, the Shoreline Phase I Project is expected to have positive regional economic impacts as a result of both a reduction in flood risk and the expenditure of funds to implement the projects (USACE 2012a).These positive effects would apply to all populations in the study area. The following paragraphs examine the potential environmental justice population effects associated with constructing the FRM levee and ecosystem restoration components and the long-term management of the study area.

Flood Risk Management Levee

In the long term, the greatest flood risk improvements would be experienced by those living in the community of Alviso, which supports an environmental justice population.

The community of Alviso is at an elevation at or below about 5 feet NAVD 88. Because of the low elevation of the town, a coastal flood event could result in flood depths as great as 8 feet throughout much of the floodplain. Flood events that would result in several feet of flooding in Alviso are estimated to cause more than $100 million in direct damage to structures and contents.

The existing patchwork of non-engineered salt pond dikes that keeps bay water from the developed area has, in fact, prevented tidal flooding in the study area to date. However, according to the coastal flood risk analysis there is currently a high annual risk of flooding, and this risk will increase over the period of analysis under any of the three sea-level change (SLC) scenarios considered. According to the combined coastal and geotechnical modeling, in 2017 the annual chance of flooding is approximately one in three. Under the USACE Intermediate SLC scenario the annual risk of flooding by the year 2067 is estimated to be greater than fifty percent. This increase is due to the increase in relative sea level at the study location over the period of analysis.

Because of the significant flood depths anticipated, the flood risk is high both from a property damage perspective as well as a public health and safety perspective. If a project to reduce flood risk is not constructed, the study area would likely be vacated after repeated flooding and the community of Alviso would no longer exist.

During actual construction of the levee, most of the potential adverse social effects on the community of Alviso would take place during construction. Because the community is the

closest to the proposed construction area, residents living in the community would be the most likely to be exposed to construction-related nuisances such as noise, dust, and additional traffic. As described throughout Chapter 4 *Existing and Future Conditions/Affected Environment, Environmental Consequences, and Mitigation Measures*, these construction-related effects would be short-term and minimized through applying best management practices. For example, construction-related air quality impacts would be avoided or minimized through careful material management, equipment management, and wind erosion control. The construction-related community impacts associated with FRM levee construction would be most noticeable to Alviso residents with Alternative 5 since the proposed FRM levee location would be very close to the community. Alternatives 2 and 3 would have the least effect on the community since the FRM levee would be on the north side of New Chicago Marsh (NCM; a distance of a quarter to a half mile in most places). Construction staging would be the same under all of the alternatives. For the most part, equipment and material would be staged in areas away from the community (primarily on Wastewater Facility property to the east and northeast).

In summary, applying best management practices to control dust and noise and limiting vehicle use to concentrated staging areas east of the town would prevent or minimize adverse construction-related effects on the residents of Alviso. Improving the long-term level of flood risk management would have a beneficial effect on the Alviso community. In general, then, the overall effect of the FRM element of the Shoreline Phase I Project would benefit this environmental justice population.

Ecosystem Restoration

The ecosystem restoration activities most likely to affect residents of Alviso are construction-related nuisance impacts similar to those described for FRM levee construction. In the case of ecosystem restoration, activity would begin at Pond A12, which is the pond closest to the community, starting in Year 0 with pond preparation. People living on the west end of Alviso could experience the construction-related nuisance impacts through about Year 4, when the Pond A12 breach is scheduled to occur. After that time, pond preparation work and construction activity would move to areas farther away from the community, so dust and noise impacts would lessen. Residents would probably still experience construction-related traffic, but, given the level of traffic that would probably be associated with the in-pond work, the schedule (it is spread out over several years), and the traffic maintenance plan that would be used during construction, construction-related traffic impacts are not expected to significantly affect mobility and access in, through, and around Alviso. Because the Pond A12 construction impacts would be short-term and because other construction would be physically farther away and low-intensity, construction-related nuisance impacts are not expected to cause significant effects on the residents of Alviso.

Long-term operations associated with areas restored through outboard levee breaches, such as water control and ongoing monitoring, are not expected to result in any adverse social impacts that could disproportionately affect people living in Alviso.

US Army Corps
of Engineers

SOUTH SAN FRANCISCO BAY SHORELINE

PHASE I STUDY

ALVISO PONDS AND SANTA CLARA COUNTY, CA

Economics Appendix

(Appendix C to Feasibility Report/EIS)

November 2015

U.S. Army USACE of Engineers

San Francisco District

Appendix C - Economics Appendix

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Executive Summary

Purpose & Methods

This report describes the evaluation and comparison of the economic justification and cost effectiveness of various measures to reduce flood risk and provide ecosystem restoration in the study area.

The flood risk management options are first evaluated separately from the ecosystem restoration measures in order to determine the single-purpose flood risk management National Economic Development (NED) option. The NED flood risk management option[1] produces the greatest net national economic benefits measured in dollars. The HEC-FDA computer program was used to estimate future without-project expected flood damage and to estimate the damages reduced and residual damage associated with various project options intended to reduce flood risk in the area. Statistical results of the HEC-FDA program were used to describe existing and future without-project and with-project likelihood of coastal flooding. The HEC-FDA model is a planning model that has been certified for use in U.S. Army USACE of Engineers (USACE) feasibility studies.

The ecosystem restoration measures are evaluated and compared separately from the flood risk measures using two methods – cost-effectiveness (CE) analysis and incremental cost analysis (ICA), jointly called CE/ICA. The CE/ICA was conducted using the Institute for Water Resources (IWR) Plan computer program, which is certified for use in USACE feasibility studies. The National Ecosystem Restoration (NER) option is to be selected from the subset of cost-effective options.

Ultimately, the USACE planning process results in the identification of an alternative that is known as the NED/NER Alternative. The USACE Planning Guidance Notebook describes alternative recommendation for multi-purpose projects as follows:

Projects which produce both National Economic Development (NED) benefits and National Ecosystem Restoration (NER) benefits will result in a "best" recommended plan so that no alternative plan or scale has a higher excess of NED benefits plus NER benefits over total project costs. This plan shall attempt to maximize the sum of net NED and NER benefits, and to offer the best balance between two Federal objectives. Recommendations for multipurpose projects will be based on a combination of NED benefit-cost analysis, and NER benefits analysis, including cost effectiveness and incremental cost analysis.

The primary sources of policy and procedural guidance for this analysis are the following: *Planning Guidance Notebook* – ER 1105-2-100; *Evaluation of Environmental Investments Procedures Manual* – IWR Report 95-R-1; *Incorporating Sea Level Considerations in Civil Works Programs* – ER 1100-2-8162.

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[1] This report uses the term "option" for the single-purpose flood risk management (FRM) and ecosystem restoration (ER) plans, and reserves the term "alternative" for the combined, multi-purpose FRM and ER plans, including the NED/NER plan.

Existing & Future Without-Project Flood Risk

There are approximately 2,100 people living in the floodplain, mostly low-income minority families. There are estimated to be another 3,400 individuals that work in the area and are considered part of the overall "population at risk" (PAR).

Characterizing the flood risk to this and any other community involves the qualitative or quantitative description of the nature, magnitude and likelihood of the adverse effects associated with the flood hazard. The purpose of characterizing the flood risk is to support decisions related to reducing the risk to people and property in the floodplain. Characterizing the flood risk requires answering four important questions:

1. What can go wrong?
2. How can it happen?
3. What are the consequences?
4. How likely is it to happen?

The goal of the flood risk analysis component of the South San Francisco Bay Shoreline Feasibility Study is to answer these four questions in sufficient detail to support decisions that may reduce the flood risk in the study area. The study is focused on reducing the risk of tidal flooding, which could happen if water from the bay overtops or breaches the non-engineered dikes that are currently the only line of defense separating the bay from the community of Alviso and other people and property in the city of San Jose, CA. The consequences of a tidal flood event in the study area would be devastating: the community of Alviso is located at an elevation below mean high tide, and the region's largest water pollution control plant is located adjacent to the town and is also at risk from flooding. Thus, the answers to the first three questions posed above are relatively straightforward. The fourth question (likelihood) is the most challenging to answer, and requires the greatest level of effort and analysis.

The existing patchwork of non-engineered levees has to date prevented tidal flooding in the study area. These non-engineered levees had been constructed and maintained for years by private interests that were using the area for salt harvesting. These companies no longer own the land or operate in these ponds.

In order to understand the existing and future risk from coastal storm events, extensive coastal hydrodynamic modeling has been conducted. The modeling effort was made more complicated by the existence of non-engineered levees that traverse the study area. The modeling had to consider static water level, wave and tidal forces, dynamic and static failure of the existing levees, and overtopping volumes into the various ponds in the study area. All of these factors affect the estimate of water surface elevation at the innermost area of the bay adjacent to the populated area.

The without-project analysis of the flood risk estimates that there is currently a high annual likelihood of tidal flood damage in the study area. When considering the combined probabilities of water level at the outboard dike, failure of the outboard dike, and failure of the low inboard dike, in the year 2017 there is an approximate 32% chance of a damaging flood event in the study area. Given that that is only a few years from the time of writing, the current flood risk is thought to be practically equivalent.

Over time and in the absence of structural measures, under any of the future sea-level change scenarios such a high risk of flooding would be expected to eventually force residents and property owners from the

floodplain. Exactly when and which residents would relocate is obviously highly uncertain, but it is only reasonable to conclude that, if faced with a high and steadily increasing future flood risk, property owners would not choose to or be allowed to rebuild or repair their structures after a significant flood event. How to incorporate these presumed relocations was one of the most challenging issues of this flood damage analysis.

Ultimately, the analysis applies some general assumptions about which structures would relocate and when. The relocations were tied to flood risk by assuming that any structure that sustains significant damage from an event with an annual chance of exceedance (ACE) of 10% or greater would relocate to a flood-free area. As the report describes in detail, once a structure was identified as having sustained significant enough damage that it would likely be relocated, the property was removed from the estimate of flood damage in subsequent modeling years.

The increasing likelihood of future coastal flooding in the area also threatens the San José-Santa Clara Regional Wastewater Facility (Wastewater Facility), which is a critical regional facility, and damage to it would be catastrophic on many levels. The Wastewater Facility serves approximately 1.4 million people and a large portion of the businesses in Silicon Valley. The plant is not in the current (year zero) coastal floodplains developed by USACE, but it is in the future floodplains that incorporate sea-level rise projections. Because this nearly $3 billion[2] facility is so important to the region, in the absence of a Federal project it is assumed that the City of San Jose would take measures to protect the facility from flooding. The cost of constructing a ring levee around this facility to reduce the risk of flood damage is estimated for planning purposes to be at least $25 million. Given that this cost is preliminary and for planning purposes only, the actual cost of implementing a stand-alone project to reduce the risk to the plant is likely greater. This planning estimate is simply incorporated in the analysis as a potential cost avoided as a result of construction of a comprehensive tidal flood risk management project.

As described above, the without-project analysis results indicate that there currently is a high probability of failure of the existing dike-pond system, and that the risk increases over time with a rise in relative sea level. In 2017 the annual chance of a damaging flood event is estimated to be 32%, and by 2067 the annual chance is estimated to be as high as 53%. Because of the low elevation of much of the properties in the floodplain (below mean sea level), a tidal flood event would cause significant property damage. If it reached the town, even water elevations associated with the more frequent flood events (50% ACE, etc), could cause tens of millions of dollars in property damage.

The without-project equivalent annual damage from flooding over the entire 50-year period of analysis is estimated to be approximately $18.5 million, $23.2 million, and $41.8 million under the USACE Low, Intermediate, and High sea level change (SLC) scenarios.

Flood Risk Management Options & Benefits

The analysis evaluates nine flood risk management project options – the No Action Plan, seven structural options, and a non-structural option. The non-structural option analyzed involves the gradual but permanent evacuation of the floodplain and relocation of residents and businesses, and includes an assumption of the construction of a ring levee and other features to protect the SJ/SC WPCP. This non-structural option would leave the floodplain looking similar to what is expected under the long-term future without-project conditions (evacuation of floodplain and ring levee around the plant), the

[2] Estimated replacement value; source – SJ/SC WPCP

difference is that the evacuation would be completed before the flood risk increased significantly – possibly avoiding much of the adverse impacts to properties and human life and safety. Preliminary estimates of the cost of such a plan were in excess of $425 million[3]. A USACE value-engineering review during the study process recommended that, in the spirit of USACE planning modernization[4], because of the extremely high cost of implementation, no detailed analysis be conducted and no additional resources were devoted to considering this alternative. This report limits the analysis of the non-structural option to an estimate of the cost of implementation.

While several levee alignments were initially considered, it was ultimately determined that there was a single most efficient levee alignment for the FRM portion of the project. Because all of the levee alignments tie into the same high ground on both sides of the study area, and because all of the alignments are bayward of the developed area, the damages reduced are simply a function of levee height. The selection of levee alignment has cost and environmental implications, but not flood damage reduction implications. Thus, the detailed NED analysis was conducted on the most efficient levee alignment, at different levee heights. Levee heights between 10' and 15.2' were analyzed.

The with-project results for the three USACE SLC scenarios all show positive net benefits, ranging from approximately $8 million to $37 million in annual net benefits. All structural projects considered have strong economic justification under the three SLC scenarios considered. The benefit-cost ratios range from about 4 to 12. The optimum levee heights based on annual net benefits for the three SLC scenarios are 12.5' for the USACE Low and Intermediate SLC scenarios, and 13.5' for the USACE High SLC scenario.

Ecosystem Restoration Measures & Benefits

The project study authority is for both flood risk management and ecosystem restoration. Ecosystem restoration outputs are not quantified in monetary terms for USACE feasibility studies, so they cannot be directly combined with the quantified economic outputs of the project. What is quantified, however, is the cost-effectiveness of the restoration options, which is a way of identifying those options or features that provide the biggest "bang for the buck" in terms of restoration output. A restoration option is more efficient than another if it provides a) at least the same restoration output at a lower economic cost, or b) more restoration output at the same cost. This report also calculates the incremental cost of each cost effective restoration option. The incremental cost of an option is the additional cost of a plan over the cost of the next smallest option. In combination, this evaluation of environmental measures is known as cost-effectiveness (CE) and incremental cost analysis (ICA) or CE/ICA. The annualized outputs provided for the CE/ICA were calculated using an uncertified spreadsheet, but the results were later verified using the certified version of IWR Planning Suite, with the result that the annualized outputs were 2.4% higher for all action alternatives. Because the difference was uniform and insignificant relative to plan selection or justification, the CE/ICA and reported outputs for the recommended plan were not revised.

The analysis of the cost effectiveness and incremental cost of the restoration options shows that, not including the No Action option, there are six cost-effective options (also known as plans) and four "Best

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[3] According to a relocation cost analysis performed by San Francisco District Real Estate and a ring levee cost estimated by HDR Inc.

[4] http://planning.usace.army.mil/toolbox/library/misc/StrongPoint%20-%20Civil%20Works%20Transformation%20-%20Planning%205%20APR%2012.pdf

Buy" options or plans when considering restoration of all of the ponds in the study area[5]. Best Buy options are those that have the greatest increase in output for the smallest increase in cost. These options are a subset of the cost-effective plans that have the lowest incremental cost per unit of output. As discussed in the study's main integrated document, the CHAP model, absent the addition of functions and calculations to capture transitional habitat (ecotone) and acceleration functions, was not able to show additional environmental outputs for restoration measures beyond the baseline restoration of basic phased restoration with a habitat "bench" (transitional habitat feature connecting upland and aquatic areas). In the case of the accelerated restoration measures that are considered, the lack of cost-effectiveness was due solely to the inability to obtain required predictions of future habitat conditions for this measure in GIS format under schedule and budget limitations. Thus, these conditions could not be input to the CHAP model to obtain results. Based on current ecological understandings, the environmental planners in the project delivery team (PDT) expect that there would, in fact, be an increase in annual habitat outputs as a result of accelerating the restoration process within the pond groupings (A9-A11, A12, A13-A15, A18).

According to USACE policy, in all but the most unusual cases, the NER Plan should be derived from the final set of Best Buy solutions. Other solutions, identified as non-cost effective in cost effectiveness analysis; as well as cost effective plans identified as relatively less efficient in production ("non-Best Buys") in incremental analysis, may continue to be considered for selection. The six cost-effective plans consist of combinations of basic phased restoration of the four pond groupings specified above. The four Best Buy plans involve basic phased restoration of subsets or all of the pond groupings. The NER option identified is the largest of the four options, which includes basic phased restoration of all of the pond complexes. This option has a greater average cost per habitat unit than the smaller Best Buy plan, but is a larger area of land and the inclusion of the additional pond complex has important environmental outputs that, according to the California State Coastal Conservancy, are critical to the regional restoration effort.

The Combined NED/NER Plan

The multi-purpose FRM and ER plan that is expected to provide the greatest net benefits and provide the best balance of outputs has been identified as the is 12.5' flood risk management levee combined with the basic restoration of all of the study area pond complexes. The 12.5' levee height would significantly reduce coastal flood risk to the study area through the period of analysis under any of three SLC scenarios considered, and generates the highest net benefits under the low and intermediate SLC scenarios. Consideration was also given to a 12' levee as the NED Plan, since it would provide only slightly less net benefits than the 12.5' levee, particularly under the low and intermediate SLC scenarios. Corps planning guidance specifies that where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is generally identified as the NED plan, even though the level of outputs may be less. However, the 12.5' levee provides substantially greater risk reduction than the 12' levee under the high SLC scenario, and reduces the probability of future levee modifications that would be required under the high SLC scenario under future conditions.

The Combined NED/NER Plan (not including recreation plan costs) has a total estimated first cost of about $105 million ($76.2 million for FRM and $28.8 million for ecosystem restoration). For the FRM component of the Combined NED/NER Plan, net benefits range from $14.8 million under the low SLC scenario to $36.3 million under the high SLC scenario. Corresponding benefit/cost ratios range from 4.99 to 10.78.

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[5] This includes ponds on USFWS land that will be restored as part of the USACE project, per WRRDA 2014 implementation guidance for Section 1025.

For the NER component of the Combined NED/NER Plan, total average annual habitat units for the restoration of all ponds are estimated at 48,508 AAHUs. Total first and average annual costs are estimated at $28.8 million and $1.3 million, respectively. The NER Plan also results in an NED recreation loss of about $212,000 due to the loss of over seven miles of Study Area trails. Factoring in both average annual implementation costs and NED recreation losses, average annual costs per AAHU are about $32.

A recreation plan was also formulated compatible with the primary FRM and ER purposes of the project. The recommended recreation plan includes two pedestrian bridges which would connect trail segments along levee alignments and across the Union Pacific railroad tracks. In addition, the plan would include ancillary recreation facilities, including viewing platforms at the end of the in-and-out trail segments, benches, and signage. The first cost of the recommended recreation plan is approximately $6.3 million. Annual benefits and costs are approximately $291,000 and $255,000, respectively. The plan is economically justified with net benefits of about $36,000 and a benefit/cost ratio of 1.14. The recreation benefits for the recommended recreation plan also outweigh the loss in recreation value attributable to the NER Plan features.

Locally Preferred Combined Plan

The locally preferred multi-purpose FRM and ER plan (LPP) includes a 15.2' flood risk management levee combined with the basic restoration of all study area pond complexes plus a 30:1 slope ecotone. The LPP (not including recreation plan costs) has a total estimated first cost of about $167.6 million ($91.9 million for FRM and $75.7 million for ecosystem restoration). For the FRM component of the LPP, net benefits range from $14.2 million under the low SLC scenario to $37.4 million under the high SLC scenario. Corresponding benefit/cost ratios range from 4.25 to 9.57.

For the ER component of the LPP, total average annual habitat units for the restoration of all ponds are estimated at 48,308 AAHUs. Total first and average annual costs are estimated at $75.7 million and $3.5 million, respectively. Like the NER Plan, the LPP ER Plan also results in an NED recreation loss of about $212,000 due to the loss of over seven miles of Study Area trails. Factoring in both average annual implementation costs and NED recreation losses, average annual costs per AAHU are about $76.

The same recreation plan as formulated for the NED/NER Plan is also the recommended recreation plan for the LPP. As noted above, the recommended recreation plan is economically justified with a benefit/cost ratio of 1.14, and the recreation benefits for the recommended recreation plan also outweigh the loss in recreation value attributable to the LPP ER Plan features.

1. Introduction

1.1. Purpose

The purpose of this report is to document the methodology and results of the economic analysis conducted to assess the socioeconomic impacts of various projects that have been proposed to reduce the flood risk and restore ecosystem function in the study area known as the South San Francisco Bay Shoreline. The study area consists primarily of the community of Alviso, located in the City of San Jose, California, but it also includes the largest water pollution control plant in the region – the San Jose/Santa Clara Water Pollution Control Plant (SJ/SC WPCP). Even though this is a multi-purpose project per the study authority, in order to understand and quantify the flood risk management benefits and costs, it is necessary to analyze that portion of the project separately before combining these features with ecosystem restoration features as part of a combined, multi-purpose project. The combined alternative that maximizes the sum of net benefits and best balances the mix of outputs will be identified as the NED/NER Alternative.

1.2. Guidance and References

The principal guidance referenced for this analysis comes from the U. S. Army USACE of Engineers (USACE) "*Planning Guidance Notebook*" (PGN), ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations. For the evaluation of the ecosystem restoration options: *Evaluation of Environmental Investments Procedures Manual* – IWR Report 95-R-1. Additional guidance on risk-based analysis has been obtained from USACE ER 1105-2-101, *Risk Analysis for Flood Damage Reduction Studies*, dated January 3, 2006. Guidance related to policies and procedures for incorporating future sea-level change was taken from ER 1100-2-8162 (31 Dec 2013), *Incorporating Sea-Level Change in Civil Works Programs*.

Benefits and costs for the NED/NER Plan and Locally Preferred Plan are expressed in average annual terms at fiscal year 2016 (October 2015) price levels using the 2016 federal discount rate of 3.125%. Initial plan formulation and evaluation analysis was conducted at fiscal year 2014 (October 2013) price levels and a discount rate of 3.5%. The period of analysis is 50 years. The Base Year, when it is assumed that project features would be functional and providing benefits, is 2021. Benefits and costs presented in this report were developed based upon a Base Year of 2017. This year was established early on in the study process when this year was deemed realistic/feasible and was used in the coastal and economic modeling. In reality, given funding and construction timelines, the year in which flood risk management benefits would be realized is more likely closer to 2021. A sensitivity analysis was conducted to determine whether NED Plan identification would be impacted by changing the Base Year. The 50-year period of damages/benefits/costs used to derive estimates of equivalent annual benefits, costs and net benefits were shifted to start from 2021 instead of 2017. The results showed generally uniform increases in damages, benefits and net benefits within each SLC scenario (ranging from about 5% under the Low SLC scenario to about 13% under the High SLC scenario). This analysis showed that the NED Plan identification and selection of the Recommended Plan were not sensitive to such a change. Further, updating and revising the engineering and economic results to reflect the shifted period of analysis would take significant time, effort and cost. Therefore, the economic analysis and appendix were not revised based upon the updated Base Year and period of analysis.

1.3. Flood Damage Analysis Overview

By policy, USACE Flood Risk Management feasibility reports must evaluate potential measures to reduce the risk of flooding against four "accounts." These are National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE). The USACE Planning Guidance Notebook (PGN) describes the NED account as follows:

> *Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.*

The NED account is exclusively concerned with national net economic benefits, and thus does not include local or regional economic transfers. For example, according to the PGN, the prevention of income loss results in a contribution to national economic development only to the extent that such loss cannot be compensated for by postponement of an activity or transfer of the activity to other establishments. More details on the NED account and the evaluation procedures for flood risk management projects can be found in the PGN.

This report focuses primarily on quantifying the trade-off between NED benefits and costs for various project alternatives including the no action option, structural options, and a non-structural option. Nonstructural measures or options are defined in the PGN as follows:

> *Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard. Examples are flood proofing, relocation of structures, flood warning and preparedness systems (including associated emergency measures), and regulation of floodplain uses.*

While the NED categories evaluated may differ between alternatives, the primary NED categories evaluated in this analysis are as follows:

- Structure and Content Damages
- Cost to Temporarily Displaced Residents
- Cost to Relocate Residents
- Cost to Reduce the Flood Risk to the San Jose Santa Clara WPCP

The damage and damages reduced to structures, contents, and the cost of residential displacement are all estimated within the computer program HEC-FDA v.1.2.5a (FDA), while damages related to the other categories were estimated outside of the FDA program. This version of the FDA program is the most up to date and is a USACE-certified planning tool. For those damage categories calculated in FDA, the value of these assets was estimated outside of the program, and then imported into the program along with probability-stage data for each particular structure or automobile. The base structure elevation data (not including a first floor adjustment) was provided to the USACE San Francisco Economics Section by the Geographic Information System (GIS) Section.

The FDA models were built with data for each structure, under each scenario, and for each of the eight annual chance exceedance (ACE) events – 50%, 20%, 10%, 4%, 2%, 1%, .4% and .2% events. This report uses the term "annual chance exceedance" (ACE) to describe the likelihood associated with storm and flood events. The ACE is the reciprocal in percentage terms of what is often referred to as the "return period." The return period (or recurrence interval) of an annual maximum flood event has a return period of X years if its magnitude is equaled or exceeded once, on the average, every X years. For example, a 100-year return period means that, on average, it is expected that a storm of that magnitude or greater would occur once every 100 years. The inclusion of the phrase "on average" in that definition means that it is possible to have more than one (or zero) 100-year event over any number of years - or even in the same year. The description of likelihood in "return period" terms has in recent years been supplanted by percentage-based terminology. This shift has occurred because it is believed that describing the likelihood in annual percentage terms is more precise and less prone to misinterpretation. In this report, what has been known as the "100-year" storm or flood event is described as having an ACE of 1%.

The analysis was conducted by directly inputting the water surface elevations in the bay – at the outboard dike – into FDA as the water surface profile. A levee failure function was entered into the FDA model for each without-project condition model. A relationship between the elevation of water in the bay and the elevation of water in the community of Alviso was also specified in the model. This information was developed by the team's coastal engineer. FDA calculates the depth of flooding at each structure for each event and develops the aggregated stage-damage curve. With the structure inventory elevation and first floor elevation data, FDA uses Monte Carlo simulation to calculate a flood stage-damage relationship with uncertainty. Expected annual damages are then derived based upon a Monte Carlo simulation that accounts for the exceedance probability/stage function (with uncertainty), the stage/damage relationships (with uncertainty), and the geotechnical "fragility" function, which specifies the probability of failure by elevation for the existing outboard dike. Simulation results include both expected annual damages as well as probabilistic distributions for each year analyzed.

Equivalent annual damages represent the annualized net present value of damages over the 50-year period of analysis. The HEC-FDA model is capable of computing equivalent annual damages when there are only two years analyzed (e.g., a Base Year and Future Year). Since more than one model was used for this analysis (five decadal models for the without-project condition for each SLC scenario), the computation of equivalent annual damages had to be completed outside of the FDA program; the HQUSACE-approved spreadsheet for annualizing was used ('AverageAnnual&IDC_2010').

The flood damage analysis was completed for three sea level change scenarios – Low, Intermediate, and High. These scenarios come from USACE guidance, and more on the three scenarios can be found in the Coastal Engineering and Riverine Hydraulics Summary (Appendix D1) as well as from the USACE Engineering Circular 1165-2-212. Having three scenarios makes the reporting of the results somewhat challenging. In order to minimize the reporting requirements, in some cases this report will describe the results of just one scenario (Intermediate), but the final results and those most important to the planning decision will be reported for all three future scenarios.

Additional details can be found in the sections that follow.

1.4. The Study Area

The study area is a mix of residential, industrial, and commercial structures. This area includes Alviso, a community of approximately 2,100 residents and 580 housing units. The community is located just

adjacent to the bay and has been significantly impacted in the past by riverine flood events.[6] Alviso is at a very low elevation, and as a result significant damage is expected to occur at in-basin water surface elevations (WSEL) of just over 5 ft (NAVD 88). The study area includes the San Jose Santa Clara WPCP, an elementary school, and a City of San Jose Fire Department Station. Figure 1 shows the study area location. The area labeled "Reset Interim Study Area" is the focus of this study effort, which is a subset of the larger study area that will likely be considered in future feasibility study efforts.

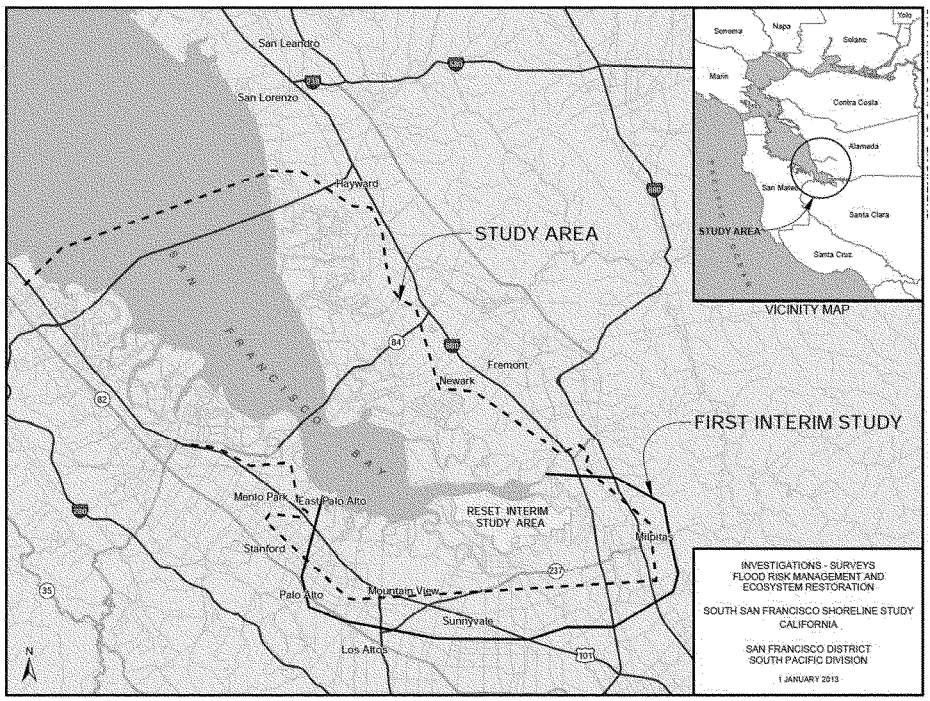

Figure 1: Location of Study Area

The study area's residents are mostly low-income, minority individuals and families. More than half of the residents are Hispanic or Latino, and about 15% are Asian. As Table 1 (Comparison of Selected Economic Indicators) shows, the area lags behind the surrounding counties and the state on several measures of economic performance.

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[6] The Guadalupe River Park Conservancy (http://www.grpg.org/flood-control) notes Guadalupe River flooding in San Jose's downtown and Alviso community, with severe flooding in 1862, 1895, 1911, 1955, 1958, 1963, 1969, 1982, 1986 and 1995.

Table 1: Comparison of Selected Economic Indicators

Category	Local Census Area*	Santa Clara County	Alameda County	San Mateo County	California
Median Household Income	$52,202	$86,850	$69,384	$85,648	$60,883
Unemployment Rate	12.4%	8.2%	8.9%	6.8%	10.5%
Percentage of Population at or Below Poverty Level	15.6%	8.9%	11.4%	7.0%	13.7
Sources: State/County: 2010 Census, State of California. **Alviso**: US Census, American Community Survey. *Census Tract 5046.02					

1.5. Historical Flooding

The community of Alviso not only lies at the edge of the bay but also is straddled by the Guadalupe River to the west and Coyote Creek to the east. Both drain to the bay. The study area has not historically suffered damages from coastal flooding. However, the area has been flooded by waters from the Guadalupe River, which overtopped its banks in 1983, resulting in significant flood damage in the community of Alviso. Since then, the levees along the Guadalupe River have been raised (project completed in 2004), and many of the homes in the community have been raised several feet. Currently the annual risk of fluvial flooding in the community is estimated to be less than 1%.

2. Without-Project Flood Risk

The coastal floodplain includes all of the community of Alviso as well as dozens of homes and businesses further inland (see Figure 3). The community of Alviso is at an elevation of approximately 4 feet, which just above the mean sea level of about 3.7 feet . The properties in the study area are at an elevation of between 1 and 14 feet (not accounting for raises to the finished floor), with approximately one quarter of them being less than 4 feet above sea level. The increasing future coastal flood risk poses a threat to the safety and health of the residents in the area. According to the coastal flood modeling, depending on the SLC scenario, flood depths within the community of Alviso could be as high as 7 to 10 feet within the fifty-year period of analysis. Please refer to *Appendix D2 - Tidal Flood Risk Analysis Summary Report*, for a more detailed description of existing flood risks in the Study Area than that presented in this appendix.

2.1. Population at Risk (PAR)

One measure of flood risk often reported in the population at risk (PAR). This is a broader measure of risk than just those residing in the floodplain; it includes the number of people working in the area that are at risk of being adversely impacted by a flood event. Adding the number of people estimated to be working in the floodplain[7] (3,400) to the number of residents in the floodplain (2,100), the total PAR in the study area is estimated to be approximately 5,500. This figure may overstate PAR to a degree since it is unlikely that this entire population would be within the floodplain during a given flood event. However, the PAR estimate does not include those persons traveling through the study area, which would at least partially offset any such overestimation.

2.1. Property at Risk

In terms of number of structures, the study area is dominated by residential structures (see Table 2: Structure Types in 0.2% ACE Floodplain). The 0.2% ACE floodplain under the USACE High SLC scenario has approximately 1,100 structures, of which the vast majority is residential. There are several manufactured and mobile home parks, and several business parks with large commercial and industrial properties. The floodplain contains a school, several churches, a fire station (the structure is elevated out of the floodplain), critical infrastructure such as Highway 237 and the San Jose Santa Clara Water Pollution Control Plant (SJ/SC WPCP), and a wide range of commercial and industrial buildings – including many high technology and Information Technology (IT) companies. Cisco Systems, Inc. is the most well-known company located in the floodplain; their worldwide headquarters is located across Highway 237 in the study area.

[7] According to the site www.officespaceheaven.com, a rule of thumb for the amount of office space needed for each employee is between 175 and 250 square feet. From the assessor data collected for this study, there is estimated to be 830,000 SF of office space in the floodplain. If the average vacancy rate for commercial office space in the county (12.8%) is applied, the total square footage in use is estimated to be 726,000. Using the midpoint of the range of square feet per employee (212.5), the total number of persons working in the floodplain is roughly estimated to be 3,400.

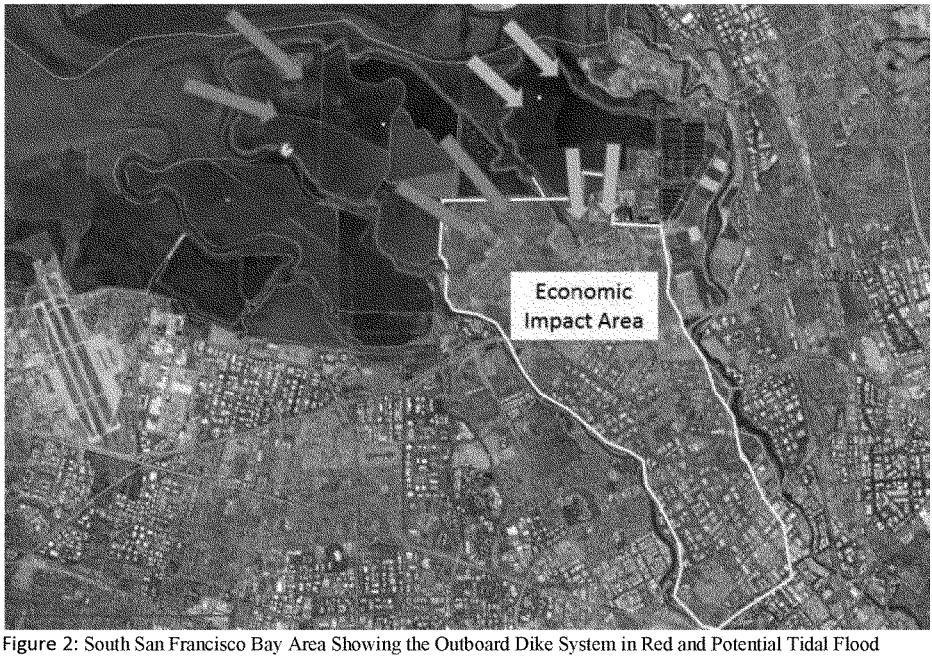


Figure 2: South San Francisco Bay Area Showing the Outboard Dike System in Red and Potential Tidal Flood Pathways to the Alviso Economic Impact Area

Table 2: Structure Types in 0.2% ACE Floodplain

Residential	Commercial	Industrial	Public	Total
1,034	54	42	9	1,140

The colored areas shown in Figure 3 (Land Use in the Study Area) represent parcels with structures in the study's damage analysis inventory. The extent of the inventory was based on the 0.2% ACE floodplain extent of the USACE High SLC scenario at the end of the period of analysis (Year 50). The floodplain extent under the other two SLC scenarios is similar because of the flat topography in the study area and the relatively small difference in water surface elevations.

For presentation purposes, the land use map only shows four general land use categories, but the structure inventory database and the flood damage analysis contain 20 different structure types.

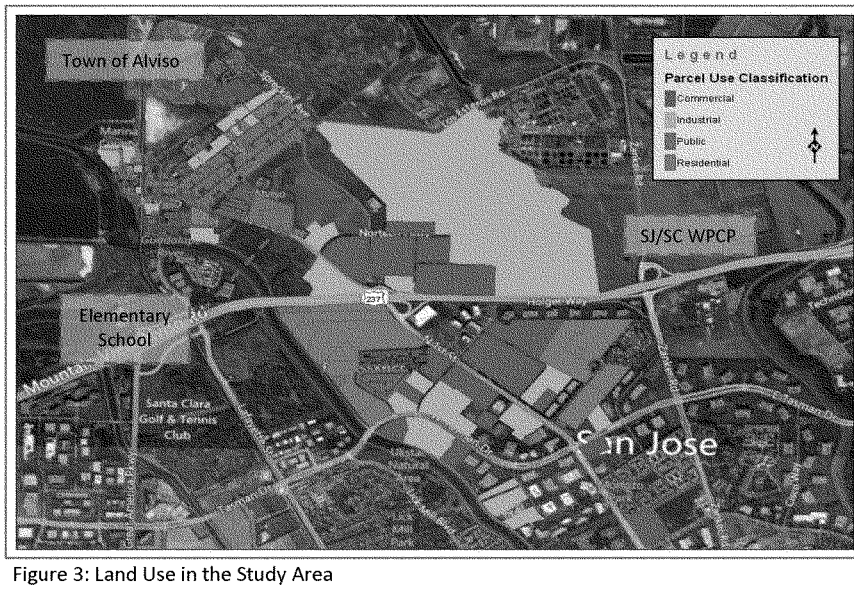


Figure 3: Land Use in the Study Area

Figure 4 displays the approximate elevations of the properties in the study area (NAVD88). As the figure shows, most of the community of Alviso is below 5 feet.

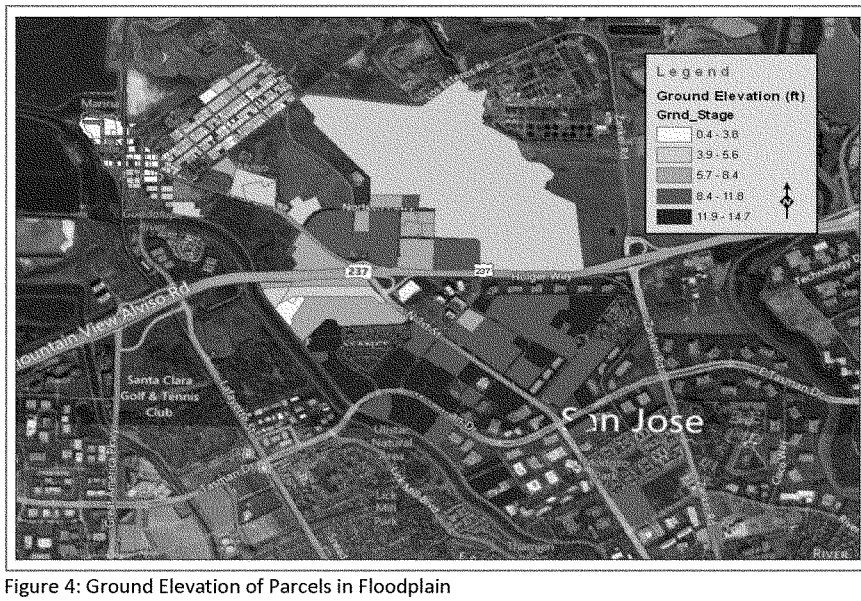


Figure 4: Ground Elevation of Parcels in Floodplain

2.2. Structure & Content Valuation

The parcels identified as located within the 0.2% ACE floodplain were matched to data downloaded from the First American Core Logic database. This real estate database includes parcel-specific information on structure type, square footage, construction date, information on improvements, etc. The vast majority of the residential structures inventoried fit into the Class D category. Class D buildings are characterized by combustible construction. The exterior walls may be made up of closely spaced wood or steel studs, as in the case of a typical frame house, with an exterior covering of wood siding, shingles, stucco, brick, or stone veneer, or other materials. They may also consist of an open-skeleton wood frame on which some form of a curtain wall is applied including the pre-engineered pole or post-frame buildings.

For the valuation of the structures in the floodplain, structures were classified into one of the following 20 categories listed below:

- Single Family Residential (SFR) 1-Story
- Single Family Residential 2-Story
- Multi-Family Residential (MFR) 1-Story
- Multi-Family Residential 2-Story
- Manufactured Housing (MH)
- Retail 1-Story
- Non-Medical Office, 1 Story
- Non-Medical Office, 2 Story
- Medical Office
- Restaurant - Fast Food
- Restaurant - Not Fast Food
- Grocery and Gas Station
- Schools - Wood Frame
- Schools – Masonry
- Public - Wood Frame
- Public – Masonry
- Light Industrial - Masonry
- R&D – Masonry
- Repair Shop - Masonry
- Warehouse – Masonry

The calculation of structure value in a floodplain can be done in several different ways, each having their advantages and disadvantages[8]. One method, estimating the Depreciated Replacement Cost of the structures in the floodplain, involves integrating the following: size of the structure, the unit cost of construction as measured in cost per square foot, and an allowance for deterioration as measured as a percent of total value. An alternative way of calculating the total structure value in the floodplain would be to use tax assessment records on each parcel's improvement value. While this assessment information is readily available, California's Proposition 13, which limits increased assessments until a home is sold, results in unequal valuations of one home relative to another. It is primarily for this reason that this study will use the Depreciated Replacement Cost method. More information on the different structure valuation methods can be found in IWR Report 95-R-9, *Procedural Guidelines for Estimating Residential and Business Structure Value for Use in Flood Damage Estimations*. The Depreciated Replacement Cost method requires visits to the structures themselves in order to attain the necessary information, which includes foundation height, structure type, and structure condition. This process is explained below.

The valuation of the structures in the floodplain requires information on structure type, construction quality, current condition, and number of stories[9]. Once collected, this information was utilized to calculate the structure depreciated replacement values. Base per square foot construction cost estimates for each structure type were determined by utilizing the Marshall and Swift Real Estate Valuation Service method according to the following procedure:

- Construction quality and current condition of the structures were noted from field surveys.
- For a given structure type, the per square foot construction cost (replacement cost) was determined using the most current Marshall & Swift Valuation Service data. This per square foot cost estimate reflects the construction quality of the structure. Values can vary significantly

[8] The Planning Guidance Notebook (ER 1105-2-100) specifies that the correct measure of structure value for benefit/cost analysis is replacement cost less depreciation to the existing (pre-flood) structure.
[9] Structure first floor elevation was also recorded for each structure visited as part of the field inventory work. While this data is not relevant for the structure valuation, it is a critical variable in the estimate of flooding damage.

based upon structure type and construction quality (e.g., the typical range for SFRs is approximately $80-$120 per square foot, while non-residential values range from as low as $40 per square foot for lower cost industrial buildings to as much as $225 per square foot for a very good construction quality hotel.

- The per square foot costs, which are based on a national average, were modified to reflect local cost conditions using Marshall & Swift local cost multipliers.
- This current, locally adjusted cost per square foot was then adjusted additionally for the condition of the structure, which determines the appropriate depreciation factor to apply. In order to correlate the current condition of the structure to a percent depreciation, the study utilized Tables 7 through 9 of IWR Report 95-R-9, '*Procedural Guidelines for Estimating Residential and Business Structure Value for Use in Flood Damage Estimations*'.
- The depreciated replacement cost per square foot values were multiplied by square footage to arrive at the total depreciated replacement value for the different types of structures. If the square footage was not available within the real estate records for a particular property, square footage estimates were made from aerial photography measurements using the Google Earth application.

Figure 5 below shows residential structures typical in the study area.

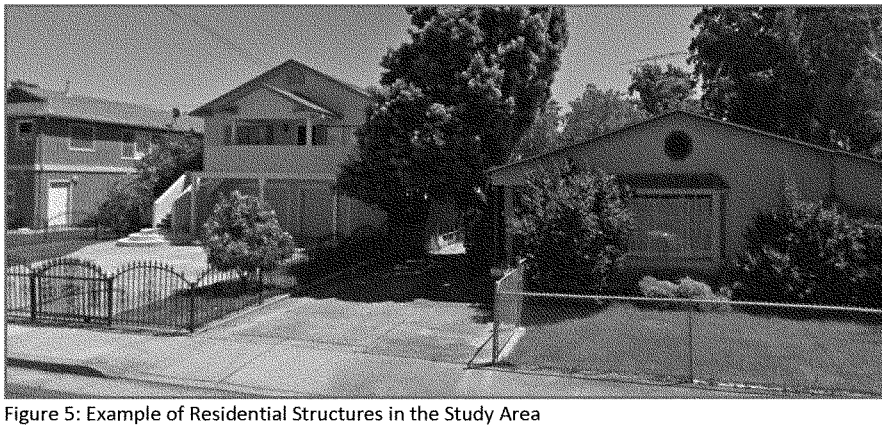


Figure 5: Example of Residential Structures in the Study Area

Table 3 (Structure and Content Value in 0.2% Floodplain) below shows the estimated structure and content value for each of the major structure categories in the 0.2% ACE floodplain (rounded for presentation purposes). In total, more than $865M of structures and contents are exposed to some level of flood risk by the end of the period of analysis. This value should not be confused with event-based or expected flood damage.

Table 3: Structure and Content Value in 0.2% Floodplain (October 2015 Price Levels)

Structure Type	Total Structure Value (1,000s)	Total Content Value (1,000s)
Commercial	$343,351	$306,617
Industrial	$72,802	$48,605
Public	$5,225	$1,898
Residential	$58,510	$28,755
Total	**$479,889**	**$385,876**

The area has a history of flood damage from overflows from the Guadalupe River[10]. As a result, many of the residences have been rebuilt or raised significantly so that the finished floor elevation is as much as six feet or more above the ground.

As described above, under this study's methodology, the value of the contents within each structure is assumed to be a function of the value of the structure. The value of the contents of each structure was estimated by multiplying the Content Structure Value Ratio (CSVR) for the particular structure type by the estimated structure value (as calculated per the method described in the previous section).

Table 4 (CSVRs per Structure Type) shows the ratios assumed for the content-to-structure values of the different classifications of residential and non-residential buildings in the floodplain. For consistency's sake the CSVRs for the non-residential structures were taken from the same source as the saltwater structure and content depth-damage curves.

[10] The levees along the Guadalupe River in the study area were raised in the 2004, reducing the risk from flooding to fluvial events larger than the 1% ACE event.

Table 4: CSVRs per Structure Type

	Structure Type	CSVR	Standard Deviation	Source
Residential	SFR	0.5	0.12	1
	MFR	0.5	0.12	1
	MH	0.5	0.12	1
Commercial	Eating and Recreation	0.4	0.65	2
	Groceries & Gas Stations	1.42	0.65	2
	Professional Businesses	0.9	0.9	2
	Retail and Personal Services	1.71	1.45	2
Other	Industrial	0.68	0.98	2
	Public	0.37	0.48	2

Sources: 1 - Per limit specified in ER 1105-2-100; 2 - Expert Panel Meeting, Houma, Louisiana, February 13, 1997

For structure and content damages, depth of flooding relative to the structure's first floor is the primary factor in the magnitude of the damage. The GIS database, provided by Santa Clara County and Alameda County, contained spatially referenced polygons for each parcel in the study area. Each parcel was then assigned a centroid in order to determine the ground elevation at the parcel, which was taken from the latest available Digital Elevation Model. A parcel centroid is the point that represents the geographic center of mass of a parcel.

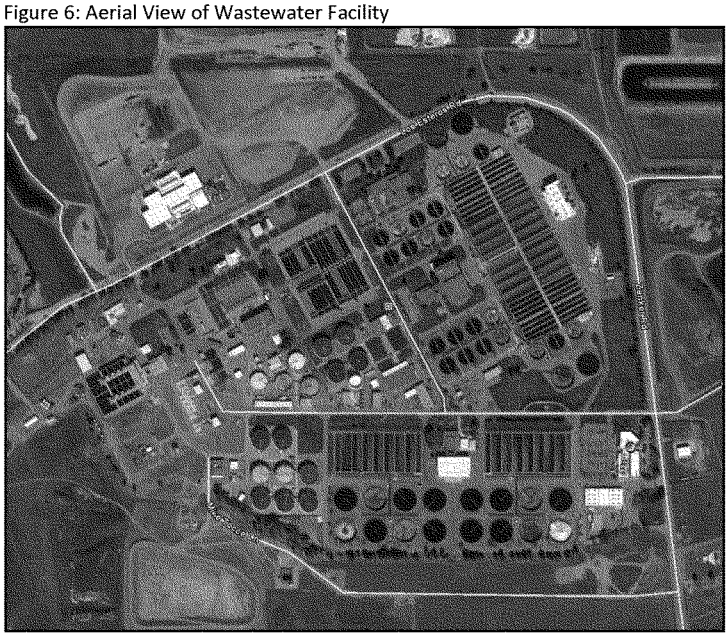
The USACE San Francisco GIS Section ran statistics on the elevation of each of the parcel centroids (NAVD88), and provided the Economics Section with data tables containing these elevations. No uncertainty was applied to these elevations, but as described below uncertainty was applied to the estimate of the extent to which the first floor of the structures has been elevated.

The elevation of each structure in the study area - along with an adjustment for the first floor elevation (FFE) - were combined with economic data (structure and content value, automobile value, displacement cost, etc.) and imported into the FDA model. For residential structures, a representative sample of first floor heights was observed in the field and applied with uncertainty to the population of structures. For residential structures the uncertainty in FFE was entered in the FDA model as a normal distribution with a 0.5 foot standard deviation. For the non-residential structures, which tend to have similar and small raises to the first floor, the complete inventory was observed in the field. The standard deviation of the normal distribution for non-residential structures was set to 0.3 feet based on professional judgment.

2.3. Impacts of Flooding at the San Jose-Santa Clara Regional Wastewater Facility

The Wastewater Facility is by far the largest water treatment facility in the region, serving 1.4 million people and around 16,000 businesses. The facility has a capacity of approximately 170 million gallons per day (gpd). According to a 2009 analysis conducted for the city of San Jose by the consulting firm CH2M Hill, the plant has a total estimated replacement value of approximately $2.8 billion. Figure 6 shows an aerial view of the facility. The facility is approximately one-half mile from the bay.

Figure 6: Aerial View of Wastewater Facility



Source: Google Earth, 2014

Most of the plant's buildings and infrastructure are elevated above of the 1% ACE floodplain, but some are within the 0.2% ACE floodplain. With sea level rise the plant will be at much greater risk within the next few decades. Current floodplains developed by the USACE show that floodwaters would reach the plant when flood waters from the bay reach approximately 10 feet (NAVD88). According to the flood risk analysis, the combined annual probability of that elevation in the bay and a failure of the existing outboard dike is approximately 1%. Under the USACE Intermediate SLC scenario, the annual likelihood of that same event occurring in the year 2067 is approximately 15%. See Table 8 for more information.

If flood waters were to reach the plant, the economic and environmental impacts would be catastrophic. The following description of the reaction to a flood threat and of the potential damage that would occur if flood waters reached the plant were developed with the assistance of personnel at the WPCP.

In the event of a flood, the WPCP would first take measures to insulate critical mechanical and electrical components to prevent inundation. These measures include placing sandbags and soil at entrances to pump stations or motor control centers to act as a physical barrier between flood waters and vital operational equipment. Temporary sump pumps would drain any flood waters that seep in. If flooding of the equipment seems inevitable, mechanical and electrical components would be turned off immediately, resulting in limited to no treatment capabilities during the flood threat. Shutting down these components would help to reduce damage to equipment and shorten overall operational downtime in the event that flood waters inundated parts of the plant. Actually implementing these measures would require special means of transportation for plant employees depending on flood depths.

When flood waters recede, any components exposed to flood water must be removed and taken off site to undergo a baking/drying process in order to be restored to full functionality. Once thoroughly dried out, the components go through an exhaustive testing and decommissioning phase. During this process, the WPCP is expected to shut down for a 2 to 3 month period unless temporary components are installed while the permanent fixtures are restored to working order. If mechanical and electrical components are not shut off before inundation, however, the impacts to the equipment and plant operation will be more significant. Mechanical and electrical components would likely require replacement, which takes 6 to 12 months for procurement and installation.

During larger flood events, the WPCP would likely shut down. The ramifications of a plant shut down include the inability to treat raw sewage and a lack of availability of recycled water to local customers who depend on it for the cooling of machinery during industrial processes. These customers include local power providers. In general, large flood events that result in plant shutdown will lead to potential sewage overflows in the communities served by the plant, degradation of the bay, and a shutdown of recycled water customers. Sewage releases into the bay would result in significant environmental damage and large fines.

There are no standardized depth damage curves or established methodologies for determining a) the value of structural/mechanical/electrical damage from flooding to these types of facilities, or b) the economic impact to the serviced communities from a decrease or cessation of waste water treatment services of various lengths of time. Working with personnel from the WPCP, a detailed accounting was compiled of the estimated flood damage to each separate facility or structure that is exposed to flood damage at the plant. Since much of the plant's electrical systems are located underground, very significant damage is expected to occur at even very shallow flood depths at the plant. The following is a list of assets that would be significantly exposed to damage from a flood event that reached the plant.

- Pump Stations
- Plant Computer System
- Treatment Areas
- Headworks
- Digesters
- Cogeneration Facilities
- Operation & Maintenance Building
- Tunnels

According to officials from the WPCP, the damage to these assets from a flood event that at least inundates the underground facilities is estimated to total more than $250 million. This does not include the impacts and costs to health and human safety and the environment from a release of raw sewage into

the bay, the cost of fines imposed by the local and state agencies, nor does it include the impact of a loss of service to homes and businesses in the region.

Given the financial, safety, and environmental impacts of a damaging flood event at the plant, it is reasonable to assume that in the absence of a larger Federal project the City of San Jose would invest in flood risk reduction measures at the plant, which would most likely consist of a ring levee and associated features. To be clear, the City of San Jose has stated that they do not currently have an alternative plan for reducing flood risk to the plant in the absence of a federally-sponsored levee project. Nonetheless, it is important to consider what the City might do rather than just assume no future action and count all expected flood damage over the period of analysis. A preliminary, planning-level estimate of the cost of a ring levee shows the construction would cost $25 million not including real estate. This cost is included in the estimate of the cost of the non-structural alternative as well as the value of the damages reduced/cost avoided for the structural alternatives.

2.4. Impacts to the Union Pacific Railroad (UPRR)

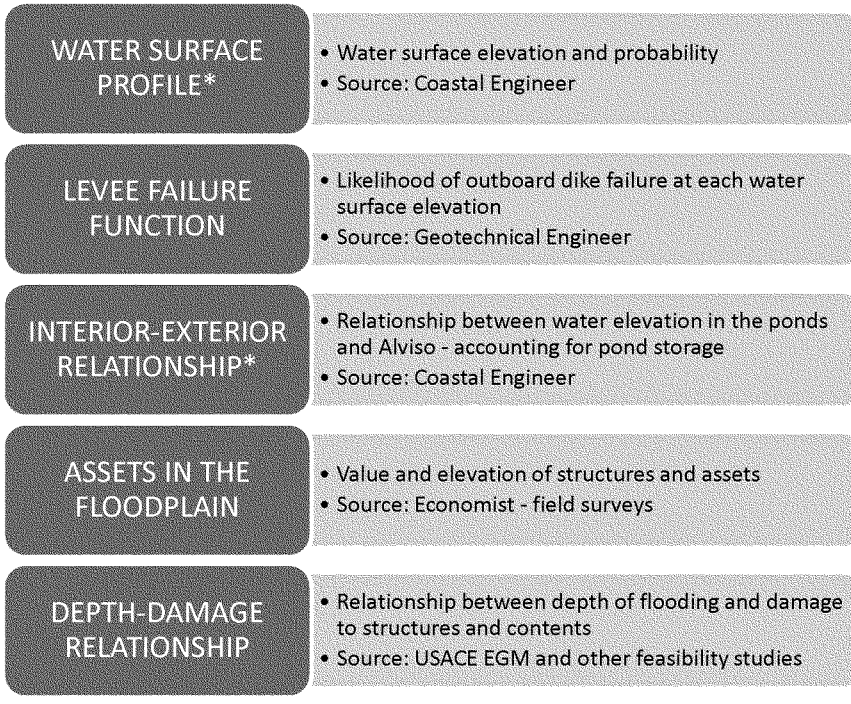
A line of rail track owned by Union Pacific Railroad (UPRR) runs through the study area and project area. With sea level rise this rail line is expected to be at risk of coastal storm damage. The damage could be in the form of additional maintenance and repair costs, restricted use (or closure) of the line, or both. However, because a large segment of the track runs through the ponds north of the study area, unless measures are taken to elevate the entire track in a way that reduces the impact of sea level rise, none of the proposed alternatives would benefit the railroad. For this reason the impacts to the UPRR have not been included in this report.

2.5. Flood Damage Modeling in HEC-FDA

The HEC-FDA program is used to combine water surface profile data and economic data (structure inventory, etc.) in order to derive a stage-damage function for each reach or impact area. HEC-FDA version 1.2.5a was used, which is a USACE certified model, and its use complies with EC 1105-2-412 (*Assuring Quality of Planning Models*).

The major inputs to the flood damage model are shown below in Figure 7 (Major Inputs to the HEC-FDA Models). They include the water surface profile, levee failure function, interior-exterior flood elevation relationship, value and location of assets in the floodplain, and the relationship between depth of flooding and structure and content damage.

Figure 7: Major Inputs to the HEC-FDA Models



**Denotes inputs that change with sea level change*

The consideration of sea level change complicates the damage analysis because under each of the scenarios the flood risk is continually increasing into the future. In a typical HEC-FDA model, a Base Year and a single Future Year would be entered into the model. The program then assumes a linear relationship between the Base Year and the Future Year conditions that have been specified in the model. However, because of the existence of the current patchwork of salt pond levees, because future sea level change is not expected to be a linear function of time, and because of the need to consider the impact of structure relocations out of the area over the period of analysis, the traditional approach to flood damage modeling in HEC-FDA is not appropriate for this analysis.

Instead, for this analysis, for each sea level change scenario the fifty-year period of analysis was separated into five without-project models – one for each decade of the analysis.

2.5.1. HEC-FDA Input 1: Water Surface Profile

Updated water surface profile data was developed for each of the three SLC scenarios – USACE Low, Intermediate, and High. To reasonably capture the change in water surface elevations over time as a result of sea level change, data was provided for project year zero and for every tenth year thereafter over the

fifty-year period of analysis. Also, in order to account for the impact of pond storage, an interior-exterior relationship was developed for each event at each time interval. This is important since the water surface elevation at the outboard dike (exterior) is not expected to always be equivalent to the elevation of floodwater that reaches the developed area (interior). A plot of the water elevations over the period of analysis for each probability event is shown below for each SLC scenario in Figure 8 through Figure 10 below. In the figures, the 0.99 ACE event corresponds to an annual likelihood of 99%, and the 0.002 corresponds to an event that has a one in five hundred chance of occurring in any given year.

Figure 8: Water Surface Elevation at Outboard Dike over Time by Return Interval (USACE Low SLC Scenario)

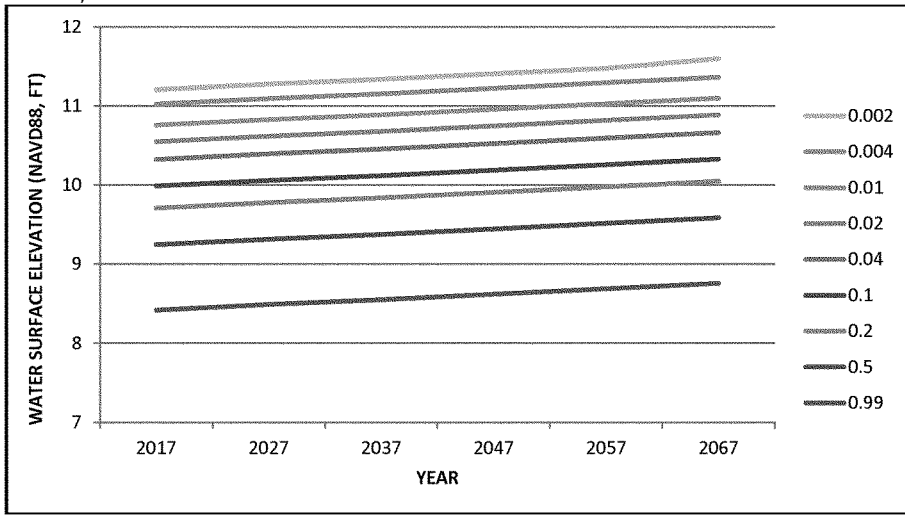


Figure 9: Water Surface Elevation at Outboard Dike over Time by Return Interval (USACE Intermediate SLC Scenario)

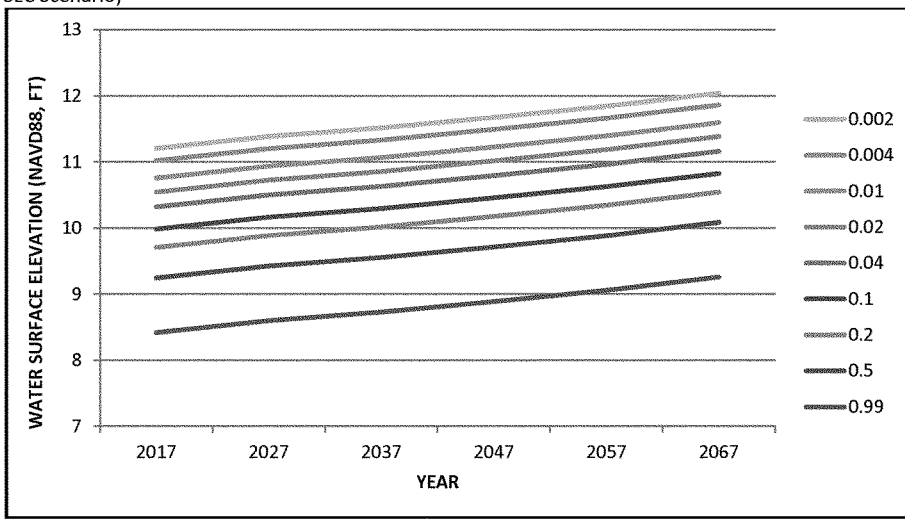
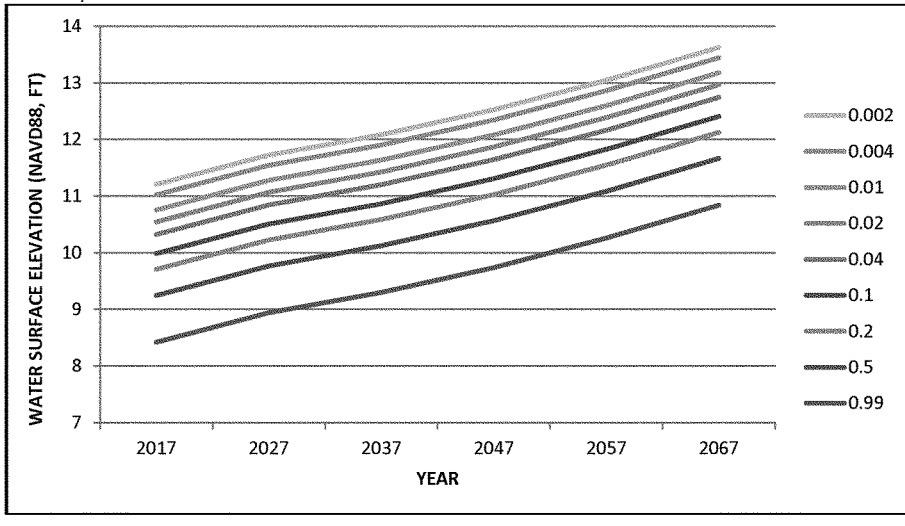


Figure 10: Water Surface Elevation at Outboard Dike over Time by Return Interval (USACE High SLC Scenario)



2.5.2. HEC-FDA Input 2: Dike Failure Function

A levee failure function, which indicates the probability of levee failure given a particular water surface elevation, was developed for the outboard pond dike to be used in the HEC-FDA models. A plot of the data entered into the HEC-FDA models is shown in Figure 11 (Dike Failure Function) below. More details on the development of the levee failure function can be found in the Geotechnical Investigation and Analysis Appendix (Appendix G) of the feasibility report.

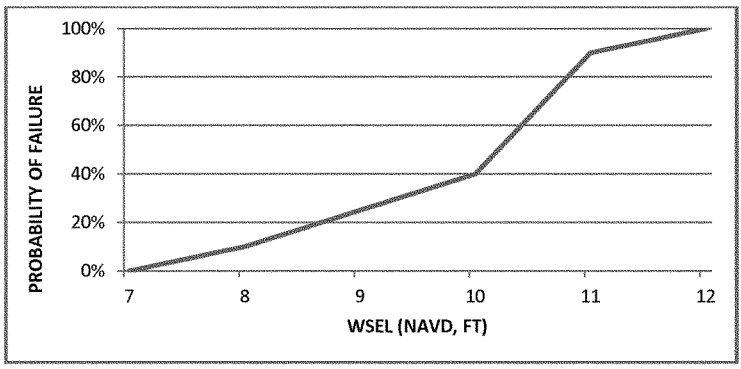


Figure 11: Dike Failure Function

2.5.3. HEC-FDA Input 3: Interior-Exterior Flooding Relationship

A breach of the outboard pond dike would not necessarily result in an equivalent elevation of flood water in the developed area of the basin (i.e., community of Alviso or near the water pollution control plant). The pond system between the outboard dike and the developed area would provide a limited amount of storage. Unless told otherwise, the HEC-FDA model assumes that the flood elevation in the developed area is equivalent to the outboard elevation at the time of dike failure. Not accounting for the storage in the ponds would generally result in an overestimation of the flood elevation and damage. For this reason, it was necessary to develop a relationship between the exterior water elevation at the outboard dike and the interior water elevation in the developed area in the event of a flood event. FDA uses the term "interior" to describe the floodplain, and "exterior" to describe the location where the source of water is located – in this case the bay. This relationship was entered into the HEC-FDA model.

The difference between the exterior and the interior water surface elevation varies over time, by annual chance of exceedance flood event, and by SLC scenario, but is generally between zero and two feet. The difference in elevation generally decreases as the events get larger (less likely) because the ponds would fill up faster during larger events. However, there is a scenario in which the interior flood elevation may be greater than the exterior elevation that resulted in the initial dike breach. For example, this can happen when a dike failure occurs at a water surface elevation that is below the astronomical high tide. In this situation the pond storage may be sufficient to keep water from overtopping the inner dike and ponding in the developed area, but because the dike-pond system would then be open to the bay waters, subsequent high tides would be expected to overtop the inner dike (which is considerably lower than the outer dike in

some places) and result in flooding in the developed area. Specifically, an outer dike breach that occurs at an exterior elevation of 7' would be expected to eventually result in an interior water elevation equivalent to mean high tide, which is 7.8' at the base year and increases over time under all future scenarios considered. More details on the development of the interior-exterior water surface elevation relationship can be found in the Coastal Engineering & Riverine Hydraulics Summary (Appendix D1) to the feasibility report.

2.5.4. HEC-FDA Input 4: Floodplain Assets

The assets in the floodplain are described in detail in Sections 2.1 through 2.3 above.

2.5.5. HEC-FDA Input 5: Depth-Damage Relationships

Flooding can cause significant damage to structures of all types. Water can cause a structure's structural components to shift or warp – including the studs and foundation. Water can also damage the wiring, gas lines, and septic system. For high water, ceilings may sag under the weight of trapped water or soggy drywall, wet floorboards can bend and buckle, and the roof may leak or break altogether. Flooding in a basement can be especially dangerous; if the water is removed too quickly, pressure from the soaked earth outside can push inward and crack the foundation walls. Most of the structures in the floodplains that are studied in this analysis are wood frame, and this type of structure will suffer greater exterior damages than those made of brick or masonry. In all types of residential housing, though, flooding will most likely destroy the interior walls. Soaked wallboard becomes so weak that it must be replaced, as do most kinds of wall insulation, and any plywood in the walls is likely to swell and peel apart. Water can also dissolve the mortar in a chimney, which creates leaks and thus a risk of carbon monoxide poisoning once the heat comes back on.

Also, floods often deposit dirt and microorganisms throughout the house. Silt and sediment can create short circuits in the electrical system as residue collects in walls and in the spaces behind each switch box and outlet. Appliances, furnaces, and lighting fixtures also fill with mud, making them dangerous to use. Anything that gets soaked through with water may contain sewage contaminants or provide a substrate for mold. Most upholstered items must be thrown away, as well as carpets and bedding.

Damages to structures, contents, and vehicles were determined based on depth of flooding relative to the structure's first floor elevation. The depth-damage relationships assign loss as a percentage of value for each parcel or structure. The deeper the relative depth, the greater the percentage of value damaged. The sources of the relationships were different depending on structure type.

In this study, the damage from flooding is exacerbated because of the corrosive effects of saltwater. A 1997 report by Gulf Engineers and Consultants for the USACE New Orleans District describes the effect of saltwater on structures and contents.

> *According to the panel of experts, saltwater causes more damages and quicker damages than freshwater. Saltwater is more corrosive on metal items. Contents that remain in saltwater for over one day will eventually begin to rust unless the items can be washed, but that is not cost-effective.*

Saltwater also damages wood quicker than freshwater. Salt causes discoloration and markings on content items due to the salinity of the water. According to the expert panel, to the human eye everything appears to be okay when the water is going down. Saltwater damages those little unnoticeable things such as screws that hold on wiring, toggle switches inside mechanisms, all of these things appear to be fine until they are examined months later. Saltwater does not necessarily have to touch the items to cause damage. For example, if saltwater gets close to an item it will still have the corrosive effect. The atmosphere is concentrated with salt so when it evaporates the salt does not stay down. The salt becomes part of the mist or the moisture in the room.

Saltwater damages light fixtures, door hinges, and other various contents. With evaporation, the salt becomes more concentrated. Eventually paint will start to flake off, recliners will not close, recliners will begin to squeak, mechanisms fail and salt line residuals will be left on the contents. The blinds may not be save [sic] in saltwater as compared to freshwater because of the residual damages.

According to the USACE engineers, depending on the circumstances, it is possible that, because of relatively poor interior drainage, flooding in the basin could persist for more than a single day - depending on the mechanism of flooding (breach or overtop). Both long-duration and short-duration saltwater curves have previously been developed by the USACE New Orleans District. These curves were developed with the hot and humid Louisiana climate in mind, and since the long-duration curves are where the effects of humidity are mostly reflected, the short-duration saltwater curves are believed to more accurately depict the effect of saltwater flooding on structures and contents in the Shoreline study area. The short-duration saltwater curves were developed by the New Orleans District for the Donaldsonville to the Gulf Feasibility Evaluation in April of 2006.

The depth-damage relationships for the primary structure types and their contents are shown in the figures below.

SFR1 and SFR2 stand for Single Family Residential 1-Story and 2-Story, respectively. The freshwater curves are taken from USACE Economic Guidance Memorandum (EGM) 04-01, and are shown for comparison's sake. The saltwater depth-damage curves were taken from the previously-referenced Expert Panel Meeting in Houma, Louisiana on February 13, 1997. The curves have a triangular uncertainty distribution, and the upper and lower bounds are shown in each of the graphs below (Figures 12 through 19). The curves for the Displacement category were taken from FEMA's '*Full Data Module for Benefit-Cost Analysis of Riverine Hazard Mitigation Projects, Mitigation BCA Toolkit CD, Version 2.0, January 2005*'

Figure 12: SFR1 Structure Depth-Damage Curve

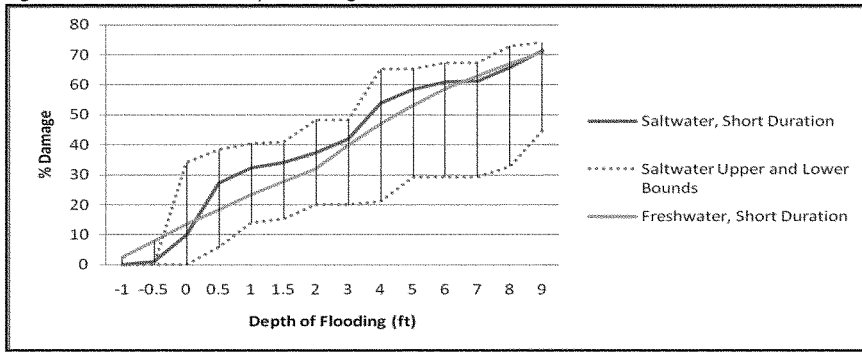


Figure 13: SFR1 Content Depth-Damage Curve

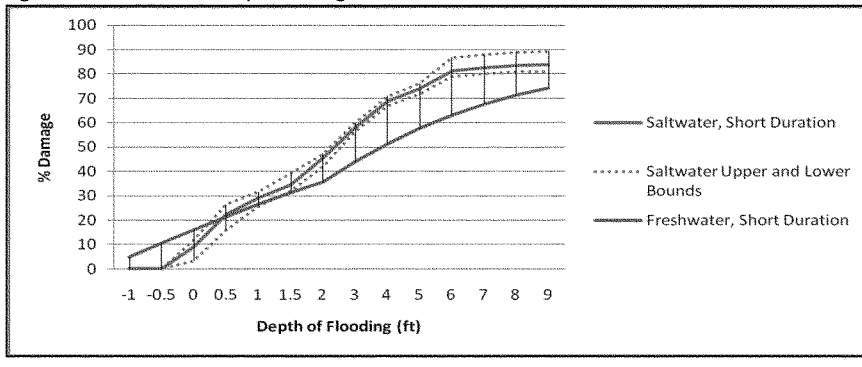


Figure 14: SFR2 Structure Depth-Damage Curve

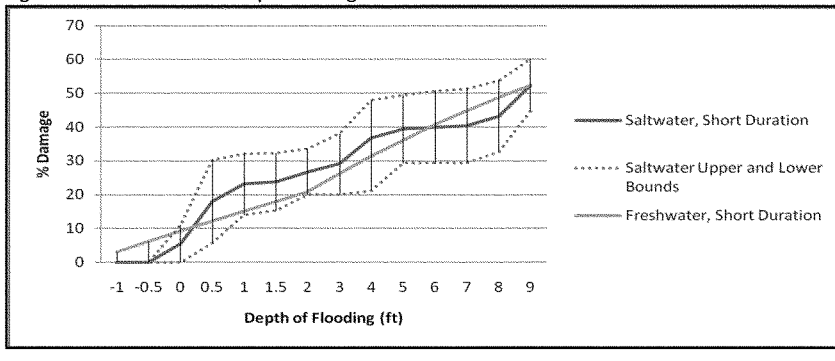


Figure 15: SFR2 Content Depth-Damage Curve

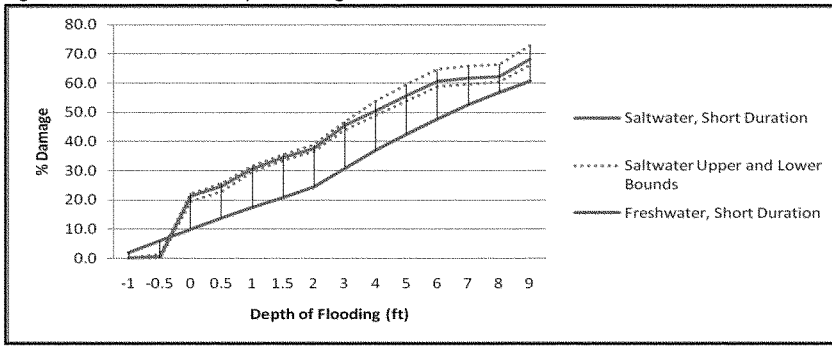


Figure 16: Commercial Structure Depth-Damage Curve

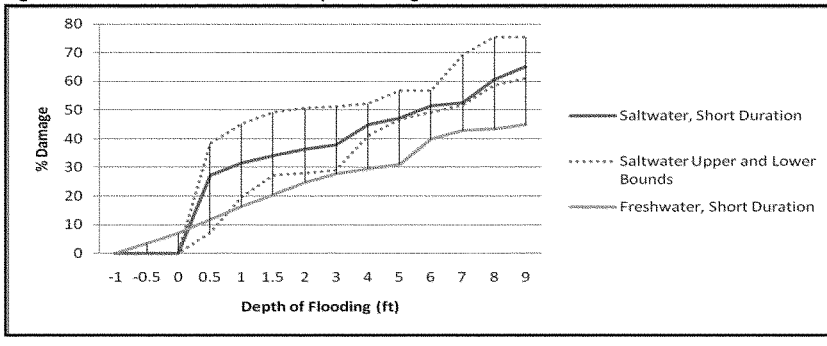


Figure 17: Commercial Content Depth-Damage Curves

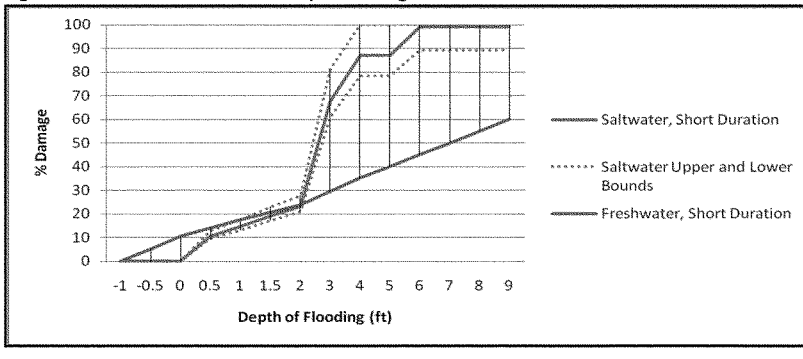


Figure 18: Industrial Structure Depth-Damage Curve

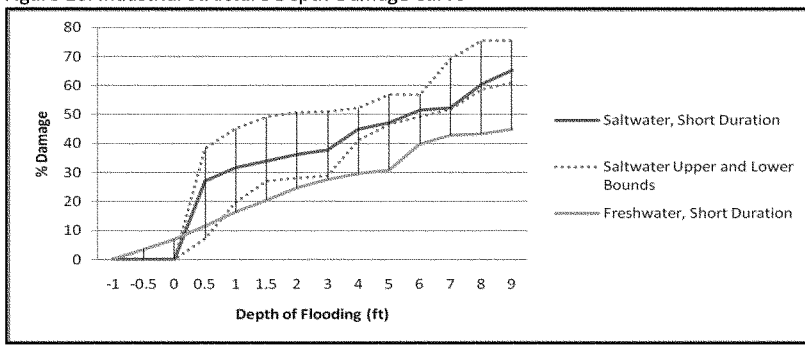
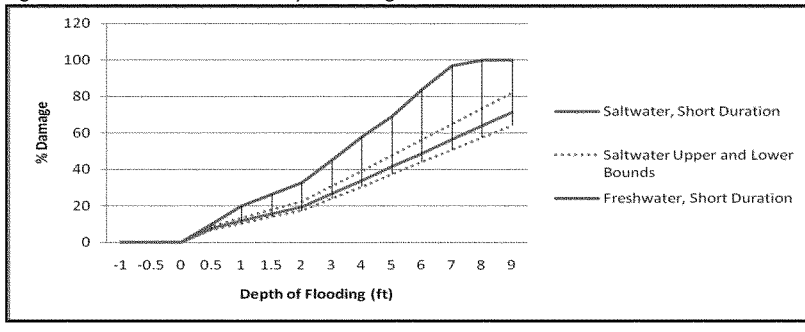


Figure 19: Industrial Contents Depth-Damage Curve



Displacement costs were estimated for the relocation and emergency services provided for those displaced both during the peak flood event and during post-flood structural renovations. In order to estimate displacement costs, it is necessary to make assumptions regarding a) the level of structure damage from flooding that generally results in temporary displacement, b) the relationship between structure damage and displacement time, and c) the percentage of households that would be forced to find rental accommodations versus the percentage that would stay with friends or family. To this end, the analysis uses an algorithm contained in FEMA's '*Full Data Module for Benefit-Cost Analysis of Riverine Hazard Mitigation Projects, Mitigation BCA Toolkit CD, Version 2.0, January 2005*'.

This algorithm has the following features:

- If building damage is <10% of building replacement value, displacement time is zero.
- If building damage is 10%, displacement equals 30 days.
- If building damage is >10%, displacement time is 30 days plus 8 days for each one percent increase in building damage above 10%.
- Displacement time is capped at 365 days.

According to this approach, for example, 30% building damage results in a displacement time of 30 days plus 20 times 8 days, for a total of 190 days. The 365-day cap on displacement means that occupants of buildings with more than about 50% damage (52%) are assumed to be typically displaced for one year. Given that a structure that is over 50% damaged would have to be extensively renovated or rebuilt, a year of displacement seems reasonable.

No specific study has yet been conducted by the USACE to determine how to estimate the percentage of displaced households that would be forced to rent alternative accommodations versus the percentage that could relocate. The current analysis makes the simplifying assumption that half of the displaced households would be able to temporarily relocate at little or no direct cost – that is, with family or friends.

The remaining variable in the equation for the estimate of total displacement costs are the monthly rental and one-time relocation costs. For the purposes of this analysis, $2,000 is assumed as the total furnished monthly rental rate, and is based on the results of internet research on the cost of rental properties in the area. The one-time cost of moving is assumed to be $500. The result is a maximum cost of $24,900 was determined and used as the total value imported into HEC-FDA, (cost if displaced for 1 year). Uncertainty parameters applied for Displacement Costs were 10% about the mean for value and 0.5 ft foundation height – the same as used for the structures themselves. These functions were calculated by relating the depth of flooding to the percent damage to the structure, to the number of days per the FEMA algorithm, to the cost associated with that number of days, to the proportion of a full year displacement that the displaced number of days represents. Depth-damage figures for Displacement Costs are shown below (Figures 20 and 21).

Figure 20: Displacement Cost and Days Displaced

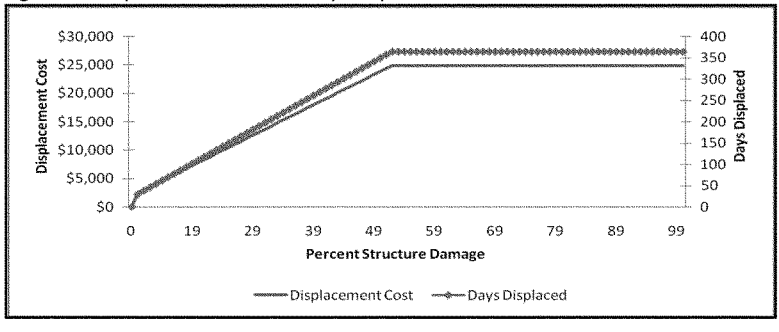
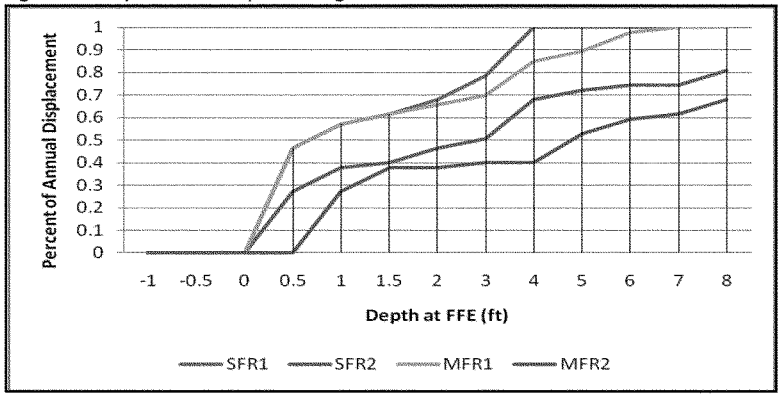


Figure 21: Displacement Depth Damage Curve



2.6. The Flood Hazard – Combined Probability of Flooding

Table 5 (Flood Hazard over Time – USACE Intermediate SLC SLC Scenario) displays how the flooding hazard in the study area increases over time under the USACE Intermediate SLC scenario. Multiplying the probability of the water surface elevation occurring in a given year by the probability that this elevation will cause a failure of the outboard non-engineered dike (which is the primary line of defense currently) results in a probability of a certain elevation of floodwater reaching structures, infrastructure, and people in the study area. In Table 5, "exterior" elevation refers to elevation at the outboard dike, and "interior" elevation refers to water surface elevation in the developed area. In 2017, there is just greater than a 1% chance of getting a flood event with 9.5 feet of water (interior elevation) in Alviso. By the end of the 50-year period of analysis, the annual probability of getting that same flood elevation in Alviso is 16%. This increase is due to the increase in relative sea level at the study location. An equivalent table (not included in the report) has been produced for the other two USACE SLC scenarios and similarly displays increases in coastal flood risk over time.

Table 5: Flood Hazard over Time – USACE Intermediate SLCSLC Scenario

	ACE of Exterior Elevation (Outboard Dike)	99%	50%	20%	10%	4%	2%	1%	0.4%	0.2%
2017	Exterior Elevation (ft)	8.42	9.25	9.71	9.99	10.32	10.55	10.76	11.02	11.21
	Prob. of Levee Failure	0.16	0.28	0.355	0.385	0.55	0.65	0.75	0.9	0.92
	Interior Elevation (ft)	7.81	7.81	7.81	7.81	9.34	9.49	9.63	11.02	11.21
	Combined Annual Prob. of Flooding	16%	14%	7.1%	3.9%	2.2%	1.3%	0.75%	0.36%	0.18%
2027	Exterior Elevation (ft)	8.60	9.43	9.89	10.17	10.50	10.73	10.94	11.20	11.39
	Prob. of Levee Failure	0.19	0.31	0.37	0.45	0.65	0.[illegible]	[illegible]	[illegible]	[illegible]
	Interior Elevation (ft)	7.99	7.99	7.99	8.5	9.4	9.[illegible]	[illegible]	[illegible]	[illegible]
	Combined Annual Prob. of Flooding	19%	16%	7.4%	4.5%	2.6%	1.5%	0.85%	0.37%	0.15%
2037	Exterior Elevation (ft)	8.73	9.56	10.02	10.30	10.63	10.86	11.07	11.33	11.52
	Prob. of Levee Failure	0.205	0.325	0.4	0.5	0.7	0.8	0.9	0.93	0.95
	Interior Elevation (ft)	8.12	8.12	8.5	9.5	9.8	10.6	11.07	11.33	11.52
	Combined Annual Prob. of Flooding	21%	16%	8%	5%	2.8%	1.6%	0.9%	0.37%	0.19%
2047	Exterior Elevation (ft)	8.89	9.72	10.18	10.46	10.79	11.02	11.23	11.49	11.68
	Prob. of Levee Failure	0.22	0.355	0.45	0.6	0.75	0.9	0.92	0.94	0.96
	Interior Elevation (ft)	8.28	8.28	9.45	9.65	10.4	11.02	11.23	11.49	11.68
	Combined Annual Prob. of Flooding	22%	18%	9%	6%	3%	1.8%	0.92%	0.38%	0.19%
2057	Exterior Elevation (ft)	9.06	9.89	10.35	10.63	10.96	11.19	11.40	11.66	11.85
	Prob. of Levee Failure	0.25	0.37	0.55	0.7	0.85	0.91	0.93	0.96	0.98
	Interior Elevation (ft)	8.45	8.45	9.78	10.49	10.96	11.19	11.4	11.66	11.85
	Combined Annual Prob. of Flooding	25%	19%	11%	7%	3.4%	1.8%	0.93%	0.38%	0.20%
2067	Exterior Elevation (ft)	9.26	10.09	10.55	10.83	11.16	11.39	11.60	11.86	12.05
	Prob. of Levee Failure	0.28	0.4	0.65	0.8	0.91	0.93	0.95	0.98	1
	Interior Elevation (ft)	8.65	8.65	10.55	10.83	11.16	11.39	11.6	11.86	12.05
	Combined Annual Prob. of Flooding	28%	20%	13%	8%	3.6%	1.9%	0.95%	0.39%	0.20%

A 1% ACE Flood Event at 2017 is a 16% Event by 2067

2.7. HEC-FDA Model Results

2.7.1. Expected Annual Damage

Table 6 (Expected Annual Flood Damage, USACE Intermediate Scenario) below shows the expected annual damage as calculated in the HEC-FDA models for the USACE Intermediate SLC scenario. The decrease between any two years (2026 and 2027 for example) is a result of including the relocation over time of structures according to the algorithm described in the paragraphs below. Without the assumption of structure relocations, the HEC-FDA model results would be significantly higher than shown below, as a large number of structures would sustain significant flood damage repeatedly. The Addendum at the end of this appendix details the without project exceedance probability/damage functions by decade generated by the HEC-FDA model, which when combined with the exceedance probability/stage functions and geotechnical fragility curves in the Monte Carlo simulation process, result in the expected annual damage results as presented below.

Table 6: Expected Annual Flood Damage, USACE Intermediate Scenario (1,000s) – (Oct 2013 Price Levels)

Year	Commercial	Displacement	Industrial	Public	Residential	Total
2017	$4,845	$471	$2,542	$553	$2,945	$11,356
2026	$7,181	$617	$3,109	$675	$3,691	$15,273
2027	$6,799	$373	$418	$255	$2,230	$10,075
2036	$10,383	$515	$565	$292	$2,712	$14,467
2037	$9,421	$419	$568	$46	$2,200	$12,654
2046	$12,716	$527	$662	$52	$2,564	$16,521
2047	$12,189	$388	$608	$52	$1,763	$15,000
2056	$21,343	$848	$887	$85	$3,262	$26,425
2057	$14,363	$680	$44	$17	$1,948	$17,052
2066	$23,421	$1,234	$69	$33	$3,466	$28,223

Using the decadal HEC-FDA models for each scenario, if a structure's first floor elevation was 1.5' or more below the 10% ACE event water surface elevation for ten years, then that structure was removed from all future HEC-FDA models. For residential structures, 1.5' of flooding above the first floor elevation corresponds to structure damage equal to between one-quarter and one-third of the value of the structure. Thus, the algorithm considers both the frequency of flood damage and the severity of damage. Over ten years, the chance of experiencing at least one 10% ACE event is 65%.

The assumptions applied to the relocation analysis are based upon professional judgment regarding reasonable expectations of human behavior when faced with significant and potentially repetitive flood damages. These assumptions were not directly based upon requirements of the National Flood Insurance Program (or "NFIP", of which the City of San Jose is a member). NFIP regulations specify that if the cost of improvements or repairs to a structure resulting from flooding exceeds 50 percent of the market value of the building, the structure must be brought up to current floodplain management standards. To meet this requirement, structures would need to be elevated or otherwise floodproofed, or alternatively relocated out of the floodplain. The 50% rule is often applied cumulatively over a period of 10 years, or even the life of a structure, such that if the cumulative damages reach 50% of the market value of the structure, it must be brought into compliance as if it were a new structure. Under without project conditions, during any outboard levee failure event, the Alviso community would be subject to deep flooding. Inundation depths for individual structures vary based upon their specific locations and foundation heights. So although it may be possible, for example, to elevate a structure on fill to raise it above the one percent ACE water surface elevation, not only would this be costly (potentially several hundred thousand dollars depending on the size of the structure), but during subsequent flood events, the

structure would likely be surrounded by deep waters, posing significant safety risks and rendering the structure inaccessible until floodwaters subside. Further, this risk would only increase over time due to the impacts of SLC.

As noted, the analysis assumed that structures would be relocated if they were susceptible to flood depths of 1.5 feet or greater from a 10% ACE event for an entire decade (after which the structure is assumed to be relocated). The corresponding damage to structures from 1.5 feet of flooding is approximately one-third, which is below the NFIP 50% limit. However, there is a significant probability of multiple damaging events over that decadal period. For example, not accounting for the impact SLC over the period, the probability of multiple damaging events resulting in 1.5 feet or more of flooding is approximately 26%. This probability is higher when factoring in increased water surface elevations under the different SLC scenarios. Further, this does not factor in damaging events over the period which would result in depths of less than 1.5 feet. For example, depths of only about 0.5 feet result in estimated structural damages of about 25%. Hence, there is a significant probability that during the decade after which the relocation trigger is applied to each structure, there will be at least 50% cumulative damages to the structure value (not accounting for damages to contents). In consideration of both the high probability of significant damages, as well as the nature of the flood threat, the assumption regarding structure relocations are reasonable for purposed of estimating future without project damages.

Table 7 (Structure Relocations over Time -- USACE Intermediate SLC Scenario) and Figure 22 (Structure Relocations over Time -- USACE Intermediate SLC Scenario) below show the relocations over time according to the algorithm specified above and under the USACE Intermediate SLC scenario.

Table 7: Structure Relocations over Time – USACE Intermediate SLC Scenario

Structure Type	Year					
	2017	2027	2037	2047	2057	2066
Residential	1035	951	927	884	832	822
Commercial	54	49	48	45	43	42
Industrial	42	22	21	19	15	14
Public	9	5	3	3	2	2
Total Structures	1140	1027	999	951	892	880
Cumulative Relocations	NA	113	141	189	248	260

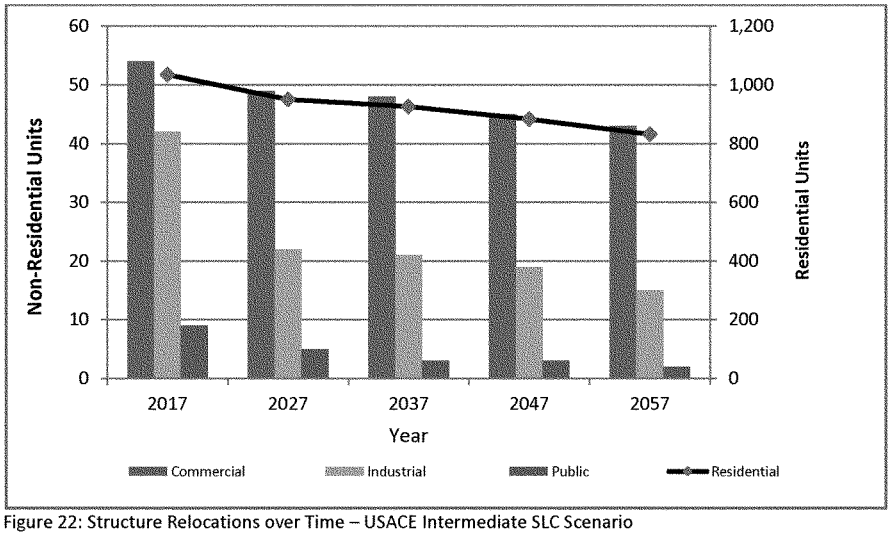


Figure 22: Structure Relocations over Time – USACE Intermediate SLC Scenario

The cost of relocating to similar properties outside of the floodplain was included in the ultimate expected annual damage (EAD) calculations performed outside of the HEC-FDA model. The cost per structure was estimated by USACE Sacramento District Real Estate personnel in 2012. Adding the cost of structure relocations increases the total expected annual damages by decade shown in Table 6. When factoring in structure relocation costs, equivalent annual damages over the period of analysis increase approximately 46% - from $15.4M to $22.5M.

In addition to considering the cost of relocations, the without-project damage analysis considers the cost to reduce the flood risk to the San Jose-Santa Clara Regional Wastewater Facility. The facility serves 1.4 million people and thousands of businesses, and is the largest treatment facility in the region. In the absence of a structural project to keep coastal storm water from reaching the basin, it is assumed that, because of its economic and environmental importance, actions would be taken to reduce the likelihood of damage to the facility. A ring levee surrounding the plant was estimated to cost $25M to construct. It was assumed that in the face of increased coastal flood risk the ring levee would be constructed by 2027.

Table 8 (Example of Without-Project Total EAD Calculation -- USACE Intermediate SLC Scenario) below shows an example of how the total EAD is calculated for each year of the period of analysis. The table only shows eleven years of the period of analysis, for illustrative purposes. For each year, the damages from all of the damage categories are summed and the present value is calculated using the applicable discount rate. The values for the intervening years between the beginning and end of each HEC-FDA model's 10-year analysis intervals were calculated by interpolation. The sum total of the annual present values is then annualized to calculate an equivalent annual damage. This example is provided for illustrative purposes, since equivalent annual damages are more typically computed within the HEC-FDA program.

Table 8: Example of Without-Project Total EAD Calculation – USACE Intermediate SLC Scenario (1,000s)

Year of Project	Year	Present Value Factor	EAD From FDA Model	Relocation Cost	Ring Levee Construction	Total	Present Value
0	2017	1.000	$11,356	$0	$0	$11,356	$11,356
1	2018	0.966	$11,791	$0	$0	$11,791	$11,392
2	2019	0.934	$12,226	$0	$0	$12,226	$11,413
3	2020	0.902	$12,661	$0	$0	$12,661	$11,420
4	2021	0.871	$13,096	$0	$0	$13,096	$11,413
5	2022	0.842	$13,532	$0	$0	$13,532	$11,393
6	2023	0.814	$13,967	$0	$0	$13,967	$11,362
7	2024	0.786	$14,402	$0	$0	$14,402	$11,320
8	2025	0.759	$14,837	$0	$0	$14,837	$11,268
9	2026	0.734	$15,273	$0	$0	$15,273	$11,206
10	2027	0.709	$10,075	$168,484	$25,000	$203,559	$144,306

The total equivalent annual damage (which is the term used for the calculation of expected annual damage for damage that is changing over the period of analysis) for the fifty-year period of analysis under the USACE Low, Intermediate, and High SLC scenarios is $18.2M, $22.6M, and $40.2M, respectively. These values are expressed at FY14 (October 2013) price levels and were computed based upon a 3.5% discount rate.

2.7.2. Event-Based Damages

According to the HEC-FDA model results, currently, a 10% ACE flood event would cause more than $100M in structure and content damage, and a 1% ACE event would cause more than $200M in damage. With sea level rise the damage will go up under all of the three SLC scenarios. The damages are so high for even more frequent flood events because of the low elevation of many of the properties in the floodplain; much of the area is below mean sea level.

3. Flood Risk Management Options

In the earlier phases of the feasibility study, the FRM options included both structural and non-structural measures, with structural options (levee construction) located along several different alignments through the study area. The alignments were all located north of the town of Alviso and the WPCP, and all reduced the risk to the same number of properties in the floodplain (all of them). For a given levee height, the alignments were equivalent in their reduction in flood risk and thus their total economic impact. They did, however, differ somewhat in their environmental impacts, aesthetics, and cost. A description of the array of levee alignments can be found in the Chapter 3 of the Integrated Feasibility Report and Environmental Impact Statement. Because the NED option is that which has the greatest net economic benefits (benefits minus costs), the NED structural option would be, by default, a levee of some height built along the cheapest alignment. Thus, the cheapest (most efficient) alignment was carried forward and analyzed at multiple heights in order to determine the levee height that maximized net economic benefits.

The final NED analysis evaluates twelve flood risk management project options – the No Action Plan, ten structural options, and a non-structural option. The non-structural option involves the gradual but permanent evacuation of the floodplain and relocation of residents and businesses, and the construction of a ring levee and other features to protect the SJ/SC WPCP. Preliminary estimates of the cost of the non-structural plan were in excess of $425 million. A value- engineering review during the study process recommended that, in the spirit of USACE planning modernization[11], because of the extremely high cost of implementation no detailed analysis be conducted and no additional resources were devoted to considering this option. While this option was effectively screened out, this section will include a description of the limited analysis done to develop a cost estimate for implementation.

All of the structural options involve the construction of levees bay-ward of the community of Alviso and the adjacent WPCP. For the reason described above, the options differ only in their height, but not their alignment; the least cost alignment was used for all the levee options. This least cost alignment is depicted in Figure 23 (Least Cost FRM Levee Alignment), with the levee shown in red. Levees between 10' (NAVD 88) and 15' were analyzed in half-foot increments. A 15.2' levee height was included as a local preference that corresponds to an elevation two feet above the mean 1% ACE water surface elevation at year 2067 (the end of the period of analysis). The results of the analysis of this levee are discussed in Section 8 (Results for the NED/NER and Locally- Preferred Plans).

[11] http://planning.usace.army.mil/toolbox/library/misc/StrongPoint%20-%20Civil%20Works%20Transformation%20-%20Planning%205%20APR%2012.pdf

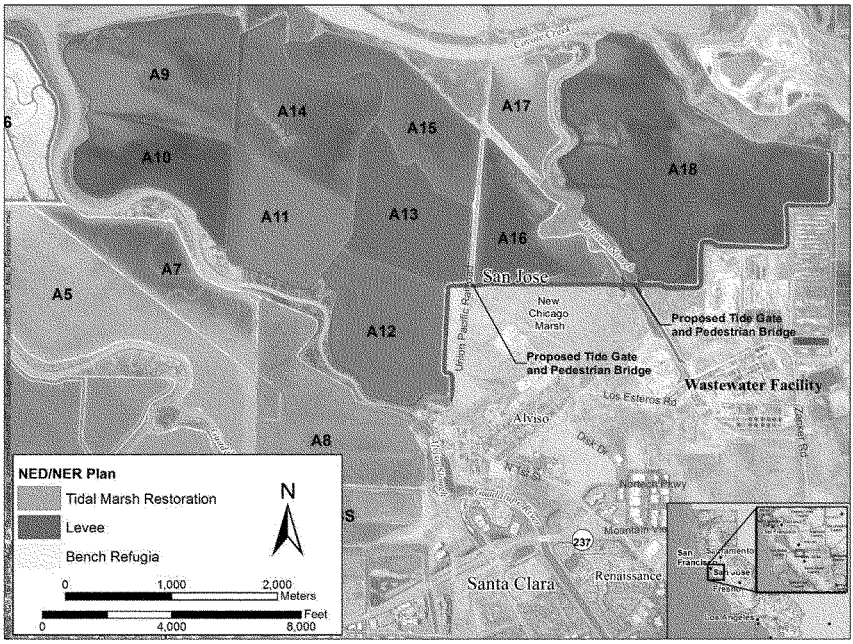


Figure 23: Least Cost FRM Levee Alignment

3.1. Non-Structural Option

Given the probability of future flooding under all sea level change scenarios, in the absence of a structural plan that keeps water away from assets and people in the study area, the only non-structural measures that are thought to be potentially feasible within a stand-alone non-structural option are those that significantly change the stage-damage relationship in the floodplain while not precluding restoration opportunities in the study area. Measures such as wet or dry flood-proofing and structure raises would result in a high residual risk to structures, and to health and human safety. Effective wet or dry flood-proofing would be impossible given the high expected future frequency of deep flooding in the area. Structure raises would be more effective at reducing the risk to structures in the study area, but would not significantly reduce the risk to health and human safety, nor to any assets and structures that cannot reasonably be elevated.

For the above reasons, it was determined that, given the characteristics of the study area and of the flood risk, the only effective non-structural alternative would include a permanent evacuation of the community of Alviso and the adjacent properties, and the construction of a ring levee around the SJ/SC WPCP.

In accordance with USACE planning policies and procedures, information developed by real estate personnel during the feasibility study was used to estimate the cost of this relocation alternative. An analysis was completed by the USACE San Francisco and Sacramento Districts Real Estate Sections in April 2012. The results of the analysis are briefly described below.

The determination of which structures would be relocated as part of the non-structural alternative is not straight forward. There is no policy that can be cited that would require that all structures within a certain return period floodplain (5-year, 10-year, etc.) be relocated. One important consideration though is that in order to be able to compare alternatives, the assumptions made for the analysis of the non-structural alternative must be consistent with those made for the structural alternatives analysis.

The flood damage reduction benefits of this non-structural alternative are equivalent to the damages reduced from relocation. Since relocating a property out of the floodplain reduces its flood risk to zero, the damages reduced for this alternative will be the sum of the without-project flood risk to those structures identified for relocation. After relocating these properties there would be some small amount of residual risk because not all properties in the floodplain are assumed to be removed. However, the damage to these properties constitutes no more than five percent of the estimated flood damage in the study area, and for this reason the benefits will be simply assumed to be equivalent to the total without-project damage.

After reviewing the cost it became clear that, no matter how the relocations were assumed to be phased or timed, this alternative would – from an NED perspective – not compete well against the structural alternatives. The total cost to acquire comparable properties in a flood-free area was estimated by USACE Real Estate to be $391 million. Adding to that property acquisition cost is the cost of a ring levee around the WPCP, and the Federal and non-Federal administrative costs of the real estate work. Table 9 (Non-Structural FRM Option Costs) below shows the estimated cost of implementing the non-structural alternative. The cost of structure demolition, which has historically been around $12k per residential structure for other projects, and other potential associated costs (cleanup, mitigation, etc.) have not been estimated in detail and are thus not included in the Table 9.

Table 9: Non-Structural FRM Option Costs (October 2013 Price Levels)

Cost Type	Cost (1,000s)
Flood-Free Property Acquisition Cost	$390,740
Fed & Non-Fed Real Estate Administration	$8,200
Ring Levee Construction (Incl. RE)	$25,000
Fed & Non-Fed Real Estate Administration	$1,500
Total	$425,440

4. FRM Option NED Analysis

4.1. Identification of the FRM NED Option by SLC Scenario

All of the options significantly reduce flood risk in the study area. Depending on the SLC scenario and levee height, the reduction in equivalent annual flood damage is between $11M and $40M. The NED levee height (that with the greatest net economic benefits) is 12.5' under the USACE Low and Intermediate SLC scenarios, and 13.5' under the USACE High SLC scenario. Table 10 through Table 12 summarize the results of the benefit-cost analysis completed for the comparison of the FRM options and the identification of the NED options. As Tables 10 through 12 show, there is very little difference in the net benefits of several of the levee options evaluated under each of the SLC scenarios. As an illustration of this point, under the USACE High SLC scenario, compared to the NED option, there is less than a 1% difference in net benefits for the next smaller and next larger levee heights. A similar story can be told for results under the USACE Low and Intermediate SLC scenarios.

The costs shown below differ slightly from the costs shown later in Section 8 (Results for the NED/NER and Locally Preferred Plans) for the final description of the NED options under each of the SLC scenarios as well as the locally-preferred FRM option (LPP). The NED and LPP levee option costs were updated to FY 16 (October 2015) price levels and subjected to a cost and schedule risk analysis as well as additional rounds of review. Performing a cost and schedule risk analysis on the entire array of alternatives would not be expected to change the identification of the NED option under each SLC scenario.

Table 10: Results of FRM Option NED Analysis – USACE Low SLC Scenario (Oct 2013 PL, 3.5% Discount Rate)

Without-Project Equivalent Annual Flood Damage (1,000s)										
Structure & Content Damage	$11,478									
Relocation Cost	$6,691									
Total	$18,170									
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)										
	No Action	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$18,170	$2,418	$1,123	$84	$17	$0	$0	$0	$0	$0
Annual Damages Reduced	$0	$15,752	$17,047	$18,086	$18,153	$18,170	$18,170	$18,170	$18,170	$18,170
Project Costs (1,000s)										
Project First Cost	$0	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
Interest During Construction	$0	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results										
Annual Net Benefits	**$0**	**$12,758**	**$13,982**	**$14,951**	**$14,966**	**$14,931**	**$14,846**	**$14,761**	**$14,577**	**$65**
Benefit-to-Cost Ratio	**N/A**	**5.26**	**5.56**	**5.77**	**5.70**	**5.61**	**5.47**	**5.33**	**5.06**	**1.00**

Table 11: Results of FRM Option NED Analysis – USACE Intermediate SLC Scenario (Oct 2013 PL, 3.5% Discount Rate)

Without-Project Equivalent Annual Flood Damage (1,000s)										
Structure & Content Damage	$15,391									
Relocation Cost	$7,153									
Total	$22,545									
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)										
	No Action	11' Levee	11.5' Levee	12' Levee	**12.5' Levee**	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$22,545	$3,894	$1,534	$131	$21	$1	$0	$0	$0	$0
Annual Damages Reduced	$0	$18,650	$21,011	$22,414	$22,524	$22,544	$22,545	$22,545	$22,545	$22,545
Project Costs (1,000s)										
Project Cost	$0	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
Interest During Construction	$0	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results										
Annual Net Benefits	$0	$15,656	$17,946	$19,278	**$19,337**	$19,305	$19,221	$19,136	$18,952	$4,440
Benefit-to-Cost Ratio	N/A	6.23	6.86	7.15	7.07	6.96	6.78	6.61	6.28	1.25

Table 12: Results of FRM Option NED Analysis, USACE High SLC Scenario (Oct 2013 PL, 3.5% Discount Rate)

Without-Project Equivalent Annual Flood Damage (1,000s)										
Structure & Content Damage	$31,902									
Relocation Cost	$8,293									
Total	$40,195									
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)										
	No Action	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	**13.5' Levee**	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$40,195	$29,154	$14,490	$5,071	$1,575	$419	$92	$16	$0	$0
Annual Damages Reduced	$0	$11,040	$25,704	$35,123	$38,619	$39,776	$40,103	$40,178	$40,195	$40,195
Project Costs (1,000s)										
Project Cost	$0	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
Interest During Construction	$0	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,942	$0
Total Investment Costs	$0	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,478	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,215	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,602	$18,105
Results										
Annual Net Benefits	$0	$8,046	$22,639	$31,988	$35,432	$36,537	**$36,779**	$36,770	$36,592	$22,090
Benefit-to-Cost Ratio	N/A	3.69	8.39	11.20	12.12	12.28	12.07	11.79	11.16	2.22

As shown above, the 12.5' levee maximizes net benefits under the Low and Intermediate SLC scenarios, and the 13.5' levee maximizes net benefits under the High SLC scenario. Therefore, these are two of the plans identified as NED Plan candidates. However, the Planning Guidance Notebook (ER 1105-2-100), Appendix G, states the following regarding NED Plan identification:

> *Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan, even though the level of outputs may be less.*

Based upon this criteria, the 12 foot levee scale could be identified as the NED Plan, since there are not significant increases in net benefits with larger scale levees under the three SLC scenarios. The following sections provide further comparisons of the 12.0', 12.5' and 13.5' levee options used to determine the overall NED Plan.

4.2. NED Option Project Performance Comparison

Compared to the without-project future condition, all three of the potential NED levee options significantly reduce the risk of flooding over the period of analysis. Table 13 (HEC-FDA Project Performance Statistics in 2067) below displays the project performance statistics for the No Action option and the three FRM levee options in the year 2067. The Mean Annual Exceedance Probability is the likelihood of flooding in any given year, although in this case because of rising sea level this value reflects a snapshot in time at the year 2067. The Long-Term Risk (30 Years) represents the likelihood over a 30-year period that a flood event will occur. Thirty years was chosen to display because that is the duration of a typical home mortgage loan and is therefore a time interval would be familiar to members of the public during flood risk communication efforts. Assurance is the likelihood that the levee will not be exceeded (overtopped) by a storm event of a specific probability, or annual chance of exceedance (ACE). In this case project Assurance for the 10%, 2%, 1%, and 0.2% ACE events are displayed. Note that these statistics are a function of the engineering, rather than economic inputs to the HEC-FDA model.

For illustration's sake, the results table shows that, depending on the SLC scenario, a 13.5' levee at the year 2067 has between a 0.02% and 0.48% chance of being overtopped each year (mean annual exceedance probability). At the 2067 sea level, over a thirty year period there is between a 0.7% chance and 13.4% chance of a damaging flood event occurring (Long-Term Risk (30 Years)). Finally, there is between a 99% and 88% chance of that levee containing the 1% ACE event in the year 2067 (Assurance/CNP 1% ACE 2067).

Table 13 shows that all of the levee options provide a high degree of project performance under the Low and Intermediate SLC scenarios, even at the end of the period of analysis. However, there are noticeable differences in performance under the High SLC scenario at the end of the period of analysis. For example, the annual probability of flooding due to the project design being exceeded is approximately 3.2 times higher for the 12.0 foot levee relative to the 12.5 foot levee. The 12.5' levee also has at least a 67% probability of containing the more probable flood events (up to the 10% ACE event), while the 12.0 foot levee has a very low probability of containing these events. The 13.5' levee provides a significant incremental increase in project performance relative to the 12.5' levee at the end of the period of analysis. For example, the 13.5' levee has over an 88% probability of containing the 1% ACE event, while the smaller scale levees have a minimal corresponding probability. These performance statistics indicate that under the High SLC scenario there is a significant likelihood that by the end of the period of analysis, the 12.0' and 12.5' levees would need to be raised or otherwise modified to address the increasing threat to the community, while such improvement s would likely be unnecessary for the 13.5' levee.

Table 13: HEC-FDA Project Performance Statistics in 2067[12]

SLC Scenario	FRM Option	Average Annual Exceedence Probability in 2067	Long Term Risk (30 yrs) 2067	Assurance/Conditional Non Exceedance Probability by Event 2067			
				10%	2%	1%	0.20%
Low	No Action	39.40%	100.0%	36.9%	24.7%	16.2%	3.9%
	12' Levee	0.18%	5.4%	99.9%	99.9%	99.8%	64.1%
	12.5' Levee	0.08%	2.6%	99.9%	99.9%	99.9%	94.9%
	13.5' Levee	0.02%	0.7%	99.9%	99.9%	99.9%	99.9%
Intermediate	No Action	53.00%	100.0%	29.6%	7.3%	5.4%	2.5%
	12' Levee	0.37%	10.5%	99.9%	99.2%	93.0%	45.0%
	12.5' Levee	0.08%	2.0%	99.9%	99.9%	99.9%	92.6%
	13.5' Levee	0.02%	0.6%	99.9%	99.9%	99.9%	99.9%
High	No Action	94.97%	100.0%	0.3%	<.01%	<.01%	<.01%
	12' Levee	26.95%	100.0%	2.7%	<.01%	<.01%	<.01%
	12.5' Levee	8.51%	93.1%	66.7%	3.2%	0.7%	<.01%
	13.5' Levee	0.48%	13.4%	99.9%	98.3%	88.2%	33.5%

4.3. Residual Risk

Residual risk is the risk that remains after the project has been implemented. This analysis specifically focuses on the residual risk associated with coastal flooding, and references to residual risk throughout this appendix are based upon this source of potential flooding. This analysis does not assess any residual risk that may be attributable to flooding from the Guadalupe River. However as discussed in Section 1.5, with existing flood risk improvements in the study area, the current estimated annual chance of fluvial flooding is estimated at less than one percent. All three of the levee NED option levee scales would in general have very low residual risk at the time of construction and for many years afterwards. However, the residual risk will increase as sea-level rises over time under any of the three USACE SLC scenarios, and significant differences between the residual risk of the levee heights emerge later in the period of analysis.

Equivalent annual damage remaining is one measure of residual flood risk. The expected annual damage at 2017 is at or near zero for all of levee heights between 12.0' and 15.2'. This does not mean that residual flood risk is zero, but the likelihood of flood damage is so low as to be negligible. Residual equivalent annual damages over the period of analysis are very minimal under the Low and Intermediate SLC scenarios. However, there is a more pronounced difference in residual equivalent annual damages under the High SLC scenario. The differences in residual damage are even more significant when focusing on results at the end of the study period. Under the Low and Intermediate SLC scenarios, the equivalent annual damage at the end of the period of analysis is still very low. However, under the USACE High scenario, the 12.0' and 12.5' levees have significantly more residual risk than higher levees. For example, according to the HEC-FDA modeling, in 2047 the equivalent annual damage for the 12.5' levee is nearly $1M, and increases to more than $20M by 2067. In contrast, the equivalent annual damage for the 13.5' levee does not reach $1M until 2067. Levees 15' or higher would have an extremely low likelihood of

[12] Note that low scenario project performance results for the 12.5' and 13.5' levees show slightly greater residual risk than under the intermediate scenario. This is due to slightly greater uncertainty in stages for very low probability events under the low scenario, and only under such low probability events is there any possibility of stages that exceed these levee heights. Regardless, the project performance statistics are similar for the two scenarios, e.g., both showing a 99.9% level of assurance for the 1% ACE event.

being overtopped over the period of analysis under even the USACE High SLC scenario. The degree of residual risk beyond the period of analysis obviously depends on the rate of future sea level change.

The equivalent annual damage calculations referenced above are based on overtopping events and assume no other flooding mechanism such as a levee breach. While no levee can be said to eliminate all risk of failure below the top of levee elevation, if well maintained the likelihood of structural failure for any of the three levees is estimated to be very low. The consequences of a levee breach during a storm event would be significant, but the likelihood is considered extremely low. As always, residual risk can be further reduced with effective floodplain management and flood warning and evacuation plans.

4.4. Comparison of NED Levee Options

Table 14 (Summary of NED Analysis Results) compares the primary results for three levee heights under consideration for selection as the NED Plan. From a net benefits and BCR perspective the three levee scales are very similar under each SLC scenario. Since ER 1100-2-8162 doesn't assign probabilities to the three SLC scenarios, it is not possible to identify the overall best plan by weighting the results for each levee option under the three SLC scenarios.

The real difference between the two options emerges under the USACE High SLC scenario in terms of residual risk and average annual exceedance probability. According to the results described in the Coastal Engineering & Riverine Hydraulics Summary (Appendix D1), at 2067 the 1% ACE water surface elevation is 13.2', which would exceed the 12.0' and 12.5' levees. According to the HEC-FDA modeling, the expected annual residual damage at 2067 would be over $63M for the 12.0' levee and over $22M for the 12.5' levee, while the damage with a 13.5' levee would be significantly less.

Table 14: Summary of NED Analysis Results (October 2013 Price Levels, 3.5% Discount Rate)

SLC Scenario	FRM Option	Total Equivalent Annual Benefits	Net Benefits	BCR @ 3.5%	Residual Equivalent Annual Damage	Residual Annual Damage in 2067	Average Annual Exceedence Probability in 2067
Low	12' Levee	$18,086	$14,951	5.77	$84	$457	0.18%
	12.5' Levee	$18,153	$14,966	5.70	$17	$244	0.08%
	13.5' Levee	$18,167	$14,846	5.47	$3	$60	0.02%
Intermediate	12' Levee	$22,414	$19,278	7.15	$131	$826	0.37%
	12.5' Levee	$22,524	$19,337	7.07	$21	$300	0.08%
	13.5' Levee	$22,542	$19,221	6.78	$0	$2	0.02%
High	12' Levee	$35,123	$31,988	11.20	$5,071	$63,236	26.95%
	12.5' Levee	$38,619	$35,432	12.12	$1,575	$22,322	8.51%
	13.5' Levee	$40,103	$36,779	12.07	$92	$1,588	0.48%

Dollars in thousands

After consideration of all of the factors evaluated, the 12.5' levee scale has been identified as the NED Plan. The primary reasons are because the 12.5' levee:

- Provides positive net benefits under all 3 SLC scenarios
- Maximizes net benefits under the Low and Intermediate SLC scenarios.
- Provides substantially greater risk reduction than the 12' levee under High SLC scenario:
  - 11% higher net benefits
  - 69% lower residual equivalent annual damages.
  - 65% reduction in EAD under future conditions.
  - 68% lower annual exceedance probability under future conditions.

- Is adaptable and can be raised in the future if necessary to accommodate sea level rise under the High SLC scenario.

4.5. Sensitivity Analysis: Economic Justification and Levee Failure Probability

The results presented above show strong economic justification for the alternatives evaluated. The strong justification is in large part the result of the finding that there is currently a high annual likelihood of flooding in the study area. The most uncertain of the inputs to the estimation of the likelihood of flooding in the study area is the likelihood of failure of the outer dike, which is incorporated in the FDA model as the without-project levee failure function. Because of the uncertainty, a sensitivity analysis was conducted to determine how changes to the levee failure function affect project economic justification. The results of this sensitivity analysis are presented in Addendum B at the end of this appendix. These results show that if the without project levee failure function is modified to reflect a zero percent chance of failure up to an elevation of 10 feet, without project damages, without project performance statistics and with project benefits are all substantially reduced. However, the proposed alternatives still show strong economic justification. See Addendum B for further details.

5. Cost-Effectiveness & Incremental Cost Analysis (CE/ICA) of Restoration Plans

This section describes the result of the cost-effectiveness and incremental cost analysis (CE/ICA) that was conducted in order to provide economic metrics with which to compare the various ecosystem restoration options. The IWR Planning Suite software was used for the CE/ICA analysis (USACE certified version – 2.0.6.1) This process helps to identify the National Ecosystem Restoration (NER) option, which by definition is one of the cost-effective plans, and is typically chosen be chosen from the suite of what are called "Best Buy" plans.

5.1. Overview of Evaluation Procedures

Ecosystem restoration projects incur the same types of financial costs as a traditional USACE project, such as preconstruction engineering and design, real estate, construction, and ongoing operation, maintenance and rehabilitation. Unlike for a traditional project, however, benefits arising from an ecosystem restoration project are not monetized. According to USACE guidance:

> *"Contributions to national ecosystem restoration (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units)."*[13]

A benefit-cost analysis – a comparison of net benefits and costs of each plan (or option, in the case of this study) – cannot be performed during ecosystem restoration studies because the costs and benefits are expressed in different units. While a benefit-cost analysis is considered ideal in USACE plan evaluation, cost effectiveness and incremental cost analyses (CE/ICA) provide essential information for decision making in its absence.

[13] ER 1105-2-100

In order to determine the contribution of a particular project to the Environmental Quality account, it is necessary to characterize and rank the cost effectiveness of the various options that are part of a particular study. That is, each option can generally be a combination of measures, the sum of which has a particular level of habitat value and a particular monetary cost associated with it. A cost-effectiveness analysis is simply a way of finding, for a given level of habitat output, those combinations of restoration measures that provide the best value.

The first step is to identify options that are inefficient in production, and remove them from consideration; this is the cost-effectiveness analysis. An option is defined as inefficient when another option provides the same or greater level of output at less cost. The incremental cost analysis then compares the cost of increasing output between each option. This process helps decision-makers understand cost changes as output levels are increased.

Table 15 (Costs & Outputs of Restoration Measures) shows the inputs to the CE/ICA. For each measure, the table shows the monetary cost and the environmental output. The environmental output results come from the CHAP model. More on this model can be found in Appendix B2 of the Integrated Feasibility Report and Environmental Impact Statement/Report (Environmental Benefits Analysis (CHAP) Summary and Model Outputs). Note that the annualized outputs applied in the CE/ICA were calculated using an uncertified spreadsheet, but the results were later verified using the certified version of IWR Planning Suite, with the result that the annualized outputs were 2.4% higher for all action alternatives. Because the difference was uniform and insignificant relative to plan selection or justification, the CE/ICA and reported outputs for the recommended plan were not revised.

There are four pond groupings that are being considered as part of the restoration effort (please refer to the Main Report for further details). These groupings are called A12, A9-A11, A13-A15, and A18. Table 15 below shows the cost and restoration output associated with restoration of each of the groupings with two different scales or features for each group. For each pond group, the two options are basic pond restoration, and basic pond restoration with a transitional marsh habitat (or "ecotone") with a 30:1 slope. Two additional options were also considered for each pond: accelerated restoration, and a 100:1 slope ecotone. The CHAP model used by the study to assess environmental benefits, as applied to date did not reveal that additional costs associated with accelerating restoration, or adding an ecotone larger than the minimal refugia bench included with the basic restoration option, would result in additional environmental outputs. Although this was also true for the 30:1 slope ecotone, this option was carried forward for detailed analysis in the CE/ICA as it was identified as important to the non-federal sponsors and potentially part of a locally preferred plan. The study team believes that adding transitional marsh habitat (30:1 slope ecotone) to the restoration effort would result in greater outputs than what would be realized with the smaller bench measure.

Table 15: Costs & Outputs of Restoration Measures (October 2013 price levels)[14] [15]

Restoration Measure	Total Cost	Output (CHAP)	AAC 3.375%	AAC/AAHU
No Action	$0	N/A		
Pond A12 basic restoration	$3,927,540	6,171	$163,689	$27
Pond A12 basic restoration w/ ecotone (30:1)	$14,670,402	6,115	$611,422	$100
Ponds A9 - A11 basic restoration	$11,514,519	15,356	$479,894	$31
Ponds A13 - A15 basic restoration	$10,698,311	12,403	$445,876	$36
Ponds A13 - A15 basioc restoration w/ecotone (30:1) *	$12,833,776	12,400	$534,877	$43
Pond A18 basic restoration	$8,338,038	14,577	$347,507	$24
Pond A18 basic restoration w/ecotone (30:1)	$31,114,203	14,437	$1,296,755	$90

In order to perform the analysis it is necessary to describe which measures are combinable, not combinable, dependent, and independent. Following extensive discussions with the PDT, the following logic was applied in the IWR Plan CE/ICA model:

- A18 could be implemented independently but is combinable with any of the other measures
- A12 could be implemented independently but is combinable with any of the other measures
- A9-A11 is dependent on A12, meaning it would not be implemented without A12
- A13-A15 is dependent on A9-A11 and A12, meaning that it would not be implemented without the implementation of those two pond groupings

Given the relationships and constraints specified above, including the No Action Plan there are 27 possible combinations of measures – therefore, there are 27 possible options.

As noted, the CHAP model as applied was generally unable to demonstrate that additional costs associated with accelerating restoration or adding an ecotone would result in additional environmental outputs. In fact, for Pond A12, Ponds A13-A15, and Pond A18, the model shows that additional cost and additional features result in the same or fewer average annual outputs. This model result is at odds with what the PDT believes would be the real-world result. For example, according to the PDT's environmental planners, by implementing the restoration more quickly, an accelerated phased restoration should result in a greater average annual restoration value than a slower phased restoration (i.e., basic phased restoration). Like all models, the CHAP model is an imperfect representation of the real world, and as applied for this study it was not able to demonstrate and quantify this difference.

[14] Measures called "phased restoration" are also called "basic restoration" or "basic phased restoration" in the feasibility report.

[15] The cost of the 30:1 ecotone was revised significantly downward based on changed assumptions regarding the cost of fill material. As described in Section 10, the ecotone is a feature of the locally-preferred plan. The CE/ICA analysis in this section reflects the updated costs at FY 14 price levels for the restoration features.

5.2. Cost-Effectiveness Analysis

Table 15 (CE/ICA – All Possible Ecosystem Restoration Plan Combinations) shows the list of combinations of all measures in increasing order of output.

Figure 24 (Plot of All 27 Plans - IWR Plan Results) is a scatterplot of the restoration measure combinations as shown in the program IWR Planning Suite. The costs shown in the figures and tables of the cost-effectiveness and incremental cost analysis are in average annual terms.

Table 16: CE/ICA - All Possible Ecosystem Restoration Plan Combinations (October 2013 Price Levels)

Plan	Output (HUs)	AAC
(A12 with Ecotone)	6,115	$611,422
A12	6,171	$163,689
(A18 with Ecotone)	14,437	$1,296,755
A18	14,577	$347,507
(A18 with Ecotone) + (A12 with Ecotone)	20,552	$1,908,177
(A18 with Ecotone) + A12	20,608	$1,460,444
A18 + (A12 with Ecotone)	20,692	$958,929
A18 + A12	20,748	$511,196
(A12 with Ecotone) + (A9-A11)	21,471	$1,091,316
A12 + (A9-A11)	21,527	$643,583
(A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	33,871	$1,626,192
(A12 + Ecotone) + (A9-A11) + (A13-A15)	33,874	$1,537,192
A12 + (A9-A11) + (A13-A15 with Ecotone)	33,927	$1,178,459
A12 + (A9-A11) + (A13-A15)	33,931	$1,089,459
(A18 with Ecotone) + (A12 with Ecotone) + (A9-A11)	35,908	$2,388,070
(A18 with Ecotone) + A12 + (A9-A11)	35,964	$1,940,337
A18 + (A12 with Ecotone) + (A9-A11)	36,048	$1,438,822
A18 + A12 + (A9-A11)	36,104	$991,089
(A18 with Ecotone) + (A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	48,308	$2,922,947
(A18 with Ecotone) + (A12 + Ecotone) + (A9-A11) + (A13-A15)	48,311	$2,833,947
(A18 with Ecotone) + A12 + (A9-A11) + (A13-A15 with Ecotone)	48,364	$2,475,214
(A18 with Ecotone) + A12 + (A9-A11) + (A13-A15)	48,368	$2,386,214
A18 + (A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	48,448	$1,973,699
A18 + (A12 + Ecotone) + (A9-A11) + (A13-A15)	48,451	$1,884,699
A18 + A12 + (A9-A11) + (A13-A15 with Ecotone)	48,504	$1,525,966
A18 + A12 + (A9-A11) + (A13-A15)	48,508	$1,436,966

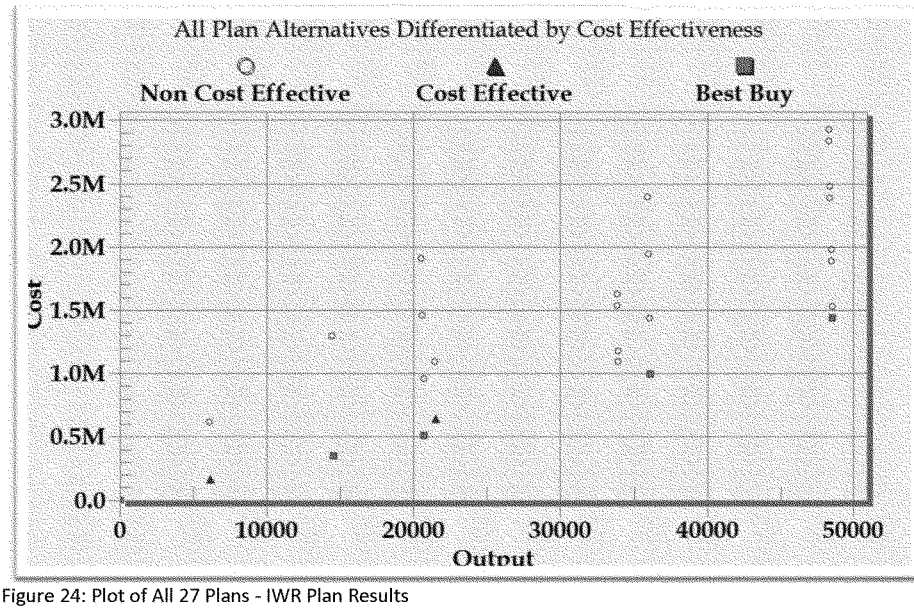


Figure 24: Plot of All 27 Plans - IWR Plan Results

After all possible plan combinations are identified, the next step is to identify those plans that are cost effective. "Cost effective" means that, for a given level of non-monetary output, no other plan costs less, and no other plan yields more output for less money. Table 17 (CE/ICA Step 2 - Identification of Cost Effective Plans) shows those plans that were screened out as a result of being designated as ineffective. The six plans highlighted in red are the remaining cost effective plans.

Table 17: CE/ICA - Identification of Cost Effective Plans (October 2013 Price Levels)

Plan	Output (HUs)	AAC	Cost Effective?
(A12 with Ecotone)	6,115	$611,422	No
A12	6,171	$163,689	Yes
(A18 with Ecotone)	14,437	$1,296,755	No
A18	14,577	$347,507	Yes
(A18 with Ecotone) + (A12 with Ecotone)	20,552	$1,908,177	No
(A18 with Ecotone) + A12	20,608	$1,460,444	No
A18 + (A12 with Ecotone)	20,692	$958,929	No
A18 + A12	20,748	$511,196	Yes
(A12 with Ecotone) + (A9-A11)	21,471	$1,091,316	No
A12 + (A9-A11)	21,527	$643,583	Yes
(A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	33,871	$1,626,192	No
(A12 + Ecotone) + (A9-A11) + (A13-A15)	33,874	$1,537,192	No
A12 + (A9-A11) + (A13-A15 with Ecotone)	33,927	$1,178,459	No
A12 + (A9-A11) + (A13-A15)	33,931	$1,089,459	No
(A18 with Ecotone) + (A12 with Ecotone) + (A9-A11)	35,908	$2,388,070	No
(A18 with Ecotone) + A12 + (A9-A11)	35,964	$1,940,337	No
A18 + (A12 with Ecotone) + (A9-A11)	36,048	$1,438,822	No
A18 + A12 + (A9-A11)	36,104	$991,089	Yes
(A18 with Ecotone) + (A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	48,308	$2,922,947	No
(A18 with Ecotone) + (A12 + Ecotone) + (A9-A11) + (A13-A15)	48,311	$2,833,947	No
(A18 with Ecotone) + A12 + (A9-A11) + (A13-A15 with Ecotone)	48,364	$2,475,214	No
(A18 with Ecotone) + A12 + (A9-A11) + (A13-A15)	48,368	$2,386,214	No
A18 + (A12 + Ecotone) + (A9-A11) + (A13+A15 with Ecotone)	48,448	$1,973,699	No
A18 + (A12 + Ecotone) + (A9-A11) + (A13-A15)	48,451	$1,884,699	No
A18 + A12 + (A9-A11) + (A13-A15 with Ecotone)	48,504	$1,525,966	No
A18 + A12 + (A9-A11) + (A13-A15)	48,508	$1,436,966	Yes

5.3. Incremental Cost Analysis

Table 18 (CE/ICA – Identification of First Best Buy Plan) shows the six cost effective plans and their output, cost, and average annual cost per unit of output over the No Action Plan. The highlighted plan (A18) is identified as the first best buy plan because it has the lowest incremental cost per unit of output over the No Action Plan.

Table 18: CE/ICA – Identification of First Best Buy Plan (October 2013 Price Levels)

Plan	Output (HUs)	AAC	AAC/AAHU
A12	6,171	$163,689	$26.52
A18	14,577	$347,507	$23.84
A18 + A12	20,748	$511,196	$24.64
A12 + (A9-A11)	21,527	$643,583	$29.90
A18 + A12 + (A9-A11)	36,104	$991,089	$27.45
A18 + A12 + (A9-A11) + (A13-A15)	48,508	$1,436,966	$29.62

The next Best Buy Plan is identified by calculating and comparing the incremental cost per unit of output over the last identified Best Buy Plan (A18). The green highlighted plan in Table 19 (CE/ICA – Identification of Second Best Buy Plan), which consists of restoration of ponds A18 and A12, has the lowest incremental cost per unit as compared to the first Best Buy Plan.

Table 19: CE/ICA – Identification of Second Best Buy Plan (October 2013 Price Levels)

Plan	Output (HUs)	AAC	Incr. HUs over Last Best Buy	Incr. AAC over Last Best Buy	Incr. AAC/HU over Last Bust Buy
A18	14,577	$347,507	14577	$347,507	$23.84
A18 + A12	20,748	$511,196	6171	$163,689	$26.52
A12 + (A9-A11)	48,311	$2,833,947	33734	$2,486,440	$73.71
A18 + A12 + (A9-A11)	36,104	$991,089	21527	$643,583	$29.90
A18 + A12 + (A9-A11) + (A13-A15)	48,508	$1,436,966	33931	$1,089,459	$32.11

Table 20 (Summary of Best Buy Plans, Annualized Values) shows the final results of the CE/ICA. As shown, there are four Best Buy plans. The table shows both costs and outputs in annual terms. Basic restoration of Pond A18 is the first Best Buy Plan, followed sequentially by the incremental addition of basic restoration of ponds A12, A9-11, and A13-15. Figure 25 shows the results of the CE/ICA analysis, identifying all of the cost effective and Best Buy Plans. In addition, it also shows the results for non-cost effective plans. Restoration of pond A18 with a 30:1 ecotone and restoration of all ponds with a 30:1 ecotone are also shown on the graph, as these plans are or interest as potential locally preferred plan options.

Table 20: Summary of Best Buy Plans, Annualized Values (October 2013 PL, 3.375% Discount Rate)

Plan	Output (HUs)	AAC	Incr. HUs	Incr. AAC	Incr. AAC/AAHU
A18	14,577	$347,507	14,577	$347,507	$23.84
A18 + A12	20,748	$511,196	6,171	$163,689	$26.52
A18 + A12 + (A9-A11)	36,104	$991,089	15,356	$479,894	$31.25
A18 + A12 + (A9-A11) + (A13-A15)	48,508	$1,436,966	12,403	$445,876	$35.95

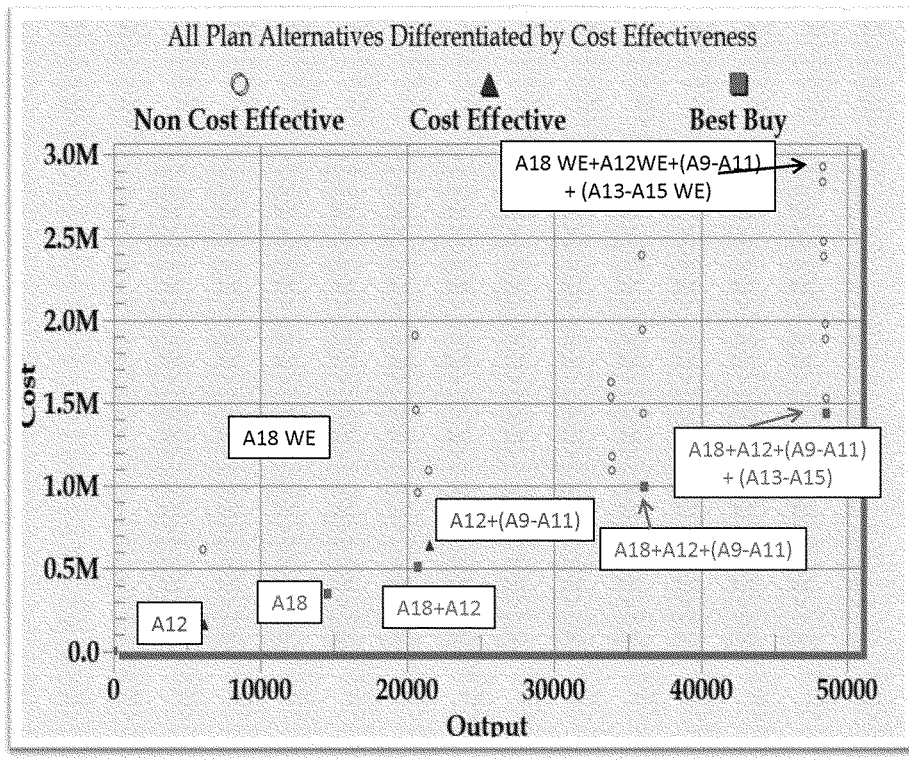


Figure 25: Plot of Cost Effective Plans - IWR Plan Model Results

Figure 26 shows a box plot of the incremental average annual cost per incremental gain in output for the four Best Buy Plans. Of particular note for this graph is that the increases in incremental costs per output are relatively minor for successively larger Best Buy Plans.

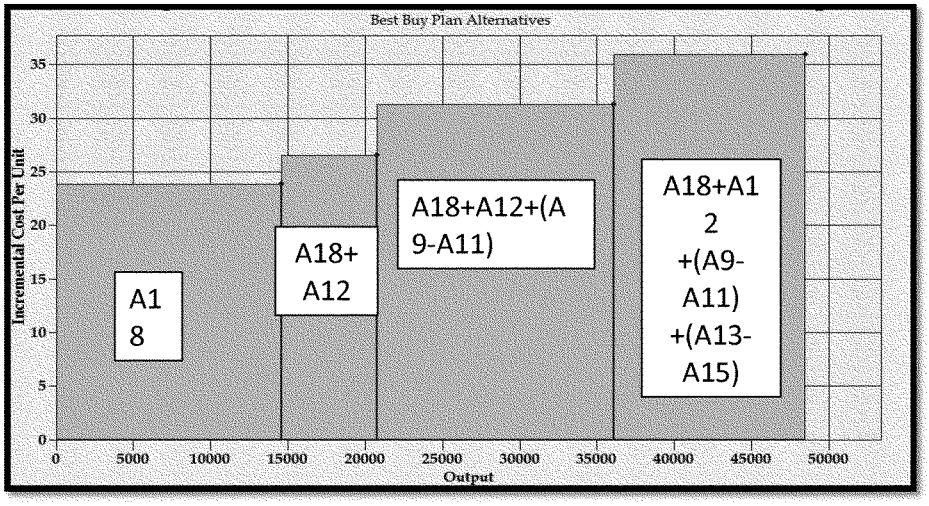


Figure 26: Plot of Cost Effective Plans - IWR Plan Model Results

5.4. Selection of the NER Plan

The analysis of the cost effectiveness and incremental cost of the restoration options shows that, not including the No Action option, there are six cost-effective options (also known as plans) and four best buy options or plans. As discussed in the study's main integrated document, the CHAP model as applied was not able to show additional environmental outputs for restoration measures beyond the baseline restoration of basic restoration with a bench. In the case of the accelerated restoration measures that are considered, the lack of cost-effectiveness was due solely to the inability to obtain required predictions of future habitat conditions for this measure in GIS format under schedule and budget limitations. Thus, these conditions could not be input to the CHAP model to obtain results. Based on current ecological understandings, the environmental planners in the PDT expect that there would, in fact, be an increase in annual habitat outputs as a result of accelerating the restoration process within the pond groupings.

In the case of the ecotone, the CHAP results showed slightly lower annualized outputs when an ecotone was included in the restoration plan. This result was due to model characteristics. CHAP effectively places a higher value on local habitat conditions that result in more species being present. This is irrespective of landscape-scale ecological considerations which could lead to different judgments of the most desirable approach to restoration or to targeting of species of particular concern. Thus, loss of fish species in high marsh and upland habitats on the ecotone and their replacement by a small number of terrestrial species, including species listed under the Endangered Species Act, resulted in lower annualized outputs of ecosystem benefits. This aspect of the model results is at odds with current ecological understandings, and the environmental planners in the PDT expect that inclusion of an ecotone would provide a more complete and sustainable restoration plan.

According to USACE policy, the NER Plan should generally be derived from the final set of Best Buy solutions. Other solutions identified as non-cost effective in cost effectiveness analysis, as well as cost effective plans identified as relatively less efficient in production ("non-Best Buys") in incremental analysis, may, however, continue to be considered for selection.

The six cost-effective plans consist of combinations of basic restoration of the four pond groupings. The four best buy plans involve basic phased restoration of one or up to all four pond complexes. The selected NER option is the largest of the Best Buy Plans, which includes basic phased restoration of all of the pond complexes. As shown in the results of the CE/ICA analysis, the incremental cost per output for the largest plan is modest relative to the smaller Best Buy Plans (i.e., there is not a significant break in the incremental cost curve). The key question is whether these incremental costs are worth the incremental output. The largest Best Buy Plan has a larger area of land and the inclusion of the additional pond complex which has important environmental outputs that, according to the California State Coastal Conservancy, are critical to the regional restoration effort. More on the importance of the pond complex to the regional environment can be found in the feasibility study integrated main report and environmental impact statement.

As documented in the next section (Section 6), the NER Plan as well as all ecosystem restoration plans that include restoration of ponds on USFS lands (ponds A9-A15) result in a reduction in average annual recreation value (an NED loss) due to the loss of trail segments within the Study Area. This applies to all Best Buy Plans except for the smallest one which only includes restoration of pond A18. The large increase in restoration outputs (nearly 34,000 AAHUs) for the NER Plan relative to the smallest Best Buy Plan that only includes restoration of pond A18 justifies the potential reduction in recreation value. Further, as is also documented in Section 6, a recreation plan has been formulated with features that are economically justified and result in an overall net gain in recreation value (recreation benefits exceed losses attributable to the restoration plans).

6. Recreational Resources Analysis

6.1. Existing Recreational Resources & Value

The study area currently contains approximately 21 miles of trails that are part of the larger regional Bay Trail[16]. The trails in this study area are of particular value because they are located in and around the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge), the nation's first urban national wildlife refuge. The refuge, created in 1974, was largely the result of grassroots efforts by the local community to protect the San Francisco Bay ecosystem. According to the Refuge Manager, approximately 150,000 persons per year use the trail in the study area. The Refuge has a parking lot for several dozen cars as well as a visitor and education center. The trail and associated recreation features currently in the project area are depicted in Figure 27 (Existing Location of the Bay Trail).

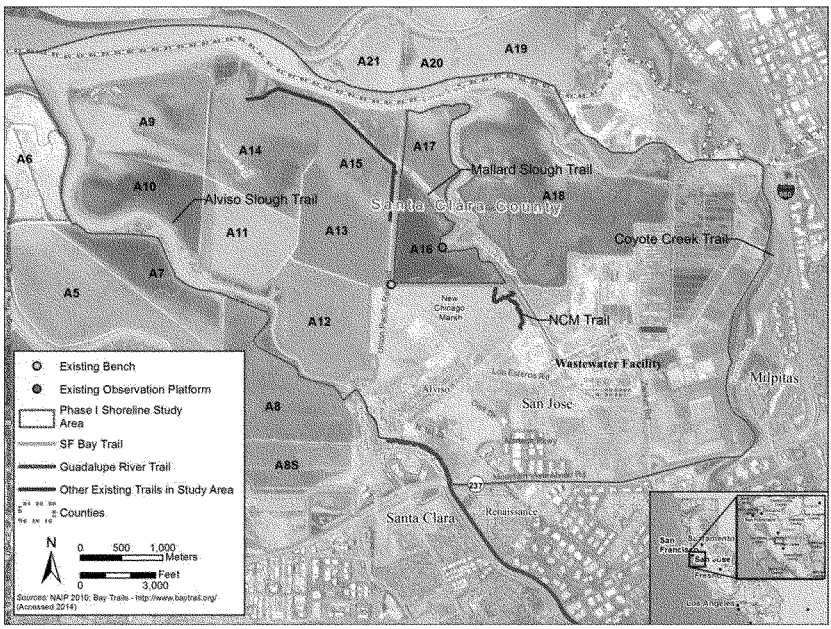


Figure 27: Existing Location of the Bay Trail

[16] According to www.baytrail.org, when complete, the Bay Trail will be a continuous 500-mile recreational corridor that will encircle the entire Bay Area, connecting communities to each other and to the Bay. It will link the shorelines of all nine counties in the Bay Area and 47 of its cities. To date, 310 miles of the Bay Trail, or more than 60 percent of its ultimate length, have been developed.

As stated above, officials at the USFWS estimate that the site gets 150,000 users per year on average. For recreation areas that are not classified as "high use" (high use is defined by the Planning Guidance Notebook as having greater than 750,000 annual visitors), USACE feasibility studies often use what is known as the Unit Day Value (UDV) method to value changes in recreational value associated with projects[17]. This method relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally-assisted recreation resources. The categories used to evaluate recreational resources are: Recreation Experience (number of activities), Availability of Opportunity (proximity of similar opportunities), Carrying Capacity (how additional use degrades the experience for the users), Accessibility, and Environmental (aesthetic qualities). The latest USACE Economic Guidance Memorandum (EGM 16-03) estimates the value of a general (non-specialized) recreation experience at between $3.90 and $11.71. The following table shows the results of the UDV analysis and estimated value of existing recreation facilities in the Study Area.

Table 21: UDV Analysis – Existing Recreation Resources (October 2015 Price Levels)

Criteria	Key Variables	Range of Point Values	UDV Points	
Recreation Experience	Number & Type of Facilities	0-30	10	Multiple General Activities. No High Value Activities.
Availability of Opportunity	Number of Similar Opportunities Nearby	0-18	3	Multiple recreation/trail systems within half hour drive.
Carrying Capacity	Adequacy of Facilities for Activities	0-14	7	Adequate facilities to support recreation activity without negative impact to experience.
Accessibility	Ease of Access to and Within Site	0-18	13	Good access to site via surrounding roads, Marina Park and Education Center.
Environmental	sthetic Quality of Site	0-20	10	Above average esthetic quality - no negative factors.
Total		**0-100**	**43**	
Unit Day Value $			$7.61	
Annual Attendance			150,000	
Total Recreation Value			**$1,142,100**	

As shown above, based upon the criteria for each category, the estimated value per visit was assessed at 43 points. This point value corresponds with dollar value per visit of $7.61. Multiplying the value per visit times the estimated annual visitation results in a total average annual recreation value of about $1.14 million.

[17] http://planning.usace.army.mil/toolbox/library/EGMs/EGM16-03.pdf

6.2. With-Project Impacts to Recreation Value (from Restoration Project Features)

In order for the ecosystem restoration purpose of the project to be implemented (under either the NER Plan or a Locally Preferred Plan that includes restoration of Ponds A9-A15 on USFWS lands, as described in Section 5), approximately 7.4 miles of the existing 11-mile loop trail located on top of levees surrounding Ponds A9 through A15 will have to be removed over time as these levees are breached to establish tidal connections between the ponds and the bay. In the absence of other measures taken, the removal of sections of this loop trail would have an adverse impact on the recreation value in the study area. The following describes the expected impact to recreation values associated with ecosystem restoration project features in place. The projected reduction in recreation value with these features represents an NED loss, and therefore must be evaluated and quantified.

Based upon discussions with the USFWS representatives, the annual visitation/use along the Alviso Slough Loop Trail is about 65,500. Eliminating 7.4 miles of the loop trail (as depicted on Figure 28) will negatively impact visitation primarily to those using this portion of the Study Area trails. Instead of a contiguous loop, the remaining portion of the existing loop trail will consist of a north/south alignment and several in-and-out segments extending along existing inner dikes to the west. Although the reduction in trail miles for the loop trail is substantial, the impact to visitation would not be proportionate. This is because most visitation along the trail is concentrated in the segments that would remain in place. Only a small proportion of visitors circumnavigate the loop, primarily due to its length of 11 miles. According to the representatives from the Refuge, a reasonable estimate for the reduction in visitation would be about 30% to 35% of those currently using the loop trail (approximately 65,500). This would correspond with a reduction in Study Area visitation of about 23,000. The following table shows the estimated recreation value with the required breaching of the USFWS ponds for the ecosystem restoration purpose of the project.

Table 22: UDV Analysis – With Ecosystem Restoration Project Features (October 2015 Price Levels)

Criteria	Key Variables	Range of Point Values	UDV Points With Pond Restoration	
Recreation Experience	Number & Type of Facilities	0-30	9	Same activities as without project, but reduction in experience due to loss of contiguous loop for Alviso Slough Loop Trail.
Availability of Opportunity	Number of Similar Opportunities Nearby	0-18	3	No Impact
Carrying Capacity	Adequacy of Facilities for Activities	0-14	5	Reduction to account for reduced trail miles
Accessibility	Ease of Access to and Within Site	0-18	11	Reduction to account for access within the site associated with loss of contiguous loop for Alviso Slough Trail
Environmental	Esthetic Quality of Site	0-20	12	Increase to High Esthetic Quality associated with restored study area ponds.
Total		**0-100**	**40**	
Unit Day Value $			$7.32	
Annual Attendance			127,068	35% Reduction in the loop trail visitation
Total Recreation Value			**$930,138**	
Total Recreation Value Loss (NED)			**$211,962**	vs. Without Project value of $1,142,100

As shown above on Table 22, in addition to the projected loss in Study Area visitation, the analysis also factors in changes in the different UDV category point values. Small reductions in point values were applied to the Recreation Experience, Carrying Capacity and Accessibility criteria. This was partially offset by small increase in the Environmental criteria, accounting for the improved esthetic quality resulting from the ecosystem restoration project in the USFWS pond area. Accounting for both the decrease in UDV dollar value per visit and reduced visitation, the overall reduction in recreation value is estimated at about $212,000. This is the estimated NED loss to recreation associated with the ecosystem restoration component of the project.

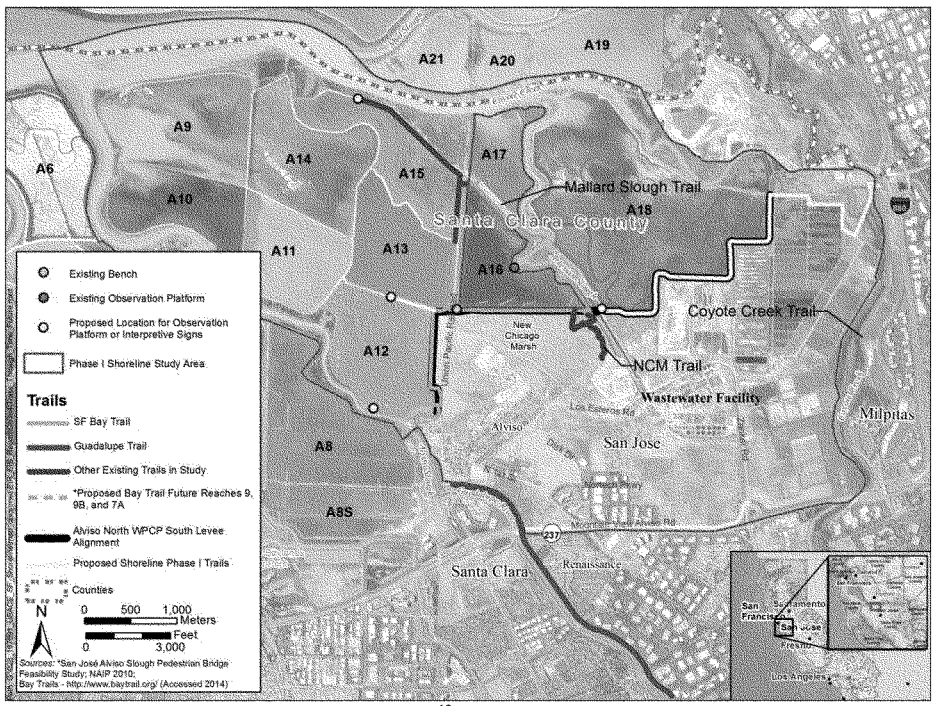


Figure 28: Potential Final Bay Trail Configuration[18]

[18] The Mountain View/Alviso Road Trail is not part of the proposed cost shared recreation plan. These improvements may be implemented by local entities.

6.3. Benefit/Cost Analysis for Recreation Project Features

The Feasibility Report and Environmental Impact Statement describes proposed recreation features. While the intent of these features is to replace recreation value lost by the breaching of the pond levees on USFWS lands, Corps policy does not support the provision of recreation features as mitigation for project impacts. Instead, any proposed recreation features must be shown to be economically justified. The following analysis shows the economic evaluation of the proposed recreation features.

The primary features of the proposed recreation plan include two pedestrian bridges. The first bridge (Artesian Slough Bridge) would connect trail segments along levee segments to the east and west of the Artesian Slough. The second bridge (Railroad Bridge) would cross the Union Pacific railroad tracks, connecting Pond A18 to points west including Alviso Slough trail, Alviso Marina, and the Guadalupe River Trail and eventually, when the City of San Jose completes gaps around Pond A8, other segments of the Bay Trail. The proposed Railroad Bridge would cross at the existing railroad gate and provide an easier-to-use, safer connection. In addition to the bridge improvements, the recommended FRM levee alignment along Pond A18 would be available for use as a recreational trail, adding several miles of trail to the system. Finally, the recreation plan includes ancillary recreation facilities, including viewing platforms at the end of the in-and-out trail segments, benches, and signage. Figure 28 (Potential Final Bay Trail Configuration) shows the project area recreation features upon completion of the pond levee breaches.

The baseline for the estimate of recreation benefits attributable to the proposed recreation features is with the FRM/ER components of the project in place, i.e., the value that accounts for the negative impact from the loss of trails due to restoration project components. This is because recreation plans are formulated as added increments to recommended FRM or ER plans, and Corps policy does not support compensatory mitigation for recreation impacts, so any adverse effects of the recommended FRM or ER plans on recreation must be included in the baseline for evaluating the economic effects of recreation plans. As noted in the prior section, the corresponding annual visitation was estimated at about 127,000. With the proposed recreation features, it is estimated that Study Area visitation would increase by at least 20 percent from this value (to a total of about 152,500), based upon input from the USFWS refuge personnel. The impact to visitation would not be limited to the loop trail, but is rather anticipated to increase overall visitation throughout the Study Area trails, given the enhanced connections provided by the bridges and the new trail segment along Pond A18. This visitation estimate is slightly higher than the current estimated Study Area visitation, without implementation of any FRM/ER project components.

The table below shows the estimated recreation value with the proposed recreation features, as well as the recreation benefit (based upon the increase in recreation value relative to the baseline condition, i.e., with FRM/ER project components in place).

Table 23: UDV Analysis – With Recreation Project Features & Ecosystem Restoration Project Features (Oct 2015 Price Levels)

Criteria	Key Variables	Range of Point Values	UDV Points With Rec Features	
Recreation Experience	Number & Type of Facilities	0-30	10	Offset of reduction from ER component due to increased overall experience from better trail connections throughout study area.
Availability of Opportunity	Number of Similar Opportunities Nearby	0-18	3	No Impact
Carrying Capacity	Adequacy of Facilities for Activities	0-14	6	Offset to reduction from loss of trail miles at Alviso Loop Trail from additional A18 trail segment and connectivity provided by bridges
Accessibility	Ease of Access to and Within Site	0-18	16	Enhanced access within the site and across Study Area trails from bridges and new A18 trail segement and link to existing trails.
Environmental	Esthetic Quality of Site	0-20	12	Reflects increase to High Esthetic Quality associated with restored study area ponds.
Total		**0-100**	**47**	
Unit Day Value $			$8.01	
Annual Attendance			152,482	20% Increase
Total Recreation Value			**$1,220,768**	
Total Recreation Benefit (vs. With NED/NER in Place)			**$290,630**	vs. value with ER features of $930,138.

Table 23 reflects increases in UDV point values for the categories of Recreation Experience, Carrying Capacity, and Accessibility. The resulting value per visit is $8.01, which when multiplied times projected visitation of 152,482, results in a total annual recreation value of about $1.22 million. This value is approximately $291,000 greater than the recreation value under the baseline condition that includes ecosystem restoration project features in place. It also represents the incremental benefit of adding recreation features to the overall project.

The project first cost is estimated at approximately $6.3 million at FY16 price levels. At an annualized cost of $254,800, the recreation plan is thus estimated to provide approximately $35,800 in annual net economic benefits, and has a benefit-cost ratio of 1.14 (see Table 24 (Results of Recreation Analysis)). In addition to being economically justified, the increase in Study Area recreation value with the proposed recreation plan improvements is estimated to more than offset recreation value losses which may result from the loss of recreational trail segments associated with the breaching of USFWS ponds required for the ecosystem restoration component of the project.

Table 24: Results of Recreation Analysis (October 2015 Price Levels)

Annual Cost	$254,800
Annual Benefits	$290,600
Annual Net Benefits	$35,800
Benefit-Cost Ratio	1.14

7. Regional Economic Development & Other Social Effects

The following two sections describe the Regional Economic Development and the Other Social Effects accounts as they pertain to the without- and/or with-project condition.

7.1. Regional Economic Development (RED)

According to EC 1105-2-409, "the regional economic development account registers changes in the distribution of regional economic activity that result from each alternative plan". In general, the RED account shows the effects of different plan alternatives on the distribution of regional economic activity in the area where implementation of the plan will have significant impacts on income and employment. The RED impacts are not added to the NED account.

All of the projects are expected to have positive regional economic impacts as a result of both a reduction in flood risk and the expenditure of funds to implement the projects. The benefits from the reduction in flood risk are generally captured in the NED analysis, while this section aims to quantify the regional impact from the expenditure of construction funds.

Implementation of a project would result in significant construction expenditure and demand for both construction labor and construction support services, providing short-term regional economic benefits. In addition to construction labor demand and increased manufacturing labor demand (due to a greater need for construction materials), the private sector may benefit from the project through contracted construction management, architectural, and landscaping employment opportunities. Expenditure on construction materials, labor, and services would in turn have a "trickle down" effect throughout the region as increased employment opportunities and higher overall earnings generate spending and inter-industry economic activity.

The RECONS model is a USACE-approved web-based model for estimating the regional economic impact of the expenditure of funds for projects or studies. The model was run using the default spending profile (assumptions on how cost is distributed across different tasks) and local purchase coefficients (assumptions on what percentage of the spending stays in the local economy versus slipping out to the broader region and nation). The model used a generic metropolitan area in California as the region of impact; no specific location is available in the model for projects that are not already in construction.

Table 25 (RED Impacts – NED/NER and LPP by Project Purpose) and Table 26: (RED Impacts – NED/NER and LPP Combined Plans, Including Recreation) show the results from the RECONS model for the components of the NED/NER plan and the larger LPP. The Total Spending applied for the RED analysis excludes real estate costs, as such costs represent a financial transaction for the value of project lands, which is not anticipated to generate RED outputs. The outputs shown are restricted to the greater metropolitan area, and the overall economic impact for the state and nation would be larger than what is shown below. Note that these results are based upon FY16 (October 2015) price levels, based upon updated costs for the NED/NER and LPP Plans (as presented in Sections 8).

The jobs estimated are simply annual equivalents, and are not necessarily new or permanent jobs. For example, assuming it takes three years to construct the NED FRM Option, it is estimated that about 496 jobs will be supported each of the three years – for a total of approximately 1,488. The extent to which these will be new jobs for persons currently unemployed or underemployed will depend on the labor market at the time of construction.

Table 25: RED Impacts – NED/NER and LPP Plans, By Project Purpose (October 2015 Price Levels)

Impacts		NED FRM Option	Locally-Preferred FRM Option	NER Plan Features	LPP ER Features	Recreation
Total Spending		$74,732,000	$90,341,000	$16,862,000	$63,752,000	$6,314,000
Direct Impact						
	Output	$65,026,184	$78,607,965	$13,273,139	$50,183,202	$5,144,247
	Job	1053	1273	143	539	45
	Labor Income	$47,925,368	$57,935,365	$5,932,802	$22,430,792	$2,757,867
	GRP*	$53,869,279	$65,120,758	$6,638,902	$25,100,420	$3,096,499
Total Impact (Direct & Indirect)						
	Output	$123,993,463	$149,891,525	$24,734,227	$93,515,385	$9,597,001
	Job	1488	1799	225	852	79
	Labor Income	$67,978,681	$82,177,140	$9,999,326	$37,805,539	$4,351,676
	GRP	$88,555,017	$107,051,180	$13,360,076	$50,511,895	$5,760,693

Table 26: RED Impacts – NED/NER and LPP Combined Plans, including Recreation (October 2015 Price Levels)

Impacts		NED/NER Plan Including Recreation	LPP FRM/ER Plan Including Recreation
Total Spending		$97,908,000	$160,407,000
Direct Impact			
	Output	$83,443,570	$133,935,414
	Job	1241	1857
	Labor Income	$56,616,037	$83,124,024
	GRP*	$63,604,680	$93,317,677
Total Impact (Direct & Indirect)			
	Output	$158,324,691	$253,003,911
	Job	1793	2731
	Labor Income	$82,329,683	$124,334,355
	GRP	$107,675,786	$163,323,768

As shown on Table 26, the NED/NER Plan (including proposed recreation features) is projected to generate 1,793 jobs, over $82 million in labor income, and over $107 million in gross regional product throughout the construction period. The LPP FRM/ER Plan (including proposed recreation features) is projected to generate over 2,700 jobs, $124 million in labor income, and over $163 million in gross regional product over the period of construction.

7.2. Other Social Effects (OSE)

OSE is defined by EC 1105-2-409 for use in USACE feasibility studies: "The other social effects account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts". Measurement of OSE is generally qualitative; however, quantitative data is encouraged within available and accepted methods. This section discusses the OSE account with respect to the FRM options.

An OSE handbook (2013-R-13) has recently been published by the Institute for Water Resources (IWR), which is part of the USACE. The publication is entitled "Applying Other Social Effects in Alternatives Analysis." Table 27 (OSE Social Factors (from IWR Report 2013-R-13)) below identifies and describes the social factors that the USACE recommends for consideration when evaluating the social effects of alternatives.

Table 27: OSE Social Factors (from IWR Report 2013-R-13)

Social Factor	Description
1. Health and Safety	Perceptions of personal and group safety and freedom from risks
2. Economic Vitality	Personal and group definitions of quality of life, which is influenced by the local economy's ability to provide a good standard of living
3. Social Connectedness	Community's social networks within which individuals interact; these networks provide significant meaning and structure to life
4. Identity	Community members' sense of self as a member of a group, in that they have a sense of definition and grounding
5. Social Vulnerability and Resiliency	Probability of a community being damaged or negatively affected by hazards and its ability to recover from a traumatic event
6. Participation	Ability of community members to interact with others to influence social outcomes
7. Leisure and Recreation	Amount of personal leisure time available and whether community members are able to spend it in preferred recreational pursuits

As described briefly below, under the future without-project condition the impacts on the social factors shown in Table 27 would be very significantly adverse, while the structural options (levee construction) would to an almost equivalent degree significantly reduce the adverse social effects that would otherwise be expected in the absence of a project.

7.2.1. Without-Project Condition (No Action Alternative)

Under the without-project condition, the increasing future flood risk represents a real risk to human health and safety in the study area. Also, in the aftermath of a flood event, the temporary or long-term displacement of people and businesses would adversely alter the community and the lives of those affected. If the flooding were severe enough to damage an unprotected WPCP, the potential release of raw sewage into the bay and the loss of service would have catastrophic impacts on the region. In the long-term, the increasing flood risk would be expected to force people to relocate out of the floodplain, and the community of Alviso would either be significantly adversely impacted or cease to exist altogether. The relocation of structures out of the area would be expected to include an elementary school, several churches, and potentially the San Jose Fire Department Station #25. The without-project condition would be associated with very significant adverse consequences across all of the factors listed in Table 27 (OSE Social Factors (from IWR Report 2013-R-13))– especially in the community of Alviso that would be affected most severely.

7.2.2. Non-Structural Option

The non-structural FRM option involves an evacuation of the high-risk area of the floodplain, and would relocate hundreds of homes, businesses, and public buildings – including all properties within the community of Alviso. While this option would be highly effective at reducing flood risk in the study area, it would very clearly have significant adverse social impacts. By dispersing the residents and businesses from the high risk flood zone, this option would eliminate the community of Alviso, disrupting lives, and adversely affecting hundreds of families and relationships in the community. The fire station would have to be relocated as well. This option would have significant adverse impacts across all seven of the social factors shown in Table 27 (OSE Social Factors (from IWR Report 2013-R-13)).

7.2.3. Structural Options

The structural project options are very similar in their expected social impacts. They would all significantly reduce the probability of the adverse social impacts described under the without-project condition. They would all significantly reduce the flood risk in the study area, and thus would improve human health and safety. There would be no displacement of residents or businesses as there would be under the non-structural option and would be expected under the without-project future condition. The decrease in flood risk compared to the without-project condition would be expected to increase the value of land and the properties in the floodplain, although the magnitude of this increase is highly uncertain and thus has not been quantified in this report. Overall each of the structural options would have a strongly positive impact on the community and public health and safety.

It should be noted, however, that there are differences in the residual risk to the community under the High SLC scenario. Should this scenario occur, by the end of the period of analysis, there would be substantially greater residual risk for levee scales lower than 13.5' due to the impact of sea level rise. It is likely that under the High SLC scenario, should a smaller scale levee (such as the NED levee scale of 12.5') be constructed, at some point in time prior to the end of the period of analysis, the levee would be raised/modified to address the increased risk to the community. Without such improvements under this scenario, there would be a significant probability of catastrophic flooding which would have substantial health and safety and other adverse social impacts. With levee scales of 13.5' or greater, the risk of levee failure and corresponding negative health, safety and other adverse social impacts would be minimal, even under the High SLC scenario.

8. Results for the NED/NER and Locally Preferred Plans

8.1. Flood Risk Management (Comparison of NED Plan and LPP)

The evaluation of the final array of alternatives identified the single-purpose NED FRM option, which is the option with the greatest net national economic benefits. As described previously, depending on the SLC scenario one of two levee heights would be identified as the NED option based upon the plan with maximum net benefits. The costs and benefits of the two levee heights (12.5' and 13.5') are very similar. The 12.5' levee has been selected as the NED FRM option for the reasons outlined in Section 4.4 (Comparison of NED Levee Options). Although the larger levee has significantly less residual risk towards at the end of the period of analysis under the USACE High SLC scenario, Corps planning guidance also generally recommends selection of smaller scale plans when plans have similar net benefits[19]. Since the 12.5' levee has similar net benefits to the 13.5' levee across all three SLC scenarios, and because it could potentially be raised in the future if necessary due to higher sea level rise than that projected under the low or intermediate scenarios, the 12.5' levee has been selected as the NED FRM option.

The locally preferred FRM option is a 15.2' levee along the same alignment as the NED option. The results for these two options are displayed in Table 28 (Comparison of NED and LPP FRM Options ($1,000s)) below. The results have been updated to FY 2016 (October 2015) price levels. In accordance with USACE policy, the results are shown at the FY 2016 discount rate of 3.125%. As Table 28 shows,

[19] ER 1105-2-100, Appendix G, Exhibit G-1.

the results for the two options are very similar. The small expected residual damage associated with the NED levee under the USACE High SLC scenario is effectively eliminated with the larger LPP levee. This decrease in with-project damage is not enough to offset the increase in project cost, which is why the net benefits of the LPP levee are slightly lower than the NED levee for each SLC scenario.

Table 28: Comparison of NED and LPP FRM Options ($1,000s) – October 2015 Price Levels, 3.125% Discount Rate

	NED FRM			LPP FRM		
	12.5' Levee			15.2' Levee		
SLC Scenario	Low	Intermediate	High	Low	Intermediate	High
Without-Project						
Equivalent Annual Flood Damage	$18,529	$23,248	$41,762	$18,529	$23,248	$41,762
With-Project						
Equivalent Annual Flood Damage	$19	$24	$1,764	$0	$0	$0
Equivalent Annual Damage Reduced	**$18,510**	**$23,225**	**$39,998**	**$18,529**	**$23,248**	**$41,762**
Project Costs						
Project First Cost	$76,157			$91,870		
Interest During Construction	$3,524			$4,251		
Total Investment Cost	$79,681			$96,121		
Average Annual Cost	$3,171			$3,825		
Annual O&M Cost	$538			$538		
Total Average Annual Cost	**$3,709**			**$4,363**		
Results @ 3.125%						
Annual Net Benefits	**$14,801**	**$19,516**	**$36,290**	**$14,166**	**$18,885**	**$37,400**
Benefit-to-Cost Ratio	**4.99**	**6.26**	**10.78**	**4.25**	**5.33**	**9.57**

Table 29 (Project Performance Statistics at 2067 – 12.5' and 15.2' Levees) displays the project performance statistics from the HEC-FDA modeling for the 12.5' and 15.2' levees at the end of the period of analysis. The results indicate that there is a very low risk of coastal flood damage with either of the levee heights under the Low and Intermediate SLC scenarios. In general the performance of the levees is very similar, and the only significant difference between the two emerges under the USACE High SLC scenario. As noted previously, there is significant residual risk with the 12.5' levee at the end of the period of analysis under the High SLC scenario. Table 28 shows that there is very minimal residual risk with the 15.2' levee, even under those same conditions.

Table 29: Project Performance Statistics at 2067 – 12.5' (NED) and 15.2' (LPP) Levees

SLC Scenario	FRM Option	Average Annual Exceedence Probability in 2067	Long Term Risk (30 yrs) 2067	Assurance/Conditional Non Exceedance Probability by Event 2067			
				10%	2%	1%	0.20%
Low	12.5' Levee	0.08%	2.6%	99.9%	99.9%	99.9%	94.9%
	15.2' Levee	0.01%	0.2%	99.9%	99.9%	99.9%	99.9%
Intermediate	12.5' Levee	0.08%	2.0%	99.9%	99.9%	99.9%	92.6%
	15.2' Levee	0.01%	0.2%	99.9%	99.9%	99.9%	99.9%
High	12.5' Levee	8.51%	93.1%	66.7%	3.2%	0.7%	<.01%
	15.2' Levee	0.02%	0.6%	99.90%	99.9%	99.9%	99.9%

Table 30 compares some of the important overall FRM outputs of the two levee heights, including the net benefits, BCR, and residual damage in both equivalent annual terms and at the end of the period of analysis.

Table 30: Summary of Results for 12.5' (NED) and 15.2' (LPP) Levees ($1,000s), Oct 2015 Price Levels, 3.125% Discount Rate

SLC Scenario	FRM Option	Total Equivalent Annual Benefits	Net Benefits	BCR @ 3.125%	Residual Equivalent Annual Damage	Residual Annual Damage in 2067	Average Annual Exceedence Probability in 2067
Low	12.5' Levee	$18,510	$14,801	4.99	$19	$244	0.08%
	15.2' Levee	$18,529	$14,166	4.25	$0	$0	0.01%
Intermediate	12.5' Levee	$23,225	$19,516	6.26	$24	$300	0.08%
	15.2' Levee	$23,248	$18,885	5.33	$0	$0	0.01%
High	12.5' Levee	$39,998	$36,290	10.78	$1,764	$21,000	8.51%
	15.2' Levee	$41,762	$37,400	9.57	$0	$0	0.02%

8.2. National Ecosystem Restoration (Comparison of NER Plan and LPP)

As described in Section 5, the NER Plan includes basic restoration of all of the ponds considered in the study. The NER Plan is the largest of the four "Best Buy" restoration plans. There is a locally preferred plan (LPP) that is larger in scale than the NED/NER Plan with respect to both the FRM and ER options. As noted in Section 8.1, the LPP has the same FRM alignment as the NED Plan, but will be designed to a final height of 15.2' instead of 12.5'. The NER component of the LPP includes 30:1 ecotone improvements in addition to basic pond restoration included in the NER Plan.

Figure 29 and Figure 30 depict the NED/NER Plan and LPP. Total first costs for the ER plans presented in Section 5 have been updated to FY16 (October 2015) price levels. Updated costs for the NER and LPP ER plans are currently estimated as follows:

- NER Plan - $28.829 million
- LPP ER Plan (All Ponds) - $75.716 million

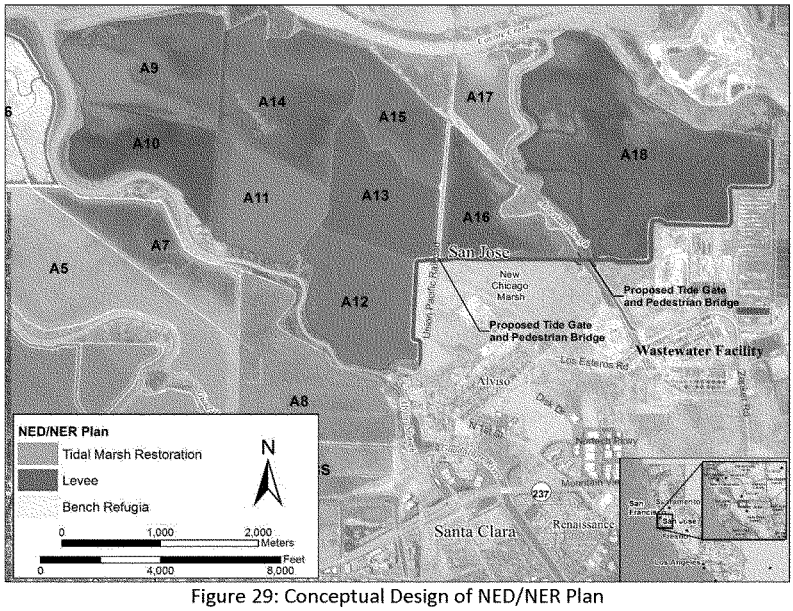


Figure 29: Conceptual Design of NED/NER Plan

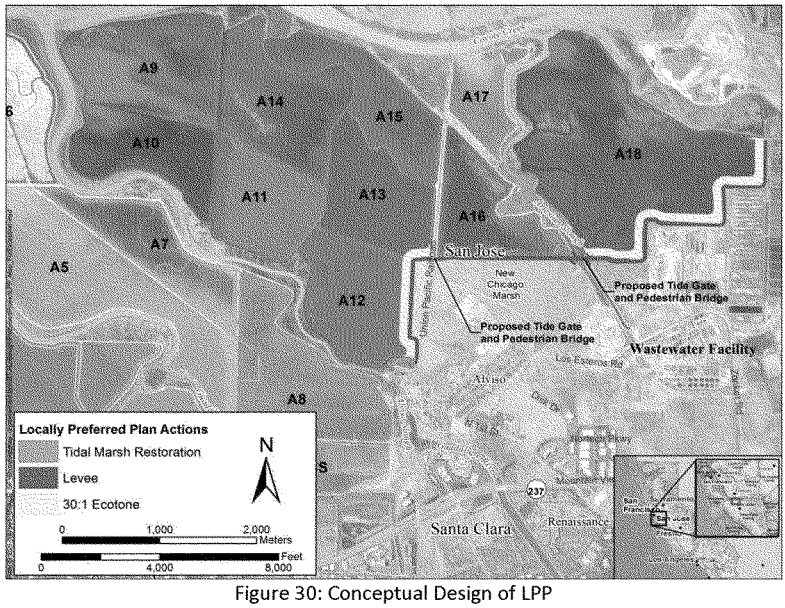


Figure 30: Conceptual Design of LPP

8.3. Summary of Benefits & Costs for NED/NER Plan and LPP

The following presents summarizes benefits and costs for the NED/NER Plan, as well as the LPP.

8.3.1. Cost Allocation

For multipurpose projects, costs must be allocated between project purposes (in this case, flood risk management (NED) and ecosystem restoration (NER). For both the NED/NER Plan and the LPP Combined Plan, all of the levee construction costs have been allocated to the FRM purpose, and all of the pond restoration costs have been allocated to the ER purpose.

For a single purpose FRM project, there would be some environmental impacts. However, the costs for mitigating for such impacts would be similar for all levee scales. Further, since the ER component of the multipurpose project provides a significant net gain in ecological outputs, a combined plan would not require mitigation and a determination was made that it is not necessary to allocate any ecosystem restoration related costs to the FRM component of the project.

If the ER components of the NED/NER or LPP Plans were implemented without the FRM levee components of these plans, the ER components would require flood risk mitigation, as these features would result in induced flood risk. The cost of such mitigation would be very significant. Accordingly, ER plans were formulated and evaluated incrementally as a second-added purpose, once the optimal levee alignments and the NED and LPP FRM plans were identified. In essence, the FRM features will allow for restoration to take place in the pond complexes – such restoration would not be considered as a stand-alone feature without first implementing the FRM component. Therefore, it has also been determined that no flood risk mitigation related costs should be allocated to the ER components of the NED/NER or LPP Plans. The costs in the summary table in the following section reflect these results and conclusions.

8.3.2. Summary of Results

Table 31 which follows summarizes the benefits and costs for the NED/NER Plan and the LPP Combined Plan. The NED levee height is 12.5'. As shown in the table, the FRM features for both the NED/NER Plan as well as the LPP are well economically justified under all three SLC scenarios.

Table 31 also presents summary results for the ER component of the NED/NER Plan and LPP Combined Plan. All of the pond complexes (with basic restoration) were identified as efficient Best Buy plan components of the NER Plan.

The LPP ER plan includes an ecotone, which was formulated to provide a more complete and sustainable restoration plan. However, the currently available and certified habitat model used to evaluate ecosystem benefits for this study, as applied to date, did not reveal that the ecotone would result in additional environmental outputs. Because the output results for the ER component of the LPP reflect a substantial increase in costs but do not reflect an increase in ER benefits, the average annual cost per AAHU is significantly higher for the LPP than for the Combined NED/NER Plan. Also note that the NED cost associated with the reduction in recreation value for both the NER and LPP ER plans is reflected in the average annual cost per habitat unit for these plans.

Benefits and costs for the recommended recreation plan are also summarized on Table 31. The proposed recreation features are economically justified, and are compatible with the ecosystem restoration features of the recommended plan.

Table 31: Summary of Economic Analysis Results (October 2015 Price Levels, 3.125% Discount Rate)

	NED/NER Plan			Locally-Preferred Plan		
NED ACCOUNT - FLOOD RISK MANAGEMENT						
Investment Costs						
FRM First Costs	$76,157,000			$91,870,000		
Interest During Construction	$3,523,678			$4,250,696		
Total	**$79,680,678**			**$96,120,696**		
Annual Cost						
Interest and Amortization	$3,170,730			$3,824,927		
Annual Maintenance Cost	$538,000			$538,000		
Total Annual Cost (Rounded)	**$3,709,000**			**$4,363,000**		
USACE SLC Scenario	**Low**	**Intermediate**	**High**	**Low**	**Intermediate**	**High**
Annual Benefits	$18,510,000	$23,225,000	$39,998,000	$18,529,000	$23,248,000	$41,762,000
Net Annual FRM Benefits	$14,801,000	$19,516,000	$36,289,000	$14,166,000	$18,885,000	$37,399,000
Benefit to Cost Ratio	4.99	6.26	10.78	4.25	5.33	9.57
EQ ACCOUNT						
Investment Costs						
ER First Costs	$28,829,000			$75,716,000		
Interest During Construction	$4,344,972			$11,411,561		
Total	**$33,173,972**			**$87,127,561**		
Average Annual Cost (Rounded)	**$1,320,000**			**$3,467,000**		
NED Loss (Recreation)	**$212,000**			**$212,000**		
Total NER Costs	**$1,532,000**			**$3,679,000**		
Average Annual Habitat Units	**48,508**			**48,308**		
Cost per Habitat Unit	**$32**			**$76**		
NED ACCOUNT - RECREATION						
Investment Costs						
Recreation First Costs	$6,314,000			$6,314,000		
Interest During Construction	$89,932			$89,932		
Total	**$6,403,932**			**$6,403,932**		
Average Annual Cost	**$254,800**			**$254,800**		
Annual Recreation Benefits	**$290,600**			**$290,600**		
Net Annual Recreation Benefits	**$35,800**			**$35,800**		
Recreation B/C Ratio	**1.14**			**1.14**		
TOTAL - ALL ACCOUNTS						
Investment Costs						
Total First Costs	$111,300,000			$173,900,000		
Interest During Construction	$7,958,582			$15,752,190		
Total	**$119,258,582**			**$189,652,190**		
Average Annual Cost	**$5,495,800**			**$8,296,800**		

ADDENDUM A – Without Project Exceedance Probability/Damage Functions

The following table and figures present without project exceedance probability/damage functions under low, intermediate and high sea level scenarios. Note that the damages presented below reflect adjustments to the structure inventory each decade to account for structure relocations. Also, these damages are based upon water surface elevations resulting from/assuming levee failure. The HEC-FDA model applies the damage functions only in simulations resulting in levee failures during the Monte Carlo simulation process.

Table 32: Without Project Exceedance Probability Damage Functions

South San Francisco Shoreline Without Project Conditions Exceedance Probability/Damage Functions ($1,000s) Low Sea Level Rise Scenario						
ACE	**2017**	**2027**	**2037**	**2047**	**2057**	**2067**
10.0%	$ 89,177	$ 75,663	$ 76,824	$ 73,050	$ 74,428	$ 77,801
4.0%	$ 106,073	$ 91,954	$ 93,008	$ 88,643	$ 89,590	$ 93,009
2.0%	$ 115,109	$ 102,422	$ 103,865	$ 100,474	$ 102,918	$ 107,474
1.0%	$ 128,995	$ 115,303	$ 117,356	$ 114,572	$ 117,501	$ 122,510
0.2%	$ 160,635	$ 147,319	$ 149,376	$ 146,059	$ 148,265	$ 166,818
EAD	$ 11,356	$ 8,500	$ 10,280	$ 10,109	$ 11,134	$ 13,454

South San Francisco Shoreline Without Project Conditions Exceedance Probability/Damage Functions ($1,000s) Intermediate Sea Level Rise Scenario						
ACE	**2017**	**2027**	**2037**	**2047**	**2057**	**2067**
10.0%	$ 89,177	$ 80,556	$ 80,881	$ 83,978	$ 64,283	$ 75,291
4.0%	$ 106,073	$ 97,197	$ 94,996	$ 101,780	$ 84,076	$ 97,366
2.0%	$ 115,109	$ 106,964	$ 106,961	$ 117,187	$ 98,687	$ 111,207
1.0%	$ 128,995	$ 119,972	$ 128,278	$ 132,299	$ 111,810	$ 123,353
0.2%	$ 160,635	$ 155,323	$ 155,605	$ 160,105	$ 134,996	$ 144,557
EAD	$ 11,356	$ 10,075	$ 12,654	$ 15,000	$ 17,052	$ 28,223

South San Francisco Shoreline Without Project Conditions Exceedance Probability/Damage Functions ($1,000s) High Sea Level Rise Scenario						
ACE	**2017**	**2027**	**2037**	**2047**	**2057**	**2067**
10.0%	$ 89,177	$ 97,626	$ 104,058	$ 97,487	$ 57,220	$ 75,973
4.0%	$ 106,073	$ 115,963	$ 127,657	$ 115,715	$ 66,860	$ 88,617
2.0%	$ 115,109	$ 132,258	$ 143,181	$ 125,528	$ 75,221	$ 101,799
1.0%	$ 128,995	$ 147,319	$ 155,312	$ 135,127	$ 82,555	$ 115,534
0.2%	$ 160,635	$ 173,880	$ 176,623	$ 158,304	$ 106,864	$ 152,069
EAD	$ 11,356	$ 19,884	$ 32,221	$ 37,212	$ 25,829	$ 41,943

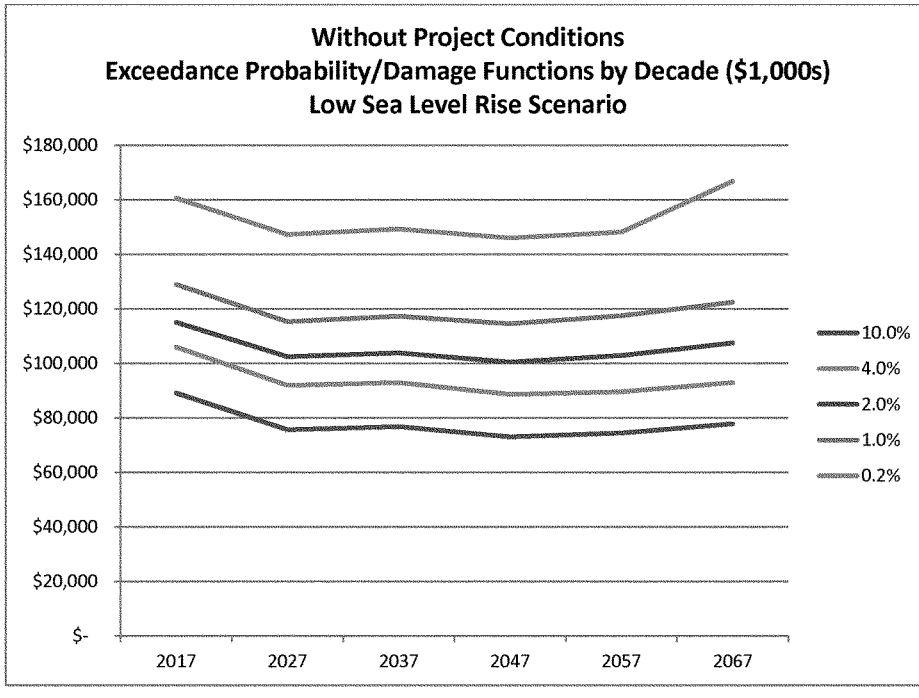


Figure 31: Without Project Exceedance Probability Damage Functions, Low SLR Scenario

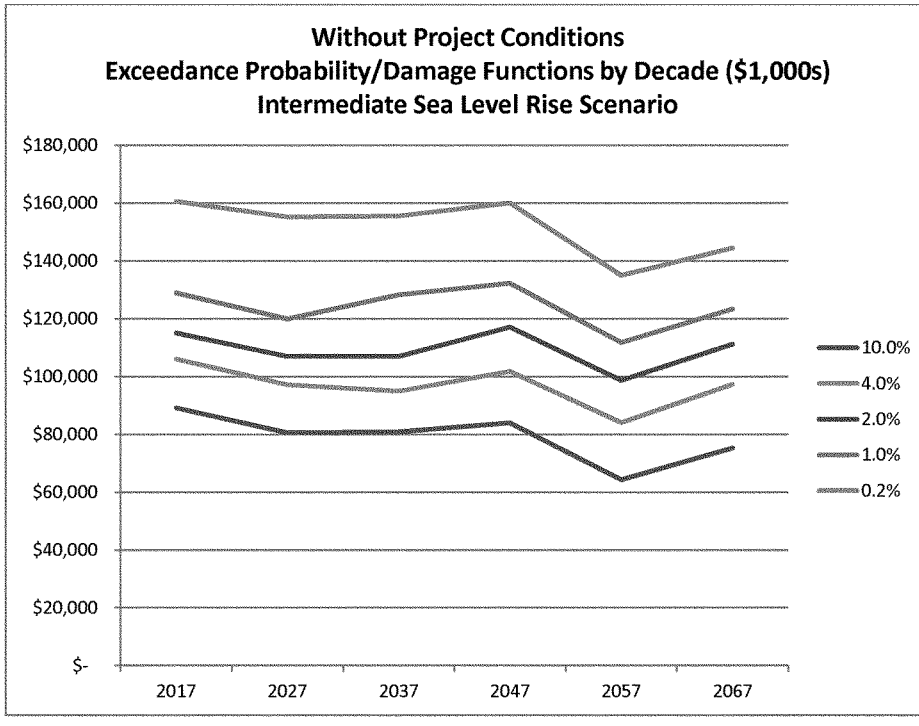


Figure 32: Without Project Exceedance Probability Damage Functions, Intermediate SLR Scenario

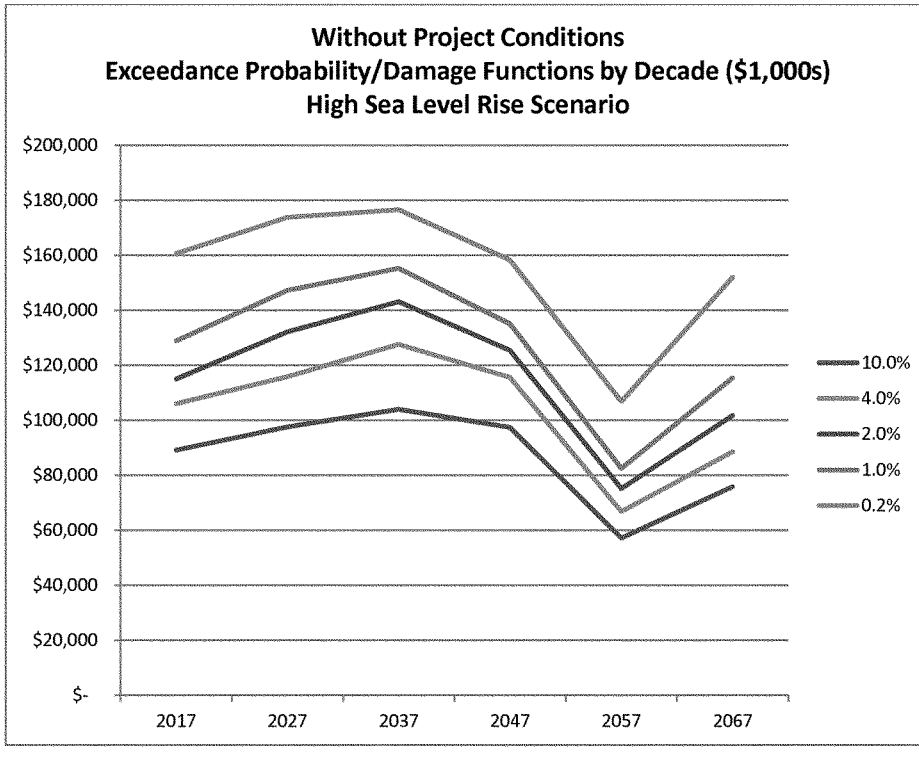


Figure 33: Without Project Exceedance Probability Damage Functions, High SLR Scenario

ADDENDUM B – Sensitivity Analysis: Economic Justification & Levee Failure Probability

As shown in this Economic Appendix, there is a very strong economic justification for the construction of a levee to reduce the risk of flooding in the study area. The strong justification is in large part the result of the finding that there is currently a high annual likelihood of flooding in the study area. The most uncertain of the inputs to the estimation of the likelihood of flooding in the study area is the likelihood of failure of the outer dike, which is incorporated in the FDA model as the without-project levee failure function. Because of the uncertainty, an obvious and useful sensitivity analysis is to determine how changes to the levee failure function affect project economic justification. The following presents the results of this sensitivity analysis.

Summary of Existing Dike-Pond System Performance

The FDA program produces what it calls "performance statistics" that are an indicator of the likelihood of damaging flood events under both the without- and with-project conditions. When levees (or dikes) are present that have some likelihood of geotechnical failure (as is the case under the without-project condition), the project performance is computed based on the joint probability of annual exceedance and probability of geotechnical failure – breach or overtopping of the levee is thus the Target Stage referenced in the development of the performance statistics. Table 33 below shows the performance results for the existing dike-pond system in the year 2017. The Annual Exceedance Probability is the likelihood that a damaging flood event will occur in any given year, the Long-Term Risk is the risk of damaging event over some defined period of time for a particular water surface profile, and the Conditional Non-Exceedance Probability is the likelihood that the damages would not occur as the result of a particular exceedance probability event. According to the FDA model, beginning in 2017 there is about a 32% chance of a damaging flood event in any given year. Figure 34 shows how likely it is to have one or more damaging flood events over different periods of time.

Table 33: Performance Statistics for Existing Dike-Pond System at 2017

Stream Name	Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
		Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
SSFS - Alviso	levee	0.3203	0.3211	0.9792	1.0000	1.0000	0.5272	0.3810	0.3528	0.2954	0.1950	0.1331

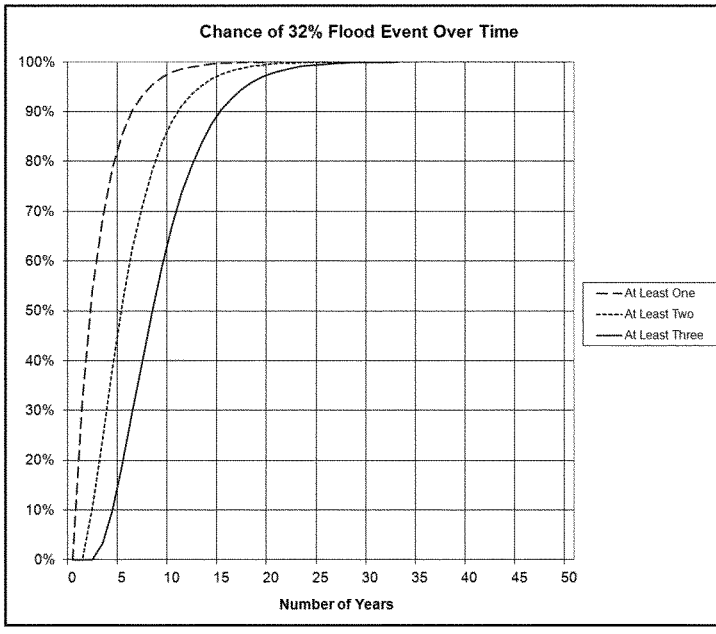


Figure 34: Binomial Distribution of Multiple Flood Events over Time Beginning 2017

The without-project performance of the dike-pond system changes over time with sea-level rise, and the performance varies by scenario. Table 34 below shows the performance statistics at the end of the period of analysis (2066) under the intermediate SLR scenario. Under any of the future scenarios considered the risk increases in the future. Table 34 shows that, according to the flood damage analysis, by 2066 the annual likelihood of a damaging flood event is essentially a coin flip, and over a ten-year period the chance of a damaging flood event is a virtual certainty.

Table 34: Performance Statistics for Existing Dike-Pond System at 2066 (Intermediate SLR Scenario)

		Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Stream Name	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	4%	2%
SSFS - Alviso	levee	0.5339	0.5325	0.9995	1.0000	1.0000	0.2960	0.1283	0.0734	0.0541	0.0363	0.0246

Modifications to Levee Failure Curve

The uncertainty in the levee failure function is greater at the lower elevations, and so for this sensitivity analysis an adjustment was made to the probability of failure near the bottom of the levee – between 7' and 10'. The probability of failure was set to zero between above 7' and below 10'. At and above 10' the probability of failure was unchanged from the expected value curve as described previously. Altering the failure curve at the lower elevation to this degree is simply an adjustment that was made for purposes of understanding the sensitivity of the economic justification to the changes in the failure curve; the adjusted curve is not an alternative to what the USACE engineers consider is the most likely relationship between water elevation and probability of levee failure. The two curves are shown in Figure 35 below for comparison's sake.

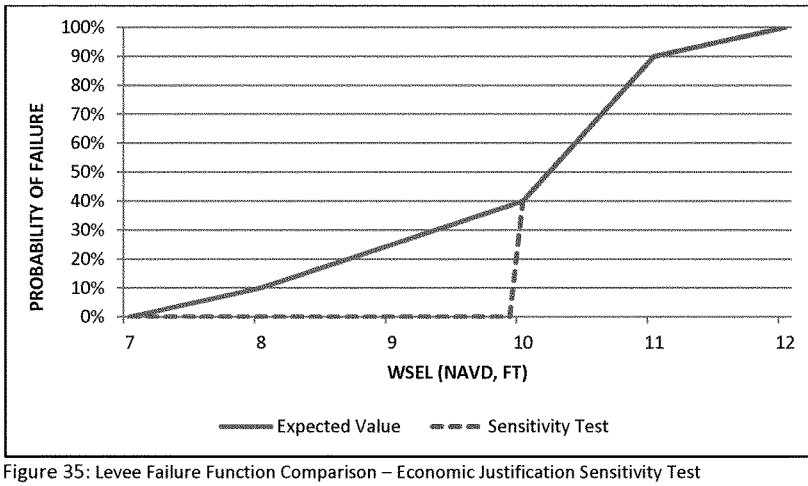


Figure 35: Levee Failure Function Comparison – Economic Justification Sensitivity Test

Sensitivity Analysis Results

For the sensitivity analysis, the without-project FDA models for the low sea-level rise scenario were altered to include the adjusted levee failure function. As a result of the significant decrease in the risk of flooding, the sensitivity analysis assumed no relocations would occur. The tables below show the results of this sensitivity analysis.

As Table 35 below shows, the change to the failure function reduces the annual likelihood of damage from 32% (see Table 33) at 2017 to 7%. However an AEP of 7% is still significant and would almost certainly lead to failure over the fifty-year period of analysis.

Table 35: Without-Project Performance with Adjusted Failure Function

Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
	Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
levee	0.0689	0.0727	0.5298	0.8960	0.9770	0.6618	0.3999	0.3567	0.2929	0.1939	0.1311

Table 36: Sensitivity Test Results - Economic Justification (October 2013 Price Levels)

Without-Project Equivalent Annual Flood Damage (1,000s)											
Structure & Content Damage	$8,688										
Relocation Cost	$756										
Total	$9,443										
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)											
	No Action	10.5' Levee	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$9,443	$6,244	$2,418	$1,123	$84	$17	$6	$3	$1	$0	$0
Annual Damages Reduced	$0	$3,199	$7,026	$8,320	$9,359	$9,427	$9,438	$9,441	$9,442	$9,443	$9,443
Project Costs (1,000s)											
Project Cost	$0	$56,611	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
IDC	$0	$2,939	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$59,550	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,537	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,924	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results											
Annual Net Benefits	**$0**	**$275**	**$4,031**	**$5,255**	**$6,224**	$6,240	**$6,199**	**$6,117**	**$6,033**	**$5,851**	**-$8,662**
Benefit-to-Cost Ratio	**N/A**	**1.09**	**2.35**	**2.71**	**2.98**	2.96	**2.91**	**2.84**	**2.77**	**2.63**	**0.52**

As Table 36 above shows, the without-project damages decreased by nearly 50% compared to the damages under the low SLR scenario when using the expected probabilities for outer dike failure. However, as the results table shows, even under the low SLR scenario the levee project is still strongly justified with the adjusted failure function. Including some consideration of structure relocations would not materially change the results because of the offsetting effects of repeated flood damages or high relocation cost. These results reflect a lower bound as far as economic justification with a modification to the levee failure function, since they are based upon the low SLR scenario. Since without project damages and with project benefits are higher under the intermediate and high SLR scenarios, conducting this same sensitivity analysis on those scenarios would yield higher net benefits and benefit/cost ratios than those shown in the table above.

Appendix D

Hydrology and Hydraulics

September 2015

(revised December 2015)

Appendix D1

Coastal Engineering and Riverine Hydraulics Summary

US Army Corps of Engineers

SOUTH SAN FRANCISCO BAY SHORELINE STUDY PHASE 1, ALVISO ECONOMIC IMPACT AREA

Appendix D1 (to the Final South San Francisco Bay Shoreline Study Feasibility Study and Environmental Impact Statement): Coastal Engineering and Riverine Hydraulics Summary

3 June 2015

U.S. Army Corps of Engineers

San Francisco District

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ACRONYMS

ACE	Annual Chance of Exceedance
ADH	ADaptive Hydraulics Modeling system
AEHW	Annual Extreme High Water level
CDF	Cumulative Distribution Function
CEPD	Comprehensive Evaluation of Project Datums
cfs	cubic feet per second
DDR	Design Documentation Report
DTM	Direct Transfer Method
EAD	Equivalent (or Expected) Annual Damage
EC	Engineer Circular
EM	Engineer Manual
ENSO	El Nino-Southern Oscillation
ER	Engineer Regulation
HEC-FDA	Hydrologic Engineering Center-Flood Damage reduction Analysis
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HEC-SSP	Hydrologic Engineering Center-Statistical Software Package
HUC	Hydrologic Unit Code
Ktons/yr	Kilo (thousand) tons per year
LPP	Locally Preferred Plan
MEHW	Monthly Extreme High Water level
MHW	Mean High Water tidal datum
MLLW	Mean Lower Low Water tidal datum
MTL	Mean Tide Level tidal datum
NAVD88	North American Vertical Datum of 1988
NED	National Economic Development
NOAA	National Oceanographic and Atmospheric Administration
NRC	National Research Council
PDO	Pacific Decadal Oscillation
PED	Preconstruction Engineering and Design
RT	Residual Tide
SCC	California State Coastal Conservancy
SCVWD	Santa Clara Valley Water District
SLC	Sea Level Change
SSC	Suspended Solids Concentration
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VE	Value Engineering
WSE	Water Surface Elevation

1 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This report summarizes the water resource engineering analyses required to support the planning and Federal interest determination of a multi-purpose flood risk management, ecosystem restoration, and recreation civil works project in South San Francisco Bay. This project is referred to as the "South San Francisco Bay Shoreline Study Phase 1, Alviso Economic Impact Area", or more generically as the "study" or "study area" in this report [see Figure 1 (South San Francisco Bay Shoreline Interim Study Areas)]. The area considered in the water resource engineering analyses differs from the study area, going further south into the watershed. This area for water resource engineering analyses will be referred to throughout the report as the "hydrologic study area" and is also shown in Figure 1 (South San Francisco Bay Shoreline Interim Study Areas).

This report is written as an appendix to the "Shoreline Phase 1 Study Integrated Interim Feasibility Study and Environmental Impact Statement/Report", also referred to simply as the "Integrated Document". The water resources engineering analyses span a decade of effort (2004 to 2014) and some analyses have been previously released to the public. Where analyses have been previously released to the public, they are referenced in this report as appropriate. Analyses that have not been previously released to the public are included in the main text of this report, or as an annex to this report/appendix to the Integrated Document where applicable. One exception to the unreleased analyses being included in this report is the "Tidal Flood Risk Analysis Summary Report", which is included as its own separate appendix (Appendix F) to the Integrated Document. Significant work has been produced for this project over the last decade and some analyses are not included in the previously released documents, this report, or Appendix F to the Integrated Document; because they have been superseded by other analyses.

1.2 BACKGROUND

The larger shoreline study area was originally studied in the 1980s for the purpose of determining the feasibility of, and Federal interest in, providing flood risk reduction against tidal and tidal-related fluvial inundation for developed areas within the tidal floodplain of San Francisco Bay in southern Alameda and Santa Clara County. The study report (USACE, 1988) recommended no action at that time due to the benefit-to-cost ratios of all alternatives being less than 1.0. Based on Congressional authority in 2002, the San Francisco District reviewed the previous study and determined in September of 2004 (USACE, 2004) that there was now sufficient Federal interest to proceed into the feasibility phase. It was decided to divide the study into four interim studies, due to the very large geographic extent of the shoreline study area. The four interim study areas were designated as the "Alameda County Eden Landing", Alameda County Cargill Ponds", "Santa Clara County Alviso Pond Complex", and "San Mateo County Ravenswood Ponds" (see Figure 1). It was further decided to start with the "Santa Clara County Alviso Pond Complex" interim study area. Technical work on the Santa Clara County Alviso Pond Complex interim feasibility study area progressed from 2004 to 2011, which corresponded with the completion of the USACE Feasibility Scoping Meeting milestone.

In 2011 it was mutually decided by the San Francisco District and the study's local partners (the Santa Clara Valley Water District [SCVWD] and the California State Coastal Conservancy [SCC]) to re-scope the study into a smaller area, to produce a constructible project within a reasonable time and cost. The deaths and damages caused by Hurricanes Katrina and Rita in 2005 re-focused the USACE on making public safety paramount in all USACE future activities, resulting in more stringent enforcement of existing guidance and new guidance from 2006 to present. Some of the additional USACE guidance was of concern to our local partners, as they were not required for the study at its start in 2004. As part of the re-scoping effort, the San Francisco District in partnership with the SCVWD and SCC produced an issue paper (USACE, 2011a), which recommended some changes from accepted practice on some of the USACE guidance. The San Francisco District followed the

technical guidance given in the issue paper from 2011 through the USACE Alternative Formulation Briefing milestone in 2013. These additional technical analyses are described in Appendix F of the Integrated Document (Tidal Flood Risk Analysis Summary Report) and excerpted and referenced herein as appropriate.

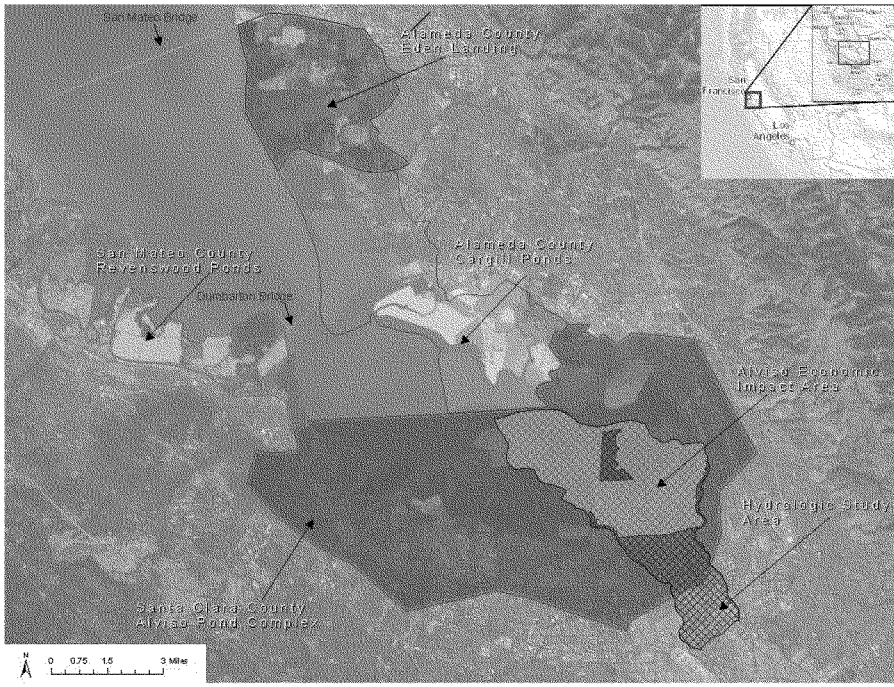


Figure 1. South San Francisco Bay Shoreline Interim Study Areas

The study's technical analyses can therefore be divided into three technical stages as given in Table 1 (The Technical Stages used in the South San Francisco Bay Shoreline Study, Phase 1). One of the significant differences between the technical stages is the treatment of sea level change (SLC). Past and current USACE policy requires that three SLC scenarios be considered when formulating and evaluating plans for a study, and was partially based on the three SLC curves given in (NRC, 1987). Typically, USACE has specified the local historical SLC for the low scenario, NRC I curve (or a modified version) for the intermediate scenario, and NRC III curve (or a modified version) for the high scenario. These National Research Council (NRC) SLC curves are shown in Figure 2-2 of (NRC, 1987); and the curves are based on a quadratic equation with the coefficients given in Table 2-4 of (NRC, 2012). The y-intercept passes through zero based on the start date for the equation; this start date varied depending on the guidance used.

Table 1. The Technical Stages used in the South San Francisco Bay Shoreline Study, Phase 1

Stage	Period	Milestone Reached	Extent - Remarks
Technical Stage I	2004 to 2011	Feasibility Scoping Meeting	Analyses covered the entire blue area in Figure 1.
Technical Stage II	2011 to 2013	Alternative Formulation Briefing	Study re-scoped so that analyses only cover the purple hatched area in Figure 1. Analyses followed guidance given in the issue paper (USACE, 2011a).
Technical Stage III	2013 to 2014	Will be included in the Public Draft Release	Analyses only cover the purple hatched area in Figure 1. Most Technical Stage II analyses were redone to meet USACE sea level change guidance.

For this report, the majority of analyses were updated during Technical Stage III to follow the latest USACE SLC guidance given in ER 1100-2-8162 (USACE, 2013). The SLC curves used during this stage were generated using the website: http://www.corpsclimate.us/ccaceslcurves.cfm. These scenarios are referred to as the USACE Low SLC scenario, USACE Intermediate SLC scenario, and USACE High SLC scenario. However, there are still some analyses being used from the previous technical stages related to the ecosystem restoration (available sediment) aspects of the project. During Technical Stage II, EC 1165-2-212 (USACE, 2011b) was followed and the Modified NRC Curve III was used in modeling the future with-project condition (see Annex 3 of this report). During Technical Stage I, (Brown, 2010) used the NRC I curve for his modeling and sediment budget analyses. The (Brown, 2010) and Annex 3 analyses were not updated to the latest SLC guidance because the uncertainty in future habitat change represents a larger uncertainty than the slight changes in SLC rates between the various guidance used. A summary of the SLC scenarios and nomenclature used in this report is given in Table 2.

With the completion of Technical Stage III, all water resources engineering technical work have been completed. All of the water resources engineering analyses needed for determination of a Federal interest and recommendation of a tentatively selected plan are now complete as of the release date of this report. No further water resources technical work is expected on this project until the Preconstruction Engineering and Design (PED) phase.

Table 2. Sea Level Change Curves and Nomenclature used in this Study

Equation for SLC Curves: $E(t) = a \times t + b \times t^2$ [ft]				
Reference - Curve	**Stage Used; Scenario/*Curve Name***	**Start date**	**a [ft/yr]**	**b [ft/yr^2]**
Historical Curve	Not Used	1986	0.00676	0
(NRC, 1987) NRC I	Technical Stage I; ***NRC I curve***	1986	0.0039	0.000092
(NRC, 1987) NRC II	Not Used	1986	0.0039	0.000217
(NRC, 1987) NRC III	Not Used	1986	0.0039	0.000344
Historical Curve	Not Used	1992	0.00676	0
(USACE, 2011b) Modified NRC Curve I	Technical Stage II; ***Modified NRC Curve I***	1992	0.0056	0.000089
(USACE, 2011b) Modified NRC Curve II	Not Used	1992	0.0056	0.000230
(USACE, 2011b) Modified NRC Curve III	Technical Stage II; ***Modified NRC Curve III***	1992	0.0056	0.000372
Historical Curve	Technical Stage III; ***USACE Low SLC scenario***	1992	0.00676	0
(USACE, 2013) Modified NRC Curve I	Technical Stage III; ***USACE Intermediate SLC scenario***	Same values as used in (USACE, 2011b), but generated from the website at: http://www.corpsclimate.us/caceslcurves.cfm		
(USACE, 2013) Modified NRC Curve II	Not Used			
(USACE, 2013) Modified NRC Curve III	Technical Stage III; ***USACE High SLC scenario***			

1.3 ORGANIZATION OF THIS REPORT

This report is organized into sections that provide the water resources engineering analyses in a logical order to support the project planning process. The major sections are organized by Existing Condition, Future Without-Project Condition, and Future With-project Condition. Under each major section are subsections based on technical disciplines or physical processes (watershed, hydrology, fluvial hydraulics, tidal hydraulics, and others). The report finishes with a Concluding Remarks section and References. Most of the material in this report comes from the analyses conducted during Technical Stage III, and are excerpted from Appendix F of the Integrated Document (Tidal Flood Risk Analysis Summary Report). Where appropriate material was also excerpted from other documents completed during Technical Stages I and II and other sources. Additional relevant information on analyses that have not been previously released to the public nor excerpted in this report is included in annexes to this report. Annexes 1, 3, and 4 are very large are referenced in this report, but are provided under their own separate cover, due to their size.

2 EXISTING CONDITION

2.1 WATERSHED

The hydrologic study area is contained within the downstream portion of the Coyote watershed and is bordered to the west by the Guadalupe watershed, where the Alviso Slough serves as the border between these two watersheds. The Coyote and Guadalupe watersheds, along with three other watersheds, all drain into South San Francisco Bay and make up the Coyote cataloging unit with the eight-digit USGS Hydrologic Unit Code (HUC) of 18050003. The HUC cataloging units are sometimes also referred to as watersheds. To avoid confusion throughout this report any reference to the Coyote watershed refers to the watershed and not the Coyote cataloging unit. The Coyote watershed drains approximately 325 square miles into San Francisco Bay.

The valley floor of the watershed once consisted of broad alluvial fans that were formed as streams emerged from the foothills, flattened, slowed and spread out, dropping out unconsolidated material. The watershed can now be characterized as a primarily flat valley area adjacent to San Francisco Bay, which has undergone rapid and extensive urbanization. The upstream foothills have undergone minor low density urbanization, while the steep mountainous regions have remained mostly rural, open space.

2.2 HYDROLOGY

Coyote Creek (eastern border) and Guadalupe River (Alviso Slough – western border) define the hydrologic boundaries of the hydrologic study area. The hydrology for these streams is derived from (USACE, 1977). This is the same hydrologic analysis used in the USACE's flood risk reduction projects. The 1977 results were updated for the year 2010 conditions for both Guadalupe River and Coyote Creek as described in the following paragraph. In November 2009 the District completed the Guadalupe Watershed Hydrologic Assessment (USACE, 2009) . The 2009 study updated the study methodology and results of the 1977 hydrology. The 2009 study results were found to be similar to the 1977 report. The peak discharge at the San Jose gage (USGS gage #11169000) for the 1% annual chance exceedance (ACE) event was estimated at 17,967 cubic feet per second [cfs] in 2009 and 17,000 cfs in the 1977 report, a 6% difference. The 2009 results are estimated for full built-out conditions. Since the difference in flow rates from 1977 to 2009 are so small, less than 10%, the changes in flow are not expected to change the results of the Guadalupe River hydraulics. The peak flood discharges for Guadalupe River, Coyote Creek, and Lower Penitencia Creek are shown in Table 3 (Guadalupe River, Coyote Creek, and Lower Penitencia Creek Peak Discharges). The hydrologic analyses reflect build-out conditions for each of the watersheds.

Table 3. Guadalupe River, Coyote Creek, and Lower Penitencia Creek Peak Discharges [cfs]

Location	Drainage Area [sq. mi.]	Percent Chance Exceedance / Peak Discharge [cfs]							
		50.0%	20.0%	10.0%	4.0%	2.0%	1.0%	0.4%	0.2%
Guadalupe River at San Jose (USACE, 1977)	144	2,700	4,500	6,700	9,700	13,500	17,000	21,000	32,000
Guadalupe River at San Jose (USACE, 2009)	146	3,317	6,059	7,712	10,463	14,251	17,967	22,431	27,942
Coyote Creek at Highway 237 (USACE, 1977)	321	3,300	6,200	8,400	10,500	13,000	14,500	16,000	18,000
Lower Penitencia Creek at Coyote Creek (NHC, 2006)	29	2,480	3,640	4,310	5,900	6,980	8,720	10,790	12,080

The hydrology presented above assumes that all of the flow is contained within the channel. This statement assumes that each creek contains the 50% thru the 0.2% Annual Chance Exceedance (ACE) flood events to the study limits. However, this does not represent the conditions out in the field. Where existing information was available the upstream channel capacities were taken into account and used in the Year 0 (2017) hydraulic

analysis. The creeks where upstream capacity restrictions affect the Year 0 hydrology are presented in Table 4 (Guadalupe River and Coyote Creek Hydrology Based on Capacity Limitations) below. Comparing Table 3 and Table 4 shows that only the largest flow event (0.2%) differ at these locations, due to breakout of the flow upstream of the these locations.

Table 4. Guadalupe River and Coyote Creek Hydrology Based on Capacity Limitations [cfs]

Location	Drainage Area [sq. mi.]	Percent Annual Chance Exceedance / Peak Discharge [cfs]							
		50.0%	20.0%	10.0%	4.0%	2.0%	1.0%	0.4%	0.2%
Guadalupe River at San Jose	144	2,700	4,500	6,700	7009	13,500	17,000	21,000	24,050
Coyote Creek at Highway 237	320.89	3,300	6,200	8,400	10,500	13,000	14,500	16,000	17,000

Guadalupe River flow is lost between Los Gatos Creek and Hwy 880; 8,500-cfs is lost to the left flood plain and the channel capacity at Interstate highway 880 will be 24,050 cfs [see (USACE, 1991)]. The reduction of flow on Coyote Creek is limited to 17,000 cfs in the vicinity of Rock Springs Road; this is due to the loss of flow from the basin in the Canoas Creek area upstream [see (USACE, 2001)].

2.3 FLUVIAL HYDRAULICS

The two watercourses bordering the hydrologic study area are Coyote Creek and Guadalupe River (Alviso Slough). Both watercourses have had flood risk reduction projects constructed on them, with levels of performance to contain the 1-percent Annual Chance Exceedance (1% ACE) flood event, or equivalently known as a 100-year return period flood event. Existing conditions for events less than the 1% ACE are therefore contained within the watercourses. Events exceeding the 1% ACE were first modeled and calibrated using steady flow HEC-RAS models, which were subsequently modified to unsteady HEC-RAS models to determine breakout locations along the watercourses. A coincident frequency analysis was performed to determine the effects of coincidence of the peak tide and peak stream discharge and to determine the downstream boundary water surface levels. The coincident frequency analysis predicted the downstream boundary condition, influenced by tidal stage, for the unsteady HEC-RAS models. Breakout hydrographs from the unsteady HEC-RAS models were then used to model floodplain inundation using FLO-2D. Downstream boundary elevations from the coincidence frequency analysis and breakout peak outflow rates and volumes are presented in Table 5 (Existing Downstream Boundary Elevations and Peak Outflow Rates and Volumes). See Annex 1 of this report for more technical details related to the modeling efforts.

2.3.1 COYOTE CREEK

Coyote Creek originates in the Diablo Mountain Range and flows in a northeasterly direction though the cities of Morgan Hill, San Jose, and Milpitas before flowing into the San Francisco Bay. Coyote Creek is bounded by the Guadalupe River Watershed on the west and by the Diablo Mountain Range on the east. The USACE and the SCVWD built a flood risk reduction system on the lower portion of Coyote Creek. The USACE (Sacramento District) designed and built the reach upstream of Highway 237 and the SCVWD designed and built the reach downstream of Highway 237. The SCVWD is currently studying the upper portion of Coyote Creek, upstream of Montague Expressway; there may be other flow breakout locations in the upper Coyote Creek during flood events.

The Coyote Creek flood risk reduction project was designed to prevent flooding for a 1% ACE flood event downstream of Interstate Highway 880. The project consists of a bypass channel with levees, and alternate side overflow channels with offset levees and crossovers. During low flows the flows move along the natural channel to the bay. However during high flow events, the lower Coyote Creek bypass moves flood waters to the bay, bypassing the natural channel, just upstream of Lower Penitencia Creek. Flood flows from lower Coyote Creek

spill into both the left (west) and right (east) floodplains. All of the flow breakout locations are concentrated downstream from Interstate highway 880 in the vicinity of Charcot Avenue. Overland flows occur in wide bands through predominantly commercial and industrial areas. On the left floodplain, the ground surface slopes away from Coyote Creek toward Guadalupe River. As a result, overland flows travel westerly and then northwesterly away from the creek. On the right floodplain, overland flows travel north between the Coyote Creek channel and Interstate Highway 880. The flow frequency curve for Coyote Creek at Highway 237 is given in Plate 17, coincident frequency (stage versus exceedance probability) results are given in Plate 43b, and the 0.2% ACE flood inundation map is shown in Plate 50, all of Annex 1 of this report (Riverine Hydraulics).

2.3.2 GUADALUPE RIVER (ALVISO SLOUGH)

Guadalupe River originates in the Santa Cruz Mountains and flows directly into San Francisco Bay, via Alviso Slough. The Guadalupe River basin is characterized by steep slopes in the mountains with a large, wide valley. The valley area is relatively flat and highly urbanized. The river flows though the heart of Silicon Valley and downtown San Jose. The drainage basin is approximately 160 square miles and 144 square miles at the confluence with Los Gatos Creek. Major tributaries to Guadalupe River include the Los Gatos Creek, Canoas Creek, Ross Creek, and Alamitos Creek watersheds.

The USACE downtown Guadalupe River flood risk reduction project includes approximately 2.5 miles of channel improvements and recreation trail for the reach of Guadalupe River between Interstate Highway 880 adjacent to downtown San Jose. This project was designed to prevent flooding for a 1% ACE flood event. Similarly, the SCVWD's Lower Guadalupe River flood risk reduction project was constructed to contain the 1% ACE flood event and runs from Interstate Highway 880 to the bay.

The 0.5% and 0.2% ACE flood events will cause overland inundation of the floodplains. The 0.2% ACE flood event will cause widespread overland inundation on both left and right floodplains along Lower Guadalupe River. Overbank outflows from the river into the left (west) floodplain occur at two locations and into the right (east) floodplain at four locations. Left-side breakouts are located at San Jose International Airport and downstream of Montague Expressway. Right-side breakouts are all located between Montague Expressway and Tasman Drive. Flooded areas on the left floodplain include northern part of San Jose International Airport, residential and commercial areas generally located between Guadalupe River and Lafayette Street, as well as commercial and open areas in the vicinity of Highway 237; while on the right floodplain overland waters pond at Highway 237, spill over the highway between 1st Street and Zanker Road, inundate a vast area north of Highway 237 and pond behind high levees surrounding salt ponds. No water spills into the baylands from either floodplain. During the 0.2% ACE flood event, the maximum inundated area on the left floodplain is 739 acres, the mean inundation depth is 2.05 feet, and the maximum inundation depth is over 10 feet, with one isolated area at the airport deeper than 20 feet. The maximum area of inundation on the right floodplain is 1,233 acres, the mean inundation depth is 2.14 feet, and the maximum inundation depth is over 13 feet. The total inundated area (including both the left and right floodplains) is 1,972 acres.

The 0.5% ACE flood event causes localized flooding on the left (west) floodplain between the breakout location at the airport and Highway 101. The maximum overland inundation area is 42 acres, the mean inundation depth is 1.54 feet, and the maximum inundation depth is almost 20 feet.

The flow frequency curve for Guadalupe River in San Jose is given in Plate 16, coincident frequency (stage versus exceedance probability) results are given in Plate 43d, and the 0.2% ACE flood inundation maps are shown in Plates 54 and 55, of Annex 1 of this report (Riverine Hydraulics).

2.3.3 TABLE OF EXISTING BOUNDARY AND PEAK OUTFLOW CONDITIONS

Table 5. Existing Downstream Boundary Elevations and Peak Outflow Rates and Volumes*

Location	River Location	Percent Chance Exceedance / Elevation [ft NAVD88]							
		50%	20%	10%	4%	2%	1%	0.4%	0.2%
Coyote Creek	73 + 65	9.48	10.64	11.28	11.90	12.58	12.99	13.35	13.57
Guadalupe River	244 + 81	9.30	11.16	12.26	13.02	13.69	14.16	14.63	14.75

Breakout Location	Breakout Station	0.5%		0.2%	
		Flow [cfs]	Volume [ac-ft]	Flow [cfs]	Volume [ac-ft]
Coyote (East)	779+02	0	0	67	50
Coyote (West)	779+02	7	3	97	78
Guadalupe (East)	332+00	7	0.5	350	520
Guadalupe (East)	338+94	7	0.5	350	520
Guadalupe (East)	372+40	7	0.5	350	520
Guadalupe (East)	396+02	7	0.5	350	520
Guadalupe (West)	385+02	0	0	134	190
Guadalupe (West)	535+70	160	40	800	1200

*Data taken from Tables 21 and 24 of Annex 1 of this report (Riverine Hydraulics).

2.4 TIDAL HYDRAULICS

Tides and tide ranges are highly variable through the length of San Francisco Bay. Tides move through the narrow opening at the Golden Gate Bridge but are modified by bottom bathymetry, the shoreline, and the earth's rotation as they propagate throughout the San Francisco Bay estuary. Tides in San Francisco Bay are mixed semidiurnal, with two high and two low tides of unequal heights each day. The tides exhibit strong spring-neap variability, with the spring tides (larger tidal range) occurring approximately every two weeks during full and new moons. Neap tides (smaller tidal range) occur approximately every two weeks during the moon's quarter phases. The tides also vary on an annual cycle in which the strongest spring tides occur in late spring and early summer and then late fall and early winter (which may be commonly referred to by the public as king tides), and the weakest neap tides occur in spring and fall.

The South San Francisco Bay area (South Bay) has elevated tides relative to the Pacific Ocean and the rest of San Francisco Bay. The maximum tide levels generally increase with distance southward. As the tides propagate from the Pacific Ocean into San Francisco Bay, in the form of shallow water waves, the tide amplitudes and phases are modified by bathymetry, reflections from the shores, the earth's rotation and bottom friction. The enclosed nature of the bay creates a mix of progressive and standing-wave behavior for tides, meaning these waves are reflected back on themselves (Walters, et al., 1985), causing an amplification of the tides and an increase in tidal range with distance from the Golden Gate Bridge. The addition of the reflected wave to the original wave increases the tidal amplitude. Amplification causes the tidal range in the South Bay to increase southward as shown in Figure 2 (Tidal Ranges in South San Francisco Bay based on the last two National Tidal Datum Epochs). The tide range increases from 5.84 feet at the San Francisco tide gage to 9.28 feet at the Alviso Slough tide gage.

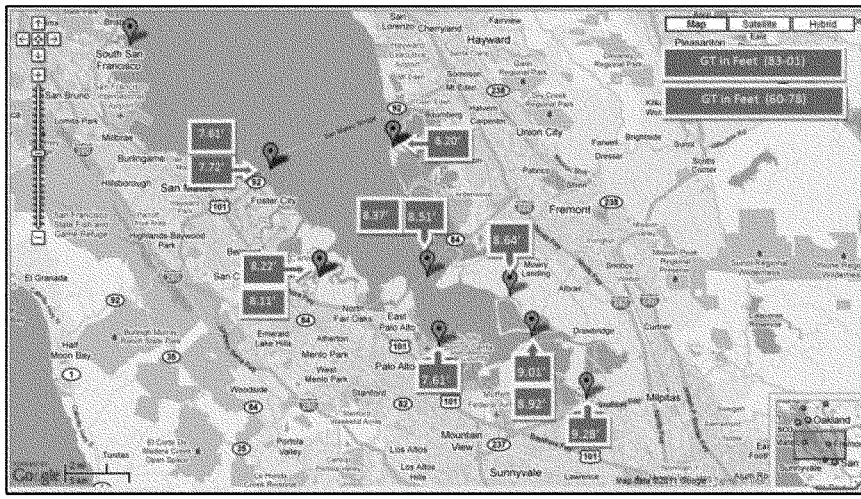


Figure 2. Tidal Ranges in South San Francisco Bay based on the last two National Tidal Datum Epochs

Tidal flood hazard analysis requires not only knowledge of astronomical tides, but also knowledge of residual tides. The residual tide is the difference between the measured water surface elevation and the water surface elevation predicted from the astronomical tide. Residual tides are commonly caused by storm events consisting of atmospheric pressure events or wind set-up. Storm events in San Francisco Bay commonly have durations of one to three days. Wind wave effects are not included in the residual tides, as they are higher frequency events that are filtered out of the tidal record.

The following subsections describe the available tidal data for San Francisco Bay, conversion of selected tidal data to the hydrologic study area, calculation of extreme water level statistics, and variability of the extreme water level statistics. The majority of information in this section comes from Appendix F of the Integrated Document (Tidal Flood Risk Analysis Summary Report); supplemented by Annexes 2 through 4 of this report (Documentation of Storm Data analysis, South San Francisco Bay Long Wave Modeling Report, and Monte Carlo Simulation Report), and [(Brown, 2010), (Sediment Analysis and Modeling for the South San Francisco Bay Shoreline Study)].

2.4.1 SAN FRANCISCO BAY TIDE DATA

There are approximately twenty active and historic water level (tide gages) measurement locations within San Francisco Bay. Tide data from two gages within the bay are used in this study (see Figure 3 (Water Level Stations used in this study)). The Coyote Creek gage (Station ID 9414575) is the closest gage to the hydrologic study area, but has a very short record length. The San Francisco gage (Station ID 9414290) has the longest continuous tide record in the United States, but is located over thirty miles from the hydrologic study area. Sections 2.4.2 (Tide Data Transfer to Hydrologic Study Area) and 2.4.3 (Extreme Water Level Statistics at the Hydrologic Study Area) describe how these two stations were used to develop the tidal data for the hydrologic study area.

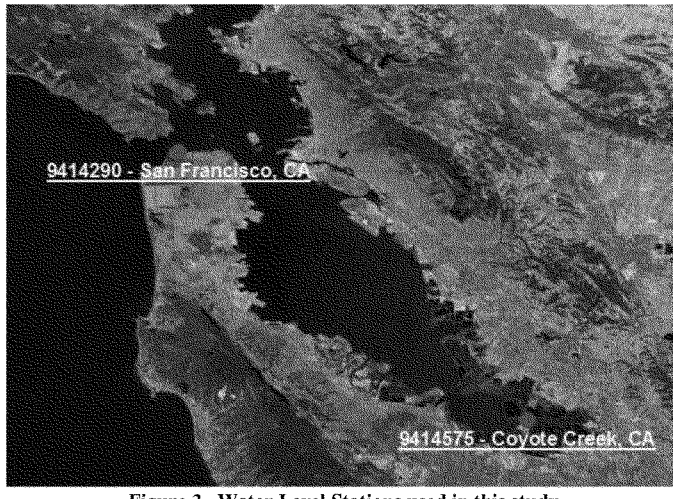


Figure 3. Water Level Stations used in this study

105 years (1901 to 2005) of tide data from the San Francisco tide gage was used to identify significant storms (residual tides) and separate them from the astronomical tides. Over 500 high-water events were identified, from which forty-seven historical storm events were used to determine residual tide statistics (see Annex 2 and Figure 4). Other statistical results were also calculated from the San Francisco gage (see Appendix F (Tidal Flood Risk Analysis Summary Report) and Annex 2 (Documentation of Storm Data analysis, South San Francisco Bay Long Wave Modeling Report)). A comparison of vertical datum information between the San Francisco gage and the Coyote Creek gage is given in Table 6 (Comparison of Vertical Datum Information between the San Francisco and Coyote Creek Gages).

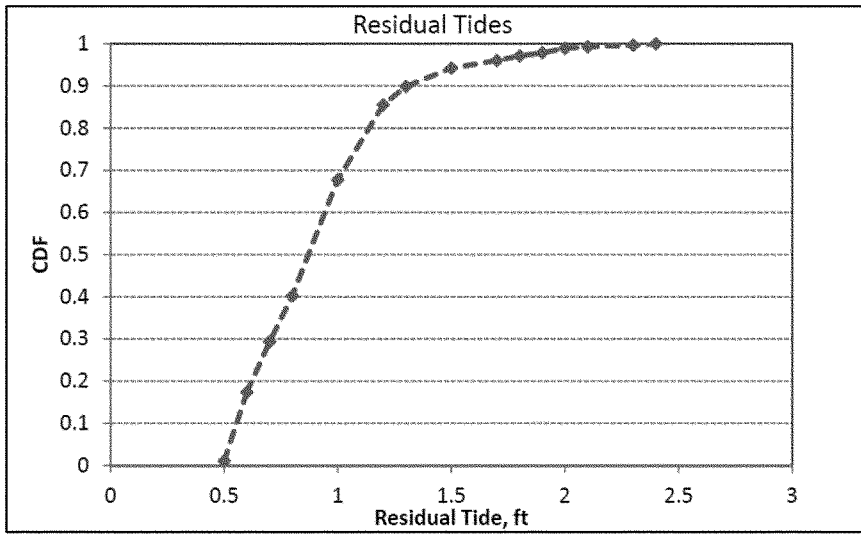


Figure 4. Cumulative Distribution Function for Residual Tides based on 47 events from gage 9414290

The Coyote Creek tide gage has been used intermittently since November 1974. A temporary National Oceanographic and Atmospheric Administration (NOAA) tide gage was deployed at Coyote Creek, Station ID 9414575, between March and August of 2011, and was used to update the tidal datum. The Mean Lower Low Water (MLLW) datum plane for the Coyote Creek tide gage was referenced to the North American Vertical Datum of 1988 (NAVD88), with some uncertainty due to difficulty in obtaining low water readings from the water level gages surveyed. The uncertainty in water surface flood elevations due to the Coyote Creek tidal datum conversion to NAVD88 has been recognized and accounted for in the water surface elevations developed for existing conditions. The project vertical datum must be the latest vertical reference frame of the National Spatial Reference System, currently NAVD88, to be held as constant for tide station comparisons, and a project datum diagram must be prepared per EM 1110-2-6056 (USACE, 2010). The Coyote Creek tide gage datum adjustment to NAVD88 will be reassessed in the PED phase, and adjustments will be made to design and other key information accordingly. A comparison of vertical datum information between the San Francisco gage and the Coyote Creek gage is given in Table 6 (Comparison of Vertical Datum Information between the San Francisco and Coyote Creek Gages).

Table 6. Comparison of Vertical Datum Information between the San Francisco and Coyote Creek s

Vertical Datum	San Francisco Gage ID 9414290 [ft NAVD88]	Coyote Creek Gage ID 9414575 [ft NAVD88]
Highest Observed Water Level (27-JAN-1983)	8.72	N/A
Mean Higher High Water	5.90	7.64
Mean High Water	5.29	6.99
Mean Tide Level	3.24	3.48
Mean Sea Level	3.18	N/A
North American Vertical Datum of 1988	0.00	0.00
Mean Low Water	1.19	-0.07
Mean Lower Low Water	0.06	-1.35
Lowest Observed Water Level (17-DEC-1933)	-2.82	N/A

2.4.2 TIDE DATA TRANSFER TO HYDROLOGIC STUDY AREA

Two methods were used to transfer tide data from the San Francisco tide gage to the hydrologic study area. The first approach employed a direct transfer method between the San Francisco to Coyote Creek tide gages, where the Coyote Creek tide gage is used to represent hydrologic study area tidal conditions. The second approach used a numerical model of the San Francisco Bay – Sacramento-San Joaquin Delta system (UnTRIM Bay-Delta model, see Annex 3 (South San Francisco Bay Long Wave Modeling Report)), using twelve synthetic storm events to produce look-up tables at twenty-three predefined locations within the hydrologic study area. The look-up tables were then used as input into a Monte Carlo Simulation (MCS) program (see Annex 4 (Monte Carlo Simulation Report)) to determine water level statistics at the hydrologic study area from the San Francisco tide gage boundary condition/input. The numerical model – MCS approach was not used in the final analysis, due to changes in the geotechnical assumptions in the model and the significant increase in time and costs to re-run the simulations.

Extreme water statistics representative of coastal flood risk from high water levels in the South Bay area near the community of Alviso were developed by computing the tidal amplification factor between the predicted (astronomical) tide at the San Francisco tide gage and the Coyote Creek tide gage. Numerical modeling simulations were conducted to evaluate the change in residual tide recorded at the San Francisco tide gage as it propagated into South San Francisco Bay; these simulations indicate that residual tide varied minimally (see Annex 3 (South San Francisco Bay Long Wave Modeling Report)). Tidal residuals (observed – predicted tide) represent storm surge, and are therefore assumed to transfer directly to the South Bay. This method is referred to as the Direct Transfer Method (DTM).

Factors used to amplify the predicted tide at San Francisco are assumed to be linear and were computed by comparing predicted tide at the San Francisco tide gage to predicted tide at the Coyote Creek tide gage. The comparison indicated tidal amplification at Coyote Creek varied with predicted tide water surface elevation at the San Francisco tide gage. Four amplification factors were developed to account for the range of predicted tides, with a focus on the daily higher-high tide and are given in Table 7 (Tidal Amplification Factor from San Francisco to Coyote Creek).

Table 7. Tidal Amplification Factor from San Francisco to Coyote Creek

Predicted Tide Range at San Francisco	Amplification Factor at Coyote Creek
Less than 4.94 feet MLLW	1.9
4.94 to 5.52 feet MLLW	1.6
5.53 to 6.15 feet MLLW	1.5
Greater than 6.15 feet MLLW	1.4

The DTM equations are given by:

$$MT_{CC} = PT_{CC} + RT_{SF} \qquad \text{Equation 1.1}$$

$$PT_{CC} = (PT_{SF} - MTL_{SF}) \times A + MTL_{CC} \qquad \text{Equation 1.2}$$

$$RT_{SF} = MT_{SF} - PT_{SF} \qquad \text{Equation 1.3}$$

where:

MT_{CC} = Estimated Measured WSE at Coyote Creek (NAVD88)
RTSF = Residual Tide at San Francisco
PTCC = Predicted Tide at Coyote Creek
PTSF = Predicted Tide at San Francisco
MTLSF = Mean Tide Level at San Francisco (3.24', MLLW)
A = Amplification Factor, Table 3
MTLCC = Mean Tide Level at Coyote Creek (3.48', NAVD88)
MTSF = Measured WSE at San Francisco (MLLW)

Comparison of the derived water levels at Coyote Creek from the predicted daily higher-high tides at San Francisco showed good agreement, as seen in Figure 5 (Comparison of DTM Transferred WSE to Measured WSE at Coyote Creek) below.

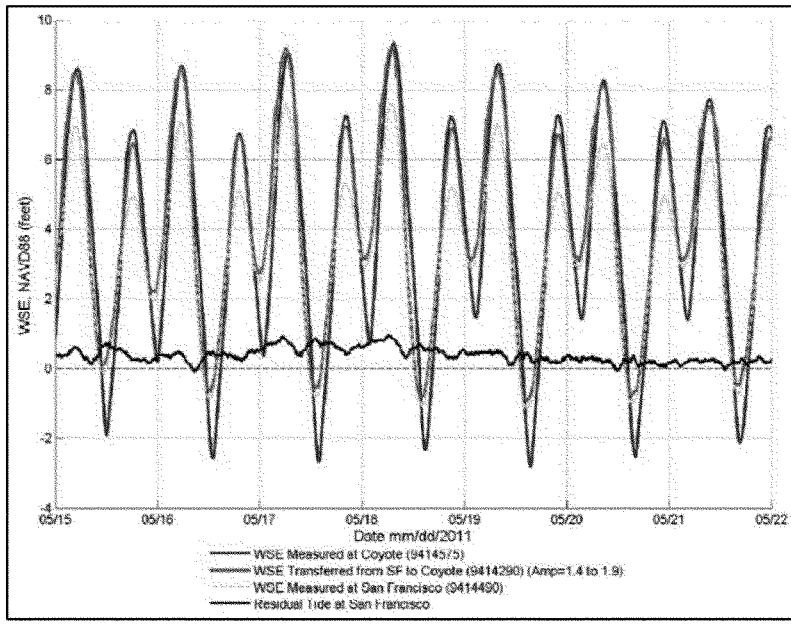


Figure 5. Comparison of DTM Transferred WSE to Measured WSE at Coyote Creek

2.4.3 EXTREME WATER LEVEL STATISTICS AT THE HYDROLOGIC STUDY AREA

Extreme water level statistics are calculated based on the DTM described in Section 2.4.2 (Tide Data Transfer to Hydrologic study area), by first computing the extreme water level statistics at the San Francisco tide gage, then applying the DTM to produce the derived Coyote Creek statistics. The results were computed using a 1992 base year, as the mid-point on which the time series data is detrended. The 1992 results are then progressed to Year 0 (2017) using the observed relative sea level rise of 0.0811 inches (2.06 millimeters) per year (an increase of 0.17 feet). For further details see Appendix F of the Integrated Document (Tidal Flood Risk Analysis Summary Report). The extreme water level statistics for both the San Francisco and Coyote Creek tide gages are given in Table 8 (Water Level Statistics for the San Francisco and Coyote Creek Tide Gages) below.

Table 8. ACE Water Levels for San Francisco and Coyote Creek Tide Gages, 1992 and 2017

	San Francisco Tide Gage (9414290)		Coyote Creek Tide Gage (9414575)	
	1992	2017	1992	2017
FREQ (%)	[feet MLLW]	[feet NAVD88]	[feet NAVD88]	[feet NAVD88]
99.99	6.89	7.12	8.25	8.42
50	7.48	7.71	9.08	9.25
20	7.81	8.04	9.54	9.71
10	8.01	8.24	9.82	9.99
4	8.25	8.48	10.15	10.32
2	8.41	8.64	10.38	10.55
1	8.56	8.79	10.59	10.76
0.4	8.75	8.98	10.85	11.02
0.2	8.88	9.11	11.04	11.21

While the numerical modeling - MCS approach was ultimately not used for transferring the San Francisco tide data to the hydrologic study area, it does provide a useful comparison and check of the results. A brief description of the numerical modeling approach is given herein. Sampling criteria and various statistical methods were developed to determine the probability input of astronomical and residual tides to the numerical model. Four scenarios were developed (three conditional sampling criteria and annual maximum) and analyzed using the extreme probability (Gumbel maximum distribution) and the joint probability methods. The results from the analyses indicated that Scenario 2 using the joint probability method provided the most reasonable results and was used for input to the Monte Carlo Simulation runs (see Annex 4 of this report (Monte Carlo Simulation Report)). The results for all four scenarios are shown in Table 9 (Water Levels for the Four Scenarios Considered for Numerical Modeling).

Table 9. Water Levels for the Four Scenarios Considered for Numerical Modeling [ft. NAVD88]

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Return Period	WSE ≥ 6.84 & RT ≥ 0.0	WSE ≥ 6.84 & RT ≥ 0.5	WSE ≥ 6.84 & RT ≥ 1.0	Annual Maximum
[years]	[ft NAVD88]	[ft NAVD88]	[ft NAVD88]	[ft NAVD88]
5	8.17	8.02	7.81	7.75
10	8.38	8.22	8.05	7.98
25	8.69	8.51	8.32	8.28
50	8.88	8.71	8.52	8.5
100	9.04	8.89	8.73	8.72
250	9.23	9.07	8.91	9.01
500	9.34	9.21	9.1	9.22

Scenario 2 using the joint probability method was selected as input in developing the look-up tables that were then used as input into the MCS model. The MCS model combined other factors such as wind speed, wind direction, and potential levee failure. While these other factors will affect the water level frequencies, they are of secondary influence when compared to the storm and tide inputs. Point 7 is the closest model output to the Coyote Creek tide gage and its results are shown in Table 10 (Water Level Frequency at Point 7 from Numerical Modeling) below.

Table 10. Water Level Frequency at Point 7 from Numerical Modeling*

Return Period [years]	Lower Bound (5%) [ft NAVD88]	Median (50%) [ft NAVD88]	Upper Bound (95%) [ft NAVD88]
2	9.51	9.55	9.58
5	9.78	9.84	9.88
10	9.97	10.05	10.14
25	10.22	10.33	10.46
50	10.35	10.53	10.65
100	10.51	10.69	10.81
250	10.68	10.85	11.05
500	10.78	10.96	11.15

*Data taken from Table 3-3 of Annex 4 of this report.

As a final check and to give better confidence in the results, the extreme water level statistic from this study was compared with results from prior studies; the comparison for the 1% ACE, or 100-year return period, is shown in Table 11 (Comparison of 1% ACE Water Level with Prior Studies).

Table 11. Comparison of 1% ACE Water Levels for San Francisco and Coyote Creek Tide Gages to Prior Studies

Gage	This Study [ft NAVD88]	Table 9 & Table 10 [ft NAVD88]	(USACE, 1984) [ft NAVD88]	(Knuuti, 1995) [ft NAVD88]	(PWA, 2007) [ft NAVD88]
San Francisco	8.79	8.89	8.69	8.89	8.72
Coyote Creek	10.76	10.69	10.99	-	11.02

Variation in the 1% ACE water levels may be attributed to many factors, such as methodology, record length and statistical methods. Accounting for these differences, the results are very consistent. The results of the current analysis, is based on an additional 7 to 31 years of data at the San Francisco tide gage. Interannual variations primarily due to El Nino-Southern Oscillation (ENSO) may influence statistics if an extreme is appended to the end of the record. Apparent SLC rates have been lower in the recent 5 to 10 years due to a neutral ENSO phase, and will account for some of the difference in the (PWA, 2007) and current result. Current SLC rates and coefficients used in the other studies have been updated in this study and account for some of the difference in results. One of the studies (PWA, 2007) contains a more in-depth discussion of the methods behind some of the other results cited.

2.4.4 NATURAL VARIABILITY, UNCERTAINTY IN COYOTE CREEK EXTREME WATER LEVEL STATISTICS

ACE statistics presented in Table 8 (Water Level Statistics for the San Francisco and Coyote Creek Tide Gages) represent the most likely or 50% occurrence. The bulk of natural variability is captured in the Cumulative Distribution Function (CDF) of tidal residuals [see Figure 4 (Cumulative Distribution Function for Residual Tides based on 47 events from gage 9414290)]. The 5 and 95 percent ACE water surface elevation estimates were computed using the DTM function and assume tidal residuals of 1.55 and 0.55 feet respectively. In the DTM formula, the residual is not amplified so the result is that the higher residual (1.55 feet) is used to compute the lower 5 percent and the lower residual (0.55 feet) is used to compute the upper 95 percent confidence interval [see Table 12 (Coyote Creek Tide Gage 2017 5, 50, 95 ACE Water Levels)]. The higher number is achieved due to a larger component of the tide is predicted or astronomical and thus subject to the amplification factor. The natural variability assumptions and computation are recognized to be a simplifying, coarse assumption, but accurate. Combinations of water level components occurring concurrently such as high astronomical tide, storm surge residual, and extreme wind generated waves are possible, but would occur in the 95 to 99.99 percentile. The confidence interval range of the water surface elevation used in the HEC-FDA model to estimate flood damage is

slightly greater than that shown in Table 12 (Coyote Creek Tide Gage 2017 5, 50, 95 ACE Water Levels). The FDA model uses order statistics to derive the confidence limit when using what is termed the "graphical method." As an example, the difference for the 50% ACE water surface elevation is about 0.1 feet, and the difference for the 0.2% ACE elevation is about 0.5 feet. Because of the small difference for the more likely events, and because the absolute value of the difference is generally symmetrical above and below the mean, this small difference in uncertainty parameters should have very little impact on the overall estimate of flood damage.

Table 12. Coyote Creek Tide Gage 2017 5, 50, 95 ACE Water Levels

	Coyote Creek Tide Gage (9414575)		
	2017 (5%)	2017 (50%)	2017(95%)
FREQ (%)	[ft NAVD88]	[ft NAVD88]	[ft NAVD88]
99.99	8.14	8.42	8.54
50	8.97	9.25	9.37
20	9.43	9.71	9.83
10	9.71	9.99	10.11
4	10.04	10.32	10.44
2	10.27	10.55	10.67
1	10.48	10.76	10.88
0.4	10.74	11.02	11.14
0.2	10.93	11.21	11.33

The El Niño-Southern Oscillation (ENSO) is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean about every two to seven years. It is characterized by variations in the sea-surface temperature of the tropical eastern Pacific Ocean (NRC, 2012). ENSO is the dominant cause of sea-level variability in the northeast Pacific Ocean on interannual timescales (Zervas, 2009). Sea level rises off the west coast of the United States during El Niño events and falls during La Niña events. The highest sea levels recorded along the west coast and at the San Francisco tide gage were associated with El Niño events. On January 27, 1983, during one of the largest El Niños in half a century, seven tide gages along the west coast recorded their highest water levels. This event produced a water level 2.82 feet above MHHW at the San Francisco gage. Figure 6 (San Francisco Tide Gage Record Showing Relative Sea Level Rise Increases during Major El Niño Events [From (NRC, 2012)]) and Figure 7 (Detrended San Francisco Tide Gage MEHW, Moving Average Showing Range Interannual Variability Due to ENSO) show the impact of ENSO on relative sea levels (NRC, 2012).

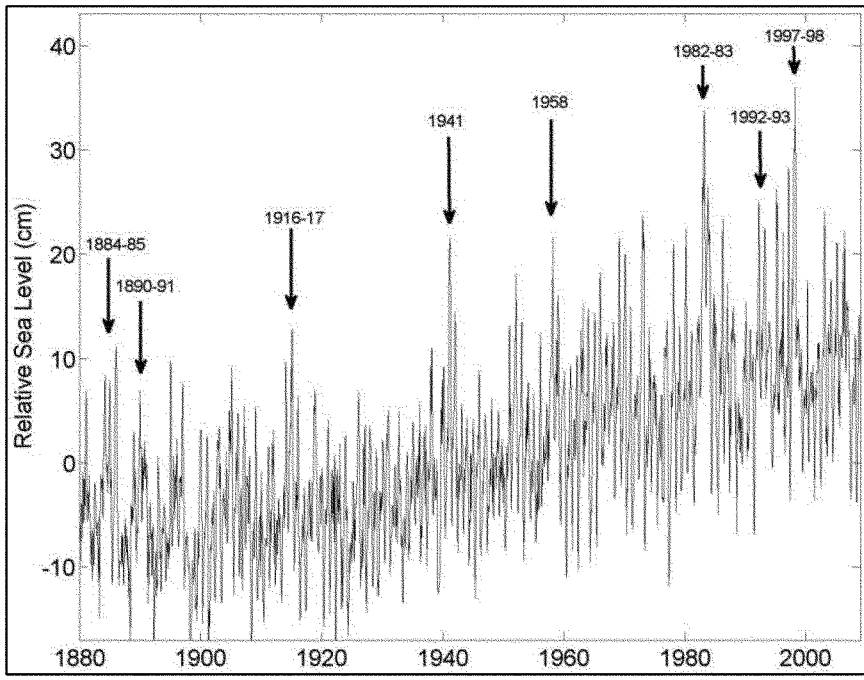


Figure 6. San Francisco Tide Gage Record Showing Relative Sea Level Rise Increases during Major El Niño Events [From (NRC, 2012)]

Most recent work on the impact of ENSO on west coast sea levels estimate the variability due to ENSO to be in the range of 0.3 to 1.0 feet (10 to 30 cm), with 0.7 feet (20 cm) the consensus. This estimate is visible by examination of Figure 7 (Detrended San Francisco Tide Gage MEHW, Moving Average Showing Range Interannual Variability Due to ENSO), which shows variability of the ENSO pattern imposed on the Monthly Extreme High Water (MEHW) level by a seven-month moving average shown in red.

Decadal and longer variability in sea level off the United States West Coast often corresponds to forcing by regional and basin scale winds associated with climate patterns such as the Pacific Decadal Oscillation (PDO) (NRC, 2012).

The daily, monthly and annual tidal cycles account for some of the natural variability in water levels and may contribute to an extreme water level when combined with other contributing factors. The Earth-Moon-Sun orbital geometry results in heightened high tides twice monthly (spring tides, near the times of the full and new moon) and every 4.4 years and 18.6 years (NRC, 2012). The largest tidal amplitudes of the year impacting San Francisco Bay occur in the winter and in summer are often more than 0.7 feet (20 cm) higher than tides in the spring and fall months. The peaks in the 4.4-year and 18.6-year cycles produce monthly high tides that are about 0.49 and 0.26 feet (15 cm and 8 cm) respectively, higher than they are in the intervening years (Flick, 2000) Table 13 (Summary of Extreme Water Level Natural Variability) summaries the various factors impacting extreme water levels.

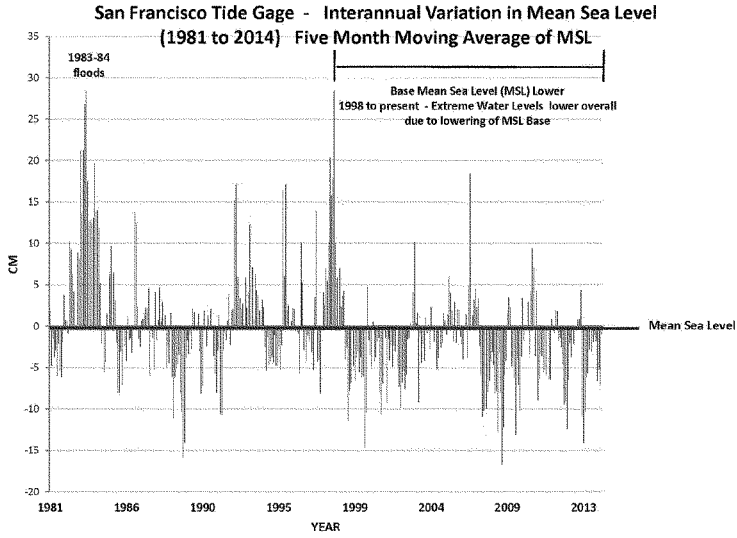


Figure 7. Detrended San Francisco Tide Gage MEHW, Moving Average Showing Range Interannual Variability Due to ENSO

Table 13. Summary of Extreme Water Level Natural Variability

Variability due to Single Event and Seasonal Climate Trends			Variability due to Tidal Cycles (added to peak)		
	Storm Surge	**ENSO**	**Seasonal**	**1 in 4.4 years**	**1 in 18.6 years**
feet	0.55 – 1.55	0.32 – 0.98	0.66	0.49	0.26
cm	17 – 47	10 – 30	20	15	8
Mean (feet)	0.85	0.66	0.66	0.49	0.26
S (feet)	0.54	0.33			

The water level component variability discussed in this section and summarized in Table 13 is reflected in the overall statistics developed for the San Francisco tide gage and DTM function for Coyote Creek. Uncertainty in the ACE for the Coyote Creek tide gage is estimated by a simple uncertainty model created through estimates of two of the major factors identified in Table 13. The total uncertainty in extreme water levels for the Coyote Creek tide gage is developed using Equation 1-4, adapted from EM 1110-2-1619 [(USACE, 1996), (Risk-Based Analysis for Flood Damage Reduction Studies)]:

$$S_{Z,total} = \sqrt{S^2_{Z,natural} + S^2_{Z,\mathrm{model}} + S^2_{Z,datum}} \qquad \text{Equation 1.4}$$

where

$S_{Z\ total}$ = total standard deviation of error representing uncertainty in extreme water levels

$S_{Z,\ natural}$ = the standard deviation associated with uncertainty in extreme water levels due to natural variability

$S_{Z,\ model}$ = the standard deviation associated with uncertainty in extreme water levels due to application and assumptions in the Direct Transfer Function (DTM)

$S_{Z,\ datum}$ = the standard deviation associated with uncertainty in extreme water levels due to tidal datum to geodetic datum gage conversion

The factors comprising the total uncertainty [see Table 14 (Uncertainty Estimate for the Confidence Intervals for the Coyote Creek Gage ACE)] are assumed to occur independently of each other, and determine the confidence interval applied to the ACE water surface elevations for Coyote Creek tide gage. The ACE elevations and associated confidence interval represent the coastal elevation-probability function which describes exposure in the economics model, HEC-FDA. The approximate confidence interval estimated by equation 1-4, 0.76 feet, is input as an "equivalent gage record" value in HEC-FDA. The equivalent gage record was estimated by a sensitivity analysis using HEC-SSP software in which gage record lengths in years were input into a graphical frequency analysis model created with the San Francisco tide gage Annual Extreme High Water (AEHW) level values and run to produce confidence intervals roughly equivalent to the value developed by equation 1.4 (Deering, 2014), in effect "backing into an equivalent gage value" which approximates the uncertainty estimate developed by equation 1.4. The HEC-SSP sensitivity analysis yielded an equivalent gage value of approximately 35 to 40 years.

Table 14. Uncertainty Estimate for the Confidence Intervals for the Coyote Creek Gage ACE Values

	Source/Type of Uncertainty				
	Natural		Model	Datum	Total
	Storm Surge	ENSO	DTM function		
S (feet)	0.54	0.33	0.33	0.25	
S^2 (feet)^2	0.29	0.11	0.11	0.06	0.57
S (feet)					0.76

2.5 SEDIMENT DYNAMICS

The general circulation pattern of sediment within San Francisco Bay has been well described by several researchers [e.g., (OBA, 1992)]. Quantification of these various transport mechanisms is very problematic, but a qualitative description of the dominant processes can be given for general guidance. San Francisco Bay can be geomorphologically divided into three bays: North Bay (e.g. San Pablo Bay), Central Bay, and South Bay. We now further divide the South Bay into South Bay (from roughly the Bay Bridge to the Dumbarton Bridge) and Far South Bay (the portion of the bay located south of Dumbarton Bridge). The hydrologic study area is located within and adjacent to Far South Bay.

Sediment supplied to San Francisco Bay via the Sacramento/ San Joaquin Delta tends to settle in the upper bays. Some large flow events can carry suspended sediment all the way to Central and South Bay, but most of the annual sediment load is deposited further upstream. Most of this sediment inflow occurs during the winter and spring. In the summer, daily winds tend to re-suspend the sediment in the shallows via wind-wave action. The sediment is then slowly transported though the bay system to Central Bay. When the sediment reaches Central Bay, it either resettles in Central Bay, travels through the Golden Gate and out of the system, or is transported into South Bay. Once in South Bay, the sediment is either deposited within the bay, or passes through Dumbarton Bridge into Far South Bay.

In addition, wave heights in Far South Bay are mitigated by their passage though the gap at Dumbarton Bridge (Smith, 2009), the dog-leg in the tidal channel and the sheltering effect provided by the pond-dike system (Annex

4 of this report). This can create a suspended sediment concentration gradient across the Dumbarton Bridge opening, and drive a net tidal dispersive transport towards Far South Bay. Sediment deposits in Far South Bay until an equilibrium is achieved between sediment supply and hydraulic erosion (tidal and wind wave erosion). The excess sediment is then transported towards Central Bay via the main tidal channel, and recirculates through the system. Also, locally derived sediment from tributaries is a significant fraction of the total available sediment in the system. These sediments are transported together with the sediments derived from the Sacramento/ San Joaquin Delta.

Suspended solids concentration (SSC) in South Bay exhibits highly dynamic short-term variability, primarily in response to sediment input from tributaries and sloughs and to tidally driven and wind-driven resuspension [(Cloern, et al., 1989); (Powell, et al., 1989); and (Schoellhamer, 1996)]. SSCs are temporally variable on tidal and seasonal scales and exhibit strong diurnal and spring-neap variability, with the highest SSCs occurring on spring tides. On a seasonal time scale, SSCs are higher in the summer months when average wind speeds and wind-wave action are greatest. Greater wind-wave action increases resuspension and reworking of the sediment deposited during the previous winter months. Wind is the most dynamic factor affecting temporal and spatial variability in SSCs (May, et al., 2003). In general, increases in fetch and wind speed will result in larger wind waves, and, in the South Bay's broad shoals, these wind waves re suspend sediments, creating more turbid conditions. Lateral exchange is also an important mechanism for sediment transport [(Jassby, et al., 1996); (Schoellhamer, 1996)]. Lateral surface flows (between the channel and shoal) result from differing velocities in the channel relative to the shoals and the interaction of tidal flow with channel-shoal bathymetry. These lateral flows can transport a significant amount of sediment to the channel (Jassby, et al., 1996), which can in turn lead to an export of sediment to Central Bay.

2.5.1 SEDIMENT TRANSPORT

The existing conditions sediment transport was modeled using the ADH hydrodynamic model coupled with the (Teeter, et al., 2001) sediment transport method (Brown, 2010). Modeling results indicate that Far South Bay currently receives surplus sediment, which is either stored as net deposition, or exported from Far South Bay via ebb currents in the main tidal channel. The numerical modeling analysis shows that, for the limited increase in sediment demand due to the proposed pond-breaching projects associated with the Year 0/baseline (2017) conditions, the sediment needed to supply these ponds will likely be derived from outside the far South Bay system. Therefore the equilibrium between the sediment supply and the hydrodynamic conditions should be maintained at Year 0, and, furthermore, the projected sediment supply through Year 50 should keep up with sea level rise for USACE Intermediate SLC scenario. Far South Bay (south of Dumbarton Bridge) currently receives surplus sediment, which is either stored as net deposition or exported from Far South Bay via ebb currents in the main tidal channel. The crucial threshold for disruption of the recent historical morphologic trend toward net deposition in Far South Bay is the threshold sediment demand, where the system switches from a sediment-rich system to a sediment-starved system.

2.5.2 SEDIMENT BUDGET

The sediment budget for South Bay—which is an accounting of all sediment delivery, export, and storage—includes mostly waterborne sediments in tributary inflows, outflows to Central Bay, dredging and deposition within open water areas, existing marshes, and restored ponds. Published sediment budgets for San Francisco Bay covering the period of 1955 through 1990 [(Krone, 1979); (Krone, 1996); (OBA, 1992); (Schoellhamer, 2011)] were reviewed and used in this study. These budgets include estimates of fluvial sediment inputs from the Sacramento/ San Joaquin Delta and local watersheds, bathymetric change, upland disposal of dredge material, and loss of sediment under Golden Gate Bridge. Recent research by (Foxgrover, et al., 2004) proposes significant revisions to earlier sediment budgets with important implications for the hydrologic study area and suggest that South Bay has undergone net erosion from 1956 through 1983, rather than deposition. The most recent review (Zoulas, 2013) and research (Barnard, et al., 2013) were not used in this study. These references should be consulted during the PED phase of the project to determine if design changes are needed at that time.

As part of this study, (Scott, 2009) developed a new analysis of these local tributary inflows using the same data source, as well as one-dimensional Hydrologic Engineering Center (HEC)-6 numerical modeling results. The analysis indicates a significantly lower sediment yield to South Bay than is predicted by the previous methods, especially with respect to tributary inflows to Far South Bay. This is likely because the previous analyses assume that a large fraction of sediment load in the river reaches South Bay. Scott's analysis accounts for the fact that most coarse-grained sediments are not transported to South Bay because of the sharp decrease in hydraulic gradient in the tributaries as they approach South Bay. These coarse-grained sediments settle in the channel and riparian floodplain, and they either remain in situ (in place) or are dredged or mined. Therefore, Scott's analysis accounts for only the fraction of sediment that reaches South Bay, which yields a smaller estimate of these tributary inflows. (Scott, 2009) provided local tributary sediment inflow estimates that total 109 thousand tons per year (Ktons/yr), with 80 [Ktons/yr] flowing into South Bay and another 29 [Ktons/yr] flowing into Far South Bay.

(Brown, 2010) developed a sediment budget for Far South Bay using the tributary sediment inflow data of (Scott, 2009) and the bathymetric change calculations given in (OBA, 1992). The sediment budget was developed for historical (1956-1990) and baseline (2017) conditions; the results are shown in Table 15 (Sediment Budgets for Historical and Baseline Conditions for the South Bay and Far South Bay).

Table 15. Sediment Budgets for Historical and Baseline Conditions for South Bay and Far South Bay

	Sediment Budget (Rate) [Thousand Tons per Year]*		
Sediment Source/Sink Term	**South Bay**	**Far South Bay**	**Total**
Historical Condition (1956 – 1990)			
Tributary Sediment Inflow	80	29	109
Net erosion/deposition of bed sediments (erosion is positive)	174	-579 (-132)	-405 (42)
Sediment exchange from Central Bay (Flux from Central Bay to South Bay is positive)	N/A	N/A	297 (-67)
Baseline Condition (2017)			
Tributary sediment inflow	80	29	109
Net erosion/deposition of bed sediments (erosion is positive)	174 (0)	0	174 (0)
Net deposition associated with restored ponds: A6, A8, A19, A20, and A21	0	–69	–69
Additional deposition due to accelerated sea level rise (0.12 inches per year)	0	–58	–58
Sediment exchange from Central Bay (flux from Central Bay to South Bay is positive)	N/A	N/A	-155 (19)

*Values in parenthesis are calculations assuming no subsidence in Far South Bay.

2.6 WATER WAVES

The waves commonly observed along the Pacific Coast and in San Francisco Bay are technically referred to as water (media of propagation) wind-driven (primary disturbing force) gravity (primary restoring force) waves, water gravity waves, wind waves, or water waves. The period of these water waves (the time duration between successive wave crests occurring) range from 1 second to 30 seconds. These waves are commonly divided into either locally generated wind waves called "seas", or waves that have propagated long distances from their disturbing force called "swell". Seas tend to have shorter wave periods than swell and typically look less organized. In addition to seas and swell for the hydrologic study area, seismic sea waves, also called tsunamis, may be important. For a more complete list of water wave types, see Figure 1 of (Oltman-Shay & Hathaway, 1989).

2.6.1 SEAS (WIND WAVES)

Due to the sheltering effect provided by the neighboring salt ponds and levees, seas (wind-generated short-period waves) within the hydrologic study area are minimal. Simplified wave growth formulas that predict wave growth based on restricted fetches and duration-limited criteria (Leenknecht, et al., 1992) were applied to estimate the magnitude of seas approaching the outboard dikes in accordance with respective restricted fetches and duration. The forcing wind conditions, including wind speed and direction, to estimate wave heights are identical to those used in Annex 3 of this report (South San Francisco Bay Long Wave Modeling Report). The results from the analysis are provided in a wave height lookup table (see Table 16 (Wind Waves (Seas) Look-up Table for Point 7 of the Numerical Model)). The increased water level due to seas is included in Table 10 (Water Level Frequency at Point 7 from Numerical Modeling); comparison with Table 11 (Comparison of 1% ACE Water Level with Prior Studies)shows that wind generated waves have a minimal effect on the total water elevation at the hydrologic study area.

Table 16. Wind Waves (Seas) Look-up Table for Point 7 of the Numerical Model

Wind Speed [mph]	Effective Depth [feet]					
	8.0		10.0		12.0	
	Wind Direction [Degrees]					
	292.5	315.0	292.5	315.0	292.5	315.0
Significant Wave Height [feet]						
10	0.2	0.2	0.2	0.2	0.2	0.2
20	0.6	0.6	0.6	0.6	0.6	0.6
30	1.0	1.0	1.0	1.0	1.0	1.0
40	1.4	1.4	1.5	1.4	1.5	1.4
Wave Period [seconds]						
10	0.9	0.9	0.9	0.9	0.9	0.9
20	1.5	1.4	1.5	1.5	1.5	1.5
30	1.9	1.8	1.9	1.8	1.9	1.9
40	2.2	2.1	2.2	2.2	2.2	2.2

2.6.2 SWELL

Swell is not a significant factor in determining total water level in South San Francisco Bay, due to a number of landscape constrictions within the bay. Swell must first pass through the Golden Gate, which blocks a significant portion of the swell wave energy. The swell then radiates out eastward and southward, where swell wave energy is further reduced by the land constriction near the Bay Bridge. The southward propagating swell's energy is further reduced by the land constriction by Dumbarton Bridge. What little swell energy remaining must then propagate through the dog-leg of the channel before reaching the hydrologic study area. (DHI, 2010) estimates the 1% ACE and 0.2% ACE swell to be 0.01 foot. Swell was therefore not used in determining total water level for tidal flood inundation statistics.

2.6.3 TSUNAMI

Tsunami is a Japanese word meaning "harbor wave". Tsunamis are a series of water waves generated by a large displacement of water, usually caused by a submarine earthquake; but can also be caused by volcanic eruptions, underwater explosions, landslides, ice sheets breaking apart, or meteorite impacts, above or below the water surface. The risk of inundation from a tsunami at the hydrologic study area is very low. The tsunami inundation map for the hydrologic study area only shows the potential for tsunami inundation at the outboard side of the ponds (CEMA, 2009), with the community of Alviso not at risk from tsunami inundation.

2.7 WATER SURFACE ELEVATION DEFINED HABITATS

Water surface elevations based on tidal datums and sedimentation rates was provided to delineate aquatic habitats in order to determine movement of those habitat boundaries with time. The tidal datums have been previously given in Table 6 (Comparison of Vertical Datum Information between the San Francisco and Coyote Creek Gages) of Section 2.4.1 (San Francisco Bay Tide Data). The habitat type and boundaries are given in Table 17 (Habitat Delineations based on Tidal Datums). It should also be noted that the tidal datums used for habitat delineation were not the same as those given in Table 6 [see Table 7 of (ESA PWA, 2012)], and these differences are also shown in Table 17. The differences between the two elevation ranges are less than two inches and are considered insignificant in determining habitat boundaries.

Table 17. Habitat Delineations based on Tidal Datums

Habitat*	Elevation*	2017 Elevation*	Difference from Table 6
	[ft NAVD88]	[ft NAVD88]	[ft NAVD88]
Deep Subtidal	Deeper than 6m below MLLW	< -21.16	< -21.03
Shallow Subtidal A	2 to 6 m below MLLW	-21.16 to -8.04	-21.03 to -7.91
Shallow Subtidal B	2 m below MLLW to MLLW	-8.04 to -1.48	-7.91 to -1.52
Intertidal Mudflat	MLLW to MTL + 0.3 m	-1.48 to 4.33	-1.52 to 4.46
Cordgrass Dominated	MTL + 0.3 m to MHW	4.33 to 6.96	4.46 to 6.99
Pickleweed Dominated	MHW to MHHW	6.96 to 7.51	6.99 to 7.64
Upland	Above MHHW	> 7.51	>7.64

*From Table 7 of (ESA PWA, 2012)

The sediment historically deposited within the Alviso pond complex is a mix of sand, silt, and clay. The USGS collected sediment data between April and June 2003 indicating that the sediments on the pond bottoms within the Alviso pond complex are composed of 38 percent sand, 36 percent silt, and 26 percent clay (USGS, 2005). Grain size distributions show a marked difference from those of area sloughs, where channels are composed of 13 percent sand, 54 percent silt, and 33 percent clay (USGS, 2005).

The rate of sedimentation in natural and restored marshes depends on sediment supply in the water column, settling velocities, and the period of marsh inundation. Rates of sedimentation decrease over time as mudflats and marsh plains accrete and the period of tidal inundation decreases. Sedimentation rates near the Alviso pond complex are generally higher at present than those near the Eden Landing and Ravenswood pond complexes because of higher suspended sediment concentrations (sediment availability) and higher average sedimentation rates; historically, this was due to subsidence. Subsidence of land relative to water levels in the South Bay moderates sedimentation deceleration by maintaining low land elevations (relative to tidal water levels). This subsequently results in higher average sedimentation rates over specific periods of time. The sedimentation within the former salt ponds has not kept pace with past subsidence due to the reduced sediment supply to the ponds by the management operations. Consequently, the average elevation within the former salt ponds is several feet lower than the elevations of the adjacent wetlands just outside of the outboard levees.

2.8 FLOOD RISK

Flood risk is the combination of the likelihood of a flood hazard event and the consequences should that event happen. More detailed quantitative and qualitative description of the flood risk for the hydrologic study area is given in the Economics Appendix of the Integrated Document (Appendix D). USACE regulation ER 1105-2-101 (USACE, 2006) requires a qualitative description of the flood risk, suitable for the public. The qualitative descriptions of flood risk for the historical and existing conditions are presented herein. Sections 3.8 (Flood Risk) and 4.8 (Flood Risk) describe the flood risk for future without project and future with-project conditions, and the residual flood risk that remains once the project is built.

2.8.1 HISTORICAL FLOOD RISK

The community of Alviso has been subjected to high rates of subsidence from groundwater withdrawal for agriculture for the first half of last century, causing lands to sink by four to six feet. Beginning in 1971, surface water importation from the San Francisco Regional Water System and State Water Project virtually halted further subsidence in the region by offsetting the need for groundwater pumping. While the subsidence has stopped, large portions of Alviso remain below sea level (as there is no mechanism to raise the land once it has subsided), making Alviso very susceptible to flooding.

Alviso is bordered by two watercourses, Coyote Creek to the east and Guadalupe River to the west, making Alviso vulnerable to riverine flooding. Alviso has experienced riverine flooding many times in the past, the most notable recent event being the flood from Guadalupe River in 22 – 30 January1983.

The community of Alviso has not historically suffered from a bayside (tidal) flood event. While there has been no recorded tidal flood event at Alviso, the 22 – 30 January 1983 Guadalupe River flood event also corresponded with coastal storms and extreme high tides (including the largest recorded elevation in the 105-year record of the San Francisco Gage on 27 January 1983). The Sunnyvale West Channel flood was attributed to tidal flooding on 27 January 1983 (SCVWD, 1983), and it is possible that the Guadalupe River flood event occurring at the same time could have masked any tidal flooding at Alviso; or the high tides may not have directly caused any flooding, but exacerbated the riverine flooding from Guadalupe River.

2.8.2 EXISTING FLOOD RISK

Flood risk management projects on lower Coyote Creek and Guadalupe River have significantly lowered the risk of riverine flooding for the community of Alviso. The largest remaining flood risk for Alviso comes from tidal flooding. The community of Alviso has a population at risk of tidal flooding of approximately 6,000 people; this number includes residents of Alviso as well as people who work in Alviso, but does not include people commuting through Alviso. There are also over 1,100 structures at risk from tidal flooding; made up of over 1,000 residential structures, along with other commercial, industrial, and public structures. In addition the San José-Santa Clara Regional Wastewater Facility (Wastewater Facility) is at risk from tidal flooding. The Wastewater Facility serves 1.4 million people and approximately 16,000 businesses, and has a capacity of approximately 170 million gallons per day. The Wastewater Facility has a total estimated replacement value of approximately $2.8 billion.

Based on the analyses given in Appendices D (Economics) and F (Tidal Flood Risk Analysis Summary Report) of the Integrated Document, there is an approximately one in three chance of Alviso experiencing a tidal flood event under the existing condition in any given year. It is almost certain (much greater than a 99.99% chance) that tidal flooding will occur over a 30-year mortgage period under existing conditions. Without flood risk management actions, it is almost certain that Alviso will eventually experience a tidal flood event under the existing condition. The consequences of a tidal flood at Alviso would be similar to the consequences of the riverine flood of the Guadalupe River in January 1983, resulting in substantial damages to residential and other structures and the potential for loss of life.

In addition to the tidal flood risk, there is still a residual risk of flooding from the Guadalupe River (see Section 4.8.2 for a discussion of residual risk). However this flood risk is much lower than the tidal flood risk, because of the Lower Guadalupe River flood risk management project. Similarly, there is a residual risk of fluvial flooding from Coyote Creek, but the flood waters break out above the hydrologic study area (see Plate 50 from Annex 1 of this report) and do not inundate the hydrologic study area. There is also the possibility of nuisance flooding from the existing storm drain network in the hydrologic study area. The network was originally designed to contain a 33% ACE (3-year return period) flood event and may be assumed to be currently under capacity (Schaaf & Wheeler, 2010).

3 FUTURE WITHOUT-PROJECT CONDITION

3.1 WATERSHED

The Coyote watershed within the hydrologic study area under the future without-project condition is expected to remain relatively the same as under the existing conditions without considering climate change effects. The City of San Jose's growth projections for 2012-2016 show minimal commercial development in the Alviso community, and therefore the hydrologic study area is not expected to see a significant increase in surface runoff. The upstream portions of the watershed could show significant increase in urbanization in the future. However, any increases in surface runoff from the upstream portions of the watershed are expected to be mitigated before reaching the hydrologic study area.

Climate change effects are expected to have a significant effect on the Coyote watershed. The hydrologic study area, within the downstream portion of the watershed, will be inundated from accelerated sea level rise during the fifty-year study horizon (2017 – 2067). Storm events are also expected to become more intense and of shorter durations. There is not yet enough research done to quantify the future climate statistics and they have therefore not been incorporated into the hydraulic modeling.

3.2 HYDROLOGY

Hydrology for the future without-project condition was not assumed to change significantly between Year 0 (2017) and Year 50 (2067). The San Francisquito Creek is also located in South San Francisco Bay and would experience similar hydrology changes as the hydrologic study area. According to the San Francisquito Creek Hydrology Study (SCVWD, 2007), the changes in future flows for the 1% ACE event only increase by approximately 1-2%, which is considered insignificant. This is mainly due to the limited capacity of the storm drain system, which is typical of the South San Francisco Bay Area. Therefore, no changes were made to the hydrology for Year 50.

3.3 FLUVIAL HYDRAULICS

There has not yet been enough research conducted on regional to local scale climate change effects for the hydrologic study area to quantify the future climate statistics, and they have therefore not been incorporated into the hydraulic modeling. The results of the Year 50 (2067) HEC-RAS analyses found that the water surface elevations did not change significantly from Year 0 (2017) to Year 50 (2067). From the coincident frequency analysis it was found that the Year 50 sea level change of +0.73 feet (Modified NRC Curve I) has little effect on the downstream boundary conditions, such that there is little change between Year 0 and Year 50 water surface elevations. Therefore, there is little to no change in the volume of water leaving the streams and entering the floodplains from Year 0 to Year 50. As a result there is no change in the fluvial flood inundation maps for Year 0 and Year 50 riverine floodplains for Coyote Creek and Guadalupe River (Alviso Slough).

3.3.1 COYOTE CREEK

The future without-project hydraulics for Coyote Creek are expected to remain the same as under the existing condition, which are given in Section 2.3.1 (Coyote Creek) of this report.

3.3.2 GUADALUPE RIVER (ALVISO SLOUGH)

The future without-project hydraulics for Guadalupe River are expected to remain the same as existing conditions, which are given in Section 2.3.2 (Guadalupe River (Alviso Slough)) of this report.

3.4 TIDAL HYDRAULICS

The future condition in the hydrologic study area is impacted by sea level change (rise), which in turn further reduces the performance and reliability of the existing west and east dike pond systems currently preventing tidal flooding in the hydrologic study area. Under the three USACE sea level change (SLC) scenarios, the assumption is that the tidal ranges in San Francisco Bay remain unchanged, but shift to higher levels and inland. The water level statistics are projected forward under the three USACE SLC rates. The ability of the existing dike-pond systems to prevent tidal flooding declines significantly and rapidly under the USACE High SLC scenario. Figure 8 (Alviso and the Coyote Creek Gage Exterior-Interior Relationship for Outboard Dike Breaching) illustrates the transfer in volume under an assumed failure of the dike-pond system that defines the exterior-interior relationship between Coyote Creek and Alviso in the base year of 2017.

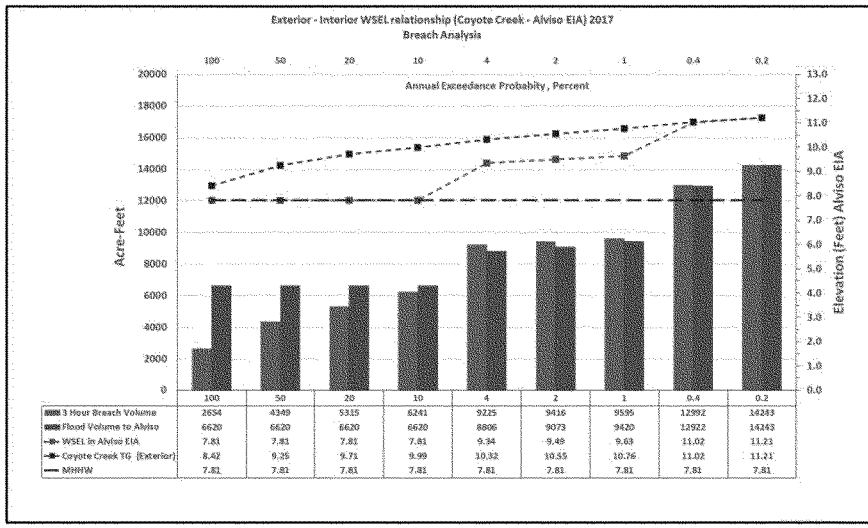


Figure 8. Alviso and the Coyote Creek Gage Exterior-Interior Relationship For Outboard Dike Breaching

The impact of SLC on the performance of the dike-pond system and the change in exterior-interior water surface elevation relationship can be seen in Figure 9 (Water Levels for Coyote Creek and Alviso for 2016 and 2067 under the USACE High SLC Scenario). The change in mean sea level, potentially several feet higher under the USACE High SLC scenario effectively eliminates any flood risk reduction benefit by the dike-pond system through storage. Water would only need to rise by 1 to 1.5 feet for the inboard dikes to be overtopped and fail. The transition to a completely open system now occurs at the 50% ACE, and the exterior-interior relationship is no longer in effect. Water surface elevations are developed in 10-year increments for the base year 2017 through 2067 using the web tool at https://corpsclimate.us/ccaceslcurves.cfm. The low rate is used for all 2017 scenarios since the base year of 2017 is so close to the current year.

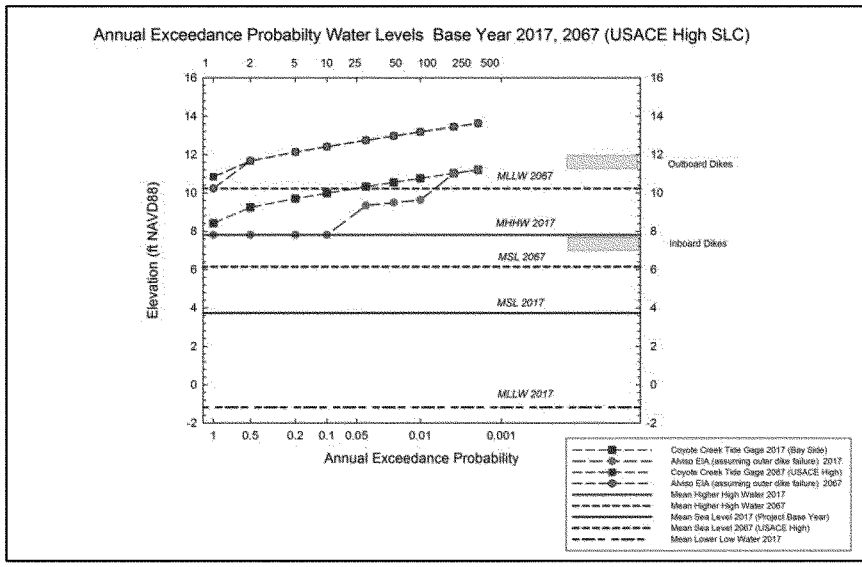


Figure 9. Water Levels for Coyote Creek and Alviso for 2016 and 2067 under the USACE High SLC Scenario

Exterior-interior relationships between the Coyote Creek tide gage and Alviso based on breach analysis developed for the existing without-project condition are estimated for the future SLC scenarios, accounting for changes impacting performance. Table 18, Table 19, and Table 20 contain ACE water levels for the three SLC scenarios, USACE Low, Intermediate, and High.

Table 18. USACE Low SLC Scenario - ACE Water Levels, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.49	7.88[1]	8.55	7.94[1]	8.62	8.01[1]	8.69	8.08[1]	8.76	8.15[1]
50	9.25	7.81[1]	9.32	7.88[1]	9.38	7.94[1]	9.45	8.01[1]	9.52	8.08[1]	9.59	8.15[1]
20	9.71	7.81[1]	9.78	7.88[1]	9.84	8.50	9.91	8.45	9.98	8.65	10.05	9.20
10	9.99	7.81[1]	10.06	8.30	10.12	8.70	10.19	8.90	10.26	9.15	10.33	9.45
4	10.32	9.34	10.39	9.36	10.45	9.65	10.52	9.80	10.59	9.99	10.66	10.20
2	10.55	9.49	10.62	9.57	10.68	9.75	10.75	9.92	10.82	10.70	10.89	10.80
1	10.76	9.63	10.83	9.75	10.89	9.85	10.96	10.80	11.03	11.03	11.10	11.10
0.4	11.02	11.02	11.09	11.09	11.15	11.15	11.22	11.22	11.29	11.66	11.36	11.36
0.2	11.21	11.21	11.28	11.28	11.34	11.37	11.41	11.41	11.48	11.85	11.85	11.85

Table 19. USACE Intermediate SLC Scenario - ACE Water Levels, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.60	7.99[1]	8.73	8.12[1]	8.89	8.28[1]	9.06	8.45[1]	9.26	8.65[1]
50	9.25	7.81[1]	9.43	7.99[1]	9.56	8.12[1]	9.72	8.28[1]	9.89	8.45[1]	10.09	8.65[1]
20	9.71	7.81[1]	9.89	7.99[1]	10.02	8.50	10.18	9.45	10.35	9.78	10.55	10.55
10	9.99	7.81[1]	10.17	8.50	10.30	9.50	10.46	9.65	10.63	10.49	10.83	10.83
4	10.32	9.34	10.50	9.40	10.63	9.80	10.79	10.40	10.96	10.96	11.16	11.16
2	10.55	9.49	10.73	9.68	10.86	10.60	11.02	11.02	11.19	11.19	11.39	11.39
1	10.76	9.63	10.94	10.55	11.07	11.07	11.23	11.23	11.40	11.40	11.60	11.60
0.4	11.02	11.02	11.20	11.20	11.33	11.33	11.49	11.49	11.66	11.66	11.86	11.86
0.2	11.21	11.21	11.39	11.39	11.52	11.52	11.68	11.68	11.85	11.85	12.05	12.05

Table 20. USACE High SLC Scenario - ACE Water Levels, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.94	8.33[1]	9.30	8.69[1]	9.74	9.13[1]	10.26	9.65[1]	10.84	10.23[1]
50	9.25	7.81[1]	9.77	8.33[1]	10.13	8.69[1]	10.57	9.85	11.09	11.09	11.67	11.67
20	9.71	7.81[1]	10.23	8.75	10.59	9.70	11.03	11.03	11.55	11.55	12.13	12.13
10	9.99	7.81[1]	10.51	9.50	10.87	10.10	11.31	11.31	11.83	11.83	12.41	12.41
4	10.32	9.34	10.84	9.80	11.20	11.20	11.64	11.64	12.16	12.16	12.74	12.74
2	10.55	9.49	11.07	11.07	11.43	11.43	11.87	11.87	12.39	12.39	12.97	12.97
1	10.76	9.63	11.28	11.28	11.64	11.64	12.08	12.08	12.60	12.60	13.18	13.18
0.4	11.02	11.02	11.54	11.54	11.90	11.90	12.34	12.34	12.86	12.86	13.44	13.44
0.2	11.21	11.21	11.73	11.73	12.09	12.90	12.53	12.53	13.05	13.05	13.63	13.63

3.5 SEDIMENT DYNAMICS

3.5.1 SEDIMENT TRANSPORT

The predicted morphology of Far South Bay for the Year 50 condition is largely dependent on the rate of sea level rise. At lower rates of sea level rise, the sediment supply to Far South Bay exceeds the demand imposed by the rate of rise, and the morphology maintains an equilibrium planform relative to the water surface. As sea level rise accelerates, at some point a threshold is reached where the sediment supply to Far South Bay can no longer keep pace with the rate of rise, and Far South Bay becomes sediment starved. At that point, it is expected that the significant changes in the mudflat planform will occur, the mudflats begin to erode, and sediment redistributed to the most efficient sinks within the system.

Figure 10 (Year 50 (2067) Bathymetry for the USACE Intermediate SLC Scenario) is a color contour plot of the expected Year 50 bathymetry for the NRC I curve rate of sea level rise. The overall platform elevation has increased by 0.72 feet (0.22 m) over the Year 0 planform elevation, to account for the total sea level rise over the project life. This maintains the same average depth in Far South Bay, indicating that the planform is in equilibrium. Pond A6 is filled completely, and Pond A8 is partially filled.

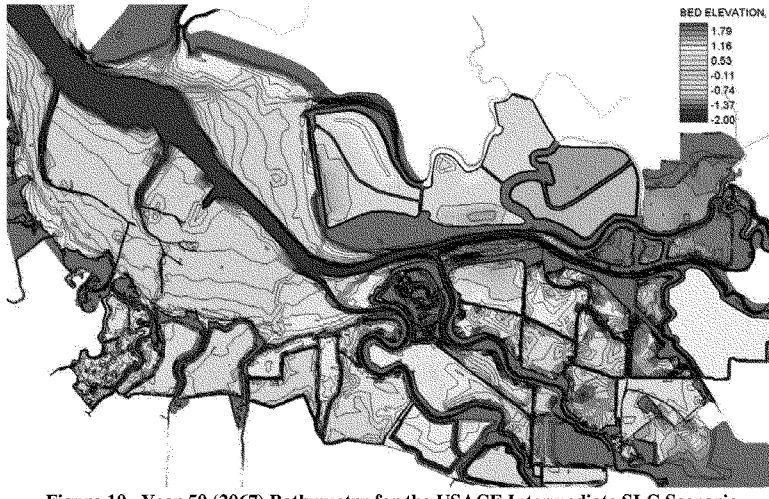


Figure 10. Year 50 (2067) Bathymetry for the USACE Intermediate SLC Scenario

3.5.2 SEDIMENT BUDGET 2067

Similarly to the historic and baseline conditions [see Table 15 (Sediment Budgets for Historical and Baseline Conditions for South Bay and Far South Bay)], a sediment budget was developed for the South Bay and Far South Bay, which used the NRC I curve to incorporate sea level change, and is shown in Table 21 (Sediment Budgets for 2067 Without Project Condition for South Bay and Far South Bay) [from (Brown, 2010)].

Table 21. Sediment Budgets for 2067 Without Project Condition for South Bay and Far South Bay

	Sediment Budget (Rate) [Thousand Tons per Year]*		
Sediment Source/Sink Term	**South Bay**	**Far South Bay**	**Total**
Tributary Sediment Inflow	80	29	109
Net erosion/deposition of bed sediments (erosion is positive)	174 (0)	0	174 (0)
Net deposition associated with restored ponds: A6, A8, and the Island Ponds	0	-23	-23
Sea Level Rise (0.00572 m/yr)	0	-150	-150
Sediment exchange from Central Bay (flux from Central Bay to South Bay is positive)	N/A	N/A	-110 (64)

*Values in parenthesis are calculations assuming no subsidence in Far South Bay.

3.6 WATER WAVES

3.6.1 SEAS (WIND WAVES)

There has not yet been enough research conducted on a regional scale to determine climate change effects for the hydrologic study area, and the seas statistics for the hydrologic study area are assumed to be the same as under the existing condition.

3.6.2 SWELL

There has not yet been enough research conducted on a regional scale to determine climate change effects for the hydrologic study area, and the swell statistics for the hydrologic study area are assumed to be the same as under the existing condition given in Section 2.6.2 (Swell); and therefore was not used in determining total water level for tidal flood inundation statistics.

3.6.3 TSUNAMI

The future without-project condition for tsunami inundation of the hydrologic study area is not expected to change from the existing condition; see Section 2.6.3 (Tsunami) for the expected condition.

3.7 WATER SURFACE ELEVATION DEFINED HABITATS

Similarly to the historic and baseline conditions (see Table 15 (Sediment Budgets for Historical and Baseline Conditions for South Bay and Far South Bay)), a sediment budget was developed for the South Bay and Far South Bay, which used the NRC I curve to incorporate sea level change, and is shown in Table 21 (Sediment Budgets for 2067 Without Project Condition for South Bay and Far South Bay). All ponds within the hydrologic study area are expected to be managed similarly to the existing condition, without a significant change in habitat. However, neighboring ponds that have been or will be breached as part of the South Bay Salt Ponds Restoration Project (such as Ponds A6 and A8) will initially increase the tidal prism, thereby scouring the channels deeper and then eventually fill in, thereby reducing the sediment supply to the hydrologic study area and limiting marsh development. Therefore, there will be a shift in habitat types towards more acreage of subtidal habitat under the future without-project condition.

3.8 FLOOD RISK

Future tidal flood risk was evaluated under the three required sea level change (SLC) scenarios: USACE Low SLC scenario, USACE Intermediate SLC scenario, and USACE High SLC scenario. There is an approximately 1 in 2 chance of Alviso experiencing a tidal flood event under the USACE Intermediate SLC scenario in any given year by 2067. It is almost certain (much greater than a 99.99% chance) that tidal flooding will occur over a 30-year mortgage period under all three scenarios. It is almost certain that Alviso will eventually experience a tidal flood event under all future without-project condition SLC scenarios. The consequences of a tidal flood at Alviso would be similar to consequences of the riverine flood of Guadalupe River in January 1983, resulting in substantial damages to residential and other structures and the potential for loss of life.

Since the hydrology for future conditions is assumed to not change significantly from existing conditions, the residual fluvial flood risk is expected to remain the same as existing conditions. Nuisance flooding of the storm drain network is expected to increase with time due to SLC. Recent work by (NOAA, 2014) shows a national trend of increased nuisance flood days, as well as the regional trend (from the San Francisco tide gage 9414290) showing similar results. Conditions at the hydrologic study area are expected to be similar. However, this increase in nuisance flooding may be mitigated, as the City of San Jose plans to upgrade the storm drain network in the future.

4 FUTURE WITH-PROJECT CONDITION

4.1 WATERSHED

Ignoring climate change effects, the with-project features (levees and ecotones) will not have any significant effect on the drainage of the watershed and therefore the future with-project condition for the Coyote watershed is expected to remain the same as under the future without-project condition given in Section 3.1 (Watershed) of this report. However, the future with-project condition will show a significant improvement over the future without-project condition when climate change effects are considered. The with-project levee features will prevent the coastal flood inundation of the downstream portion of the Coyote watershed (i.e. the hydrologic study area).

4.2 HYDROLOGY

Construction activities for the future with-project condition are expected to cause temporary disruptions to drainage paths of minor significance. These effects will be short-term and therefore the future long-term hydrology of the with-project condition is assumed to be the same as for the future without-project condition given in Section 3.2 (Hydrology) of this report, with the exception of pond breaching. Pond breaching will have a significant effect on the existing storage capacity between the outboard pond-dike and the newly constructed levee system and will alter the habitat distribution in that area. However, inboard of the levee system the hydrology is expected to remain the same.

4.3 FLUVIAL HYDRAULICS

The proposed levees will tie into the existing riverine levees on Guadalupe River/Alviso Slough and Coyote Creek. The proposed geometry would not reduce the available flow area or constrict the flow in the channel; therefore, it will not have an effect on water surface elevations in Guadalupe River/Alviso Slough or Coyote Creek. HEC-RAS models of Coyote Creek and Guadalupe River/Alviso Slough used in the without-project analysis were modified per the proposed levee design. Also, maximum tidewater elevations were increased in the with-project models to 15 feet NAVD88 to account for storm surge effects (that were not accounted for in the without project conditions). Minimum tidewater elevation under both without and with-project conditions was 2.83 ft NAVD88. Flow hydrographs representing the 1%, 0.4% and 0.2% ACE flood events were used for the with-project analyses for both watercourses. Federally constructed riverine levees on both Coyote Creek and Guadalupe River were designed to safely contain the 1% ACE flood event. Flows of magnitude equal to or less than the 1% ACE flood event will be contained in the channels within the hydrologic study area. Modeling results indicate that neither modification of the cross-section geometries (to account for the coastal levee) nor increasing the tidewater elevation to a maximum value of 15 feet NAVD88 had a significant effect on predicted backwater profiles or breakout flow rates (all changes were less than 2% -- see Tables 19.1 and 19.2 in Annex 1 (Riverine Hydraulics) of this report).

4.3.1 COYOTE CREEK

The future with-project hydraulics for Coyote Creek are expected to remain essentially the same as under the existing condition, which is given in Section 2.3.1 (Coyote Creek) of this report.

4.3.2 GUADALUPE RIVER (ALVISO SLOUGH)

The future with-project hydraulics for Guadalupe River are expected to remain essentially the same as under the existing condition, which are given in Section 2.3.2 (Guadalupe River (Alviso Slough)) of this report.

4.4 TIDAL HYDRAULICS

The with-project tidal hydraulics are significantly changed from the without-project condition. The with-project condition will have a levee of either 13.5 feet NAVD88 or 15.2 feet NAVD88 elevation in height, with the height of the levee depending on the alternative selected for the project. As shown in Table 20 (USACE High SLC Scenario - ACE Water Levels, Ext - Coyote Creek Gage, Int – Alviso), even under the USACE High SLC rate, the residual tidal flood risk has been significantly reduced, below the 0.2% ACE (500-year return period) tidal flood event up to 2057, and the 15.2 feet NAVD88 levee past 2067.

4.5 SEDIMENT DYNAMICS

The UnTRIM-SediMorph Bay-Delta modeling system was used to model bathymetry for the Year 50 (2067) with-project condition (see Annex 3 of this report (South San Francisco Bay Long Wave Modeling Report)). The model simulations incorporate both the expected accretion within the project ponds, which has been estimated as part of the ecosystem design (ESA PWA, 2012), as well as estimated channel evolution in the vicinity of the project area. It is expected that the channel and mudflat bathymetry in the project area may evolve in response to both sea level rise and due to channel adjustment, which will occur following the opening of the salt ponds to tidal action. The analysis makes use of three different methods of evaluation which use a combination of modeling and historical data analysis to estimate channel evolution in the vicinity of the project area for Year 50 condition.

First, a comparison between bathymetric and LiDAR data collected in 2004 and 2010 allowed for an assessment of the channel evolution that has occurred in the Coyote Creek region following the breaching of the three island ponds (Ponds A19, A20, and A21) in March 2006 under the South Bay Salt Ponds Restoration Project. This analysis considered the channel evolution in the project area for subtidal, intertidal and marsh areas. Second, sediment deposition patterns in mudflat and marsh areas in the Coyote region were evaluated through a short sediment transport simulation during a period when a strong net sediment flux into the Far South Bay was observed at Dumbarton Bridge. Third, the expected channel scour resulting from the restoration of Ponds A9 through A15 and Pond A18 to tidal action were investigated through simulations of channel shear stress and velocity under existing conditions and under future conditions with SLC and projected Year 50 pond bathymetry. Finally, the results of the three separate analyses were combined into a single estimate of bathymetric change in the project area to establish Year 50 (2067) conditions which included 2.13 feet (0.649 m) of sea level rise based on Modified NRC Curve III and the planned restoration of Ponds A9 through A15 and Pond A18 [see Figure 11 (Predicted Bathymetric Change for With-Project Conditions for Year 50 (2067)].

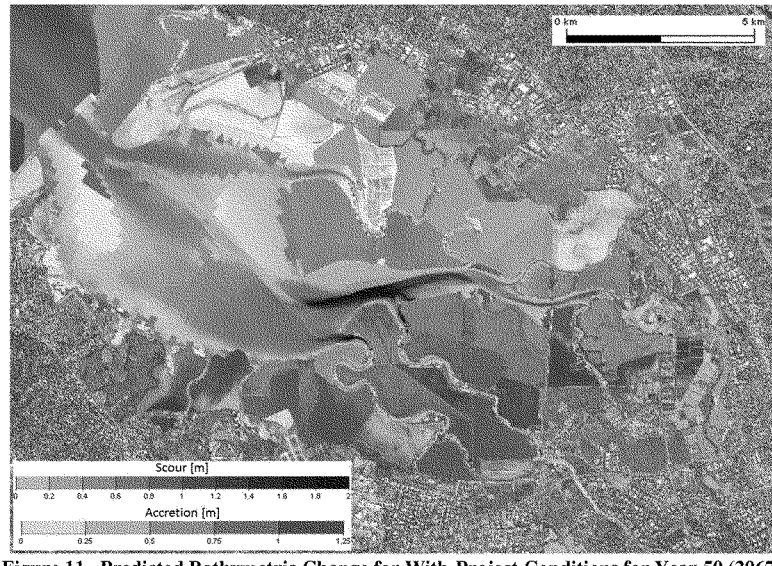


Figure 11. Predicted Bathymetric Change for With-Project Conditions for Year 50 (2067)

4.6 WATER WAVES

4.6.1 SEAS (WIND WAVES)

There has not yet been enough research conducted on a regional scale to determine climate change effects for the hydrologic study area, and the seas statistics for the hydrologic study area are assumed to be the same as under the existing condition given in Section 2.6.1 (Seas (Wind Waves)). While significant wave heights can reach up to 1.5 feet (see Table 16 (Wind Waves (Seas) Look-up Table for Point 7 of the Numerical Model)), the occurrence of large waves is associated with a very low probability (as can be inferred from Table 11 (Comparison of 1% ACE Water Level with Prior Studies)) and did not affect the design crest elevation of the with-project levee.

4.6.2 SWELL

As mentioned in Section 2.6.2 (Swell), swell will have an insignificant effect on the total water elevation for the South San Francisco Bay adjoining the hydrologic study area. The uncertainty in Coyote Creek extreme water level statistics, given in Section 2.4.4 (Variability in Extreme Water Level Statistics), are much larger than the swell; and therefore the with-project levee design is still considered conservative, even without accounting for swell.

4.6.3 TSUNAMI

The future with-project condition for tsunami inundation for the hydrologic study area may change from the existing and future without project conditions. The red area for tsunami inundation shown in (CEMA, 2009) may move shoreward towards Alviso. However, the community of Alviso is still not at risk from tsunami inundation; the with-project levee system will provide sufficient protection from tsunami inundation for the community.

4.7 WATER SURFACE ELEVATION DEFINED HABITATS

As described in Section 4.5 (Sediment Dynamics), the UnTRIM-SediMorph Bay-Delta modeling system was used to model the bathymetric changes in Year 50 (2067) future with-project condition, with the results shown in Figure 11 (Predicted Bathymetric Change for With-Project Conditions for Year 50 (2067)). The results for the hydrologic study area suggest that the majority of the sediment accretion will occur in marsh areas, that relatively little deposition will occur in mudflat areas, and that channel areas are likely to scour downstream of pond areas that are restored to tidal action. Further details are given in Annex 3 of this report (South San Francisco Bay Long Wave Modeling Report).

4.8 FLOOD RISK

4.8.1 WITH-PROJECT FLOOD RISK

Building the National Economic Development (NED) flood risk management structure (the 13.5 feet NAVD88 levee) will significantly reduce the tidal flood risk to the Alviso community. The risk of tidal flooding at Alviso ranges from an approximately 1 in 50 chance to a 1 in 2 chance at Year 2067, depending on the chosen SLC scenario. There is an approximately 1 in 50 chance of Alviso suffering a tidal flood event under the USACE Intermediate SLC scenario in any given year. The risk of tidal flooding over a 30-year mortgage period for the three SLC scenarios varies from less than a 1 in 100 chance to a 1 in 7 chance.

Building the recommended locally preferred plan (LPP) flood risk management structure (the 15.2 feet NAVD88 levee) will nearly eliminate the tidal flood risk to the Alviso community for the foreseeable future. The additional 1.7 feet of height over the NED structure further reduces the tidal flood risk to contain events much greater than those mapped by the FEMA or the USACE in 2017, and still greater than the potential FEMA base flood event by 2067.

The consequences of a tidal flood at Alviso would be similar to the consequences of the riverine flood of the Guadalupe River in January 1983, resulting in substantial damages to residential and other structures and the potential for loss of life. Building either the NED or LPP levee will provide tidal flood risk reduction sufficient to contain an event of similar magnitude to the Guadalupe River flood event of January 1983.

4.8.2 RESIDUAL FLOOD RISK

It is impossible to design and build a flood risk management structure that will provide a 100% guarantee against flooding; there will always be some remaining risk of flooding. Residual flood risk is the risk that remains after all flood risk management actions have been taken (including the building of structures, and non-structural solutions such as flood warning systems, floodplain management plans, emergency action and evacuation plans, flood related building codes, etc.). The 0.2% ACE, or 500-year return period, flood event is typically used to quantify and estimate the residual risk of a project. Expected annual damages (EAD) are also used to estimate and quantify residual risk. The residual flood risks for the hydrologic study area include tidal flooding from the San Francisco Bay, riverine flooding from the Guadalupe River and Coyote Creek, and storm water drainage flooding from the existing storm drain network. Figure 12 shows the composite area of residual flood risk from these

flooding sources.

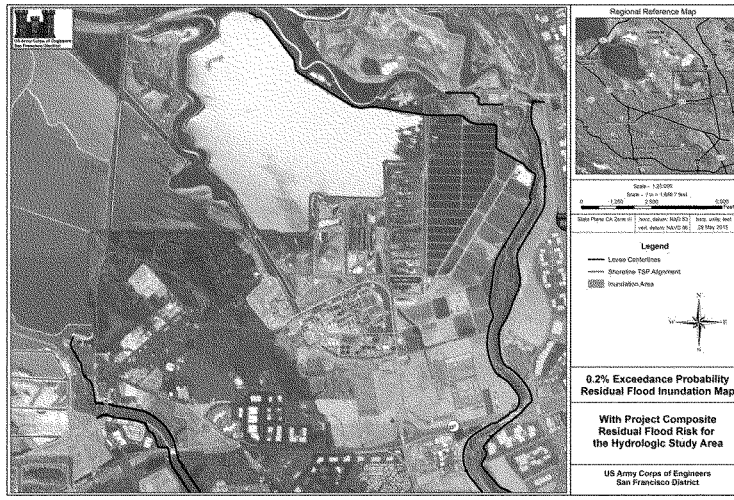


Figure 12. Residual Flood Risk for the Hydrologic Study Area

The residual tidal flood risk at 2017 building either the NED levee or LPP levee is so small that it could not be mapped in Figure 12 and its EAD is negligible (nearly $0). By 2067 the EAD is still very low ($1M) for the NED levee and much less for the LPP levee, with still very little area mapped for the 0.2% ACE event.

Once the tidal flood risk management project is built, the largest residual flood risk in the hydrologic study area will come from riverine flooding from the Coyote Creek and Guadalupe River. The residual riverine flooding for the Coyote Creek and Guadalupe River were taken from Plates 50 and 55 of Annex 1 and shown in Figure 12. Flood waters for Coyote Creek break out above the hydrologic study area and do not appear in Figure 12. By far the largest source of residual flooding comes from the Guadalupe River (compare Figure 12 to Plate 55 of Annex 1).

An evaluation of the existing storm drain network has been performed by the City of San Jose [(Schaaf & Wheeler, 2008); (Schaaf & Wheeler, 2010)]. Future residual flood risk from storm water drainage is expected to remain as nuisance flooding, with no appreciable damages or changes to the EAD (see Figure 2-10 from Schaaf & Wheeler, 2008). Nuisance flooding from the storm drain network is expected to remain the same as described in Section 3.8, with the number of nuisance flood days increasing, but no significant effect on the EAD.

5 CONCLUDING REMARKS

5.1 SUMMARY

Water resources engineering technical work for the South San Francisco Bay Shoreline Study Phase 1, Alviso Economic Impact Area, spans a decade of effort and supports the planning and Federal interest determination for the study. This report is not intended to be inclusive of all the technical work that has been performed for the study, but rather a summary of relevant technical analyses used in the study to support the planning and Federal interest decision processes. This report summarized relevant analyses, data, results, and other information on the watershed, hydrology, fluvial hydraulics, tidal hydraulics, sediment dynamics, water waves, and flood risk for the hydrologic study area. Of particular importance was the tidal hydraulics and the transferring of tide data from the long record at the San Francisco tide gage to the hydrologic study area (the Coyote Creek tide gage), which is described in more detail in Appendix F of the Integrated Document (Tidal Flood Risk Analysis Summary Report). The technical work described in this report has been reviewed following accepted USACE practice and is complete and sufficient for planning purposes, Federal interest determination, and selection of a recommended plan. No further water resources engineering work is required until the PED phase of the project.

5.2 HYDROLOGIC STUDY AREA TIDAL FLOOD RISK

Flood risk management projects on lower Coyote Creek and Guadalupe River have substantially lowered the risk of riverine flooding for the community of Alviso. The largest remaining flood risk for Alviso comes from tidal flooding. The community of Alviso is at significant risk from tidal flooding, with an approximately one in three chance of Alviso suffering a tidal flood event under in any given year. Under the existing condition, it is almost certain that tidal flooding will occur in Alviso within the next 30 years. Should flooding occur, damages similar to those experienced during the riverine flood of the Guadalupe River in January 1983 are expected.

Future sea level rise over the next fifty years will make it almost a certainty that tidal flooding will occur in Alviso in the absence of a flood risk management project. Building the 13.5 feet NAVD88 levee will significantly reduce the tidal flood risk to the Alviso community with the chance of tidal flooding in 2067 ranging from 1 in 2 to 1 in 50, depending on how fast sea level rises. For the next ten years after building the levee the chances of tidal flooding are significantly less than this range. Building the 15.2 feet NAVD88 levee will nearly eliminate the tidal flood risk to the Alviso community for the foreseeable future.

The residual tidal flood risk at 2017 after building either levee is so small that it could not be mapped on the 500-year floodplain and its expected damages are negligible (nearly $0). By 2067 the damages are still very low ($1M or smaller), with still very little area to be mapped. Riverine flooding and storm water flooding will become the largest sources of flood risk once the 13.5 or 15.2 feet NAVD88 levee is built.

5.3 FUTURE CONSIDERATIONS

No further water resources engineering work is required during the Feasibility phase of this project. Water resources engineering technical work will however be required during the Preconstruction Engineering and Design (PED) phase of the project. As is typical during the PED phase, USACE water resources staff will either be the lead engineer or support staff for the development of the Design Documentation Report (DDR). Typical DDR tasks required include refinements to project hydrology, storm statistics, and wave statistics, and determination of pertinent hydraulic design features. In addition, water resources staff will review the plans and specifications, conduct site visits, participate in value engineering (VE) studies, participate in contract negotiations, and other tasks as appropriate for the project.

Based on the technical work conducted during the Feasibility phase, the following items are recommended to be considered during the PED phase:

- Review of actual sea level change since this report and whether adaptive management or post-authorization actions are required;

- Review of changes to hydrology, and storm and wave statistics, since this report and whether these changes significantly affect the design of the project;

- Establishment of a long-term tide gage at Coyote Creek, and ensuring the survey of the gage meets the USACE's Comprehensive Evaluation of Project Datums (CEPD) criteria;

- The consequences associated with residual risk can be reduced with effective floodplain management and flood warning and evacuation plans. A plan to communicate residual flood risk to the affected community will be developed as part of the PED phase of the project;

- Development of flood inundation maps based on project hydrodynamics, to aid in the communication of flood risk to the community of Alviso.

6 REFERENCES

Barnard, P. L. et al., 2013. Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay Coastal System. *Marine Geology,* Volume 336, pp. 120-145.

Brown, G. L., 2010. *Sediment Analysis and Modeling for the South San Francisco Bay Shoreline Study, draft,* Vicksburg, MS: Coastal and Hydraulics Laboratory, ERDC, USACE.

CEMA, 2009. *Tsunami inundation map for emergency planning, Milpitas quadrangle.* Sacramento, CA: California Emergency Management Agency.

Cloern, J., Powell, T. & Huzzey, L., 1989. Spatial and temporal variability in South San Francisco Bay (USA), 2. Temporal changes in salinity, suspended sediments, and phytoplankton biomass and productivity over tidal time scales. *Estuarine, Coastal, and Shelf Science,* 28(6), pp. 599-613.

Deering, 2014. *Personal communication.* s.l.:s.n.

DHI, 2010. *Regional coastal hazard modleing study for North and Central San Francsico Bay, Final Draft* , Solana Beach, CA: DHI Water and Envrionement Inc..

ESA PWA, 2012. *Shoreline Study Preliminary Alternatives and Landscape Evolution,* San Francisco, CA: ESA PWA.

Flick, R. E., 2000. Time-of-day of peak tides in a mixed-tide regime. *Shore & Beach,* pp. 15-17.

Foxgrover, A. C. et al., 2004. *Deposition, erosion, and bathymetric change in south San Francisco Bay: 1858 - 1983,* Santa Cruz, CA: U. S. Geological Survey, Pacific Coastal and Marine Science Center.

Jassby, A., Koseff, J. & Monismith, S. G., 1996. Processess underlying phtoplankton variability in San Francisco Bay. In: J. T. Hollibaugh, ed. *San Francisco Bay: The Ecosystem.* San Francisco, CA: American Association for the Advancement of Science , pp. 325-349.

Knuuti, K., 1995. *Extreme tide prediction for San Francisco Bay,* Berkeley, CA: University of California.

Krone, R. B., 1979. Sedimentation in the San Francisco Bay System. In: T. J. Conomos, ed. *San Francisco Bay: The Urbanized Estuary.* San Francisco, CA: American Association for the Advancement of Science, Pacific Division .

Krone, R. B., 1996. Recent sedimentation in the San Francisco Bay System. In: J. T. Hollibaugh, ed. *San Francisco Bay: The Ecosystem.* San Francisco, CA: American Association for the Advancement of Science .

Leenknecht, D. A., Szuwalski, A. & Sherlock, A. R., 1992. *Automated Coastal Engineering System, users guide and technical reference,* Vicksburg, MS: Waterways Experiment Station, USACE.

May, C. et al., 2003. Effects of spatial and temporal variability of turbidity on phytoplankton blooms. *Marine Ecology - Progress Series,* Volume 254, pp. 111-128.

NHC, 2006. *Berryessa Creek Watershed Hydrology Report,* West Sacramento, CA: Northwest Hydraulic Consultants.

NOAA, 2014. *Sea Level Rise and Nuisance Flood Frequency Changes around the United States, Technical Report NOS CO-OPS 073,* Silver Spring, MD: National Oceanic and Atmospheric Administration, Center for Operational Oceanographic Products and Services.

NRC, 1987. *Responding to Changes in Sea Level: Engineering Implications,* Washnington, DC: National Research Council, The National Acadamies Press.

NRC, 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future,* Washington, DC: National Research Council, The National Acadamies Press.

OBA, 1992. *Sediment Budget Study for San Francisco Bay,* Portland, OR: Ogden Beeman & Associates and Ray B. Krone & Assoicates.

Oltman-Shay, J. & Hathaway, K., 1989. *Infragravity energy and its implications in nearshore sediment transport and sandbar dynamics,* Vicksburg, MS: Coastal Engineering Research Center, USACE.

Powell, T., Cloern, J. & Huzzey, L., 1989. Spatial and temporal variability in South San Francisco Bay (USA), 1. Horizontal distributions of salinity, suspended sediments, and phytoplankton biomass and productivity. *Estuarine, Coastal, and Shelf Science,* 28(6), pp. 583-597.

PWA, 2007. *South Bay Salt Pond Restoration Project Flood Analyses Report,* San Francisco, CA: Phillip Williams and Associates.

Schaaf & Wheeler, 2008. *Alviso storm drain evaluation and capital improvement plan,* Santa Clara, CA: Schaaf & Wheeler Consulting Engineers.

Schaaf & Wheeler, 2010. *Hydrology and Water Quality for San Jose, California, Envision San Jose 20240,* Santa Clara, CA: Schaaf & Wheeler Consulting Engineers.

Schoellhamer, D., 1996. Factors affecting suspended-solids concentrations in South San Francisco Bay, California. *Journal of Geophysical Research - Oceans,* 101(C5), pp. 12087-12095.

Schoellhamer, D., 2011. Sudden clearing of estuarine waters upon crossing the threshold from transport to supply regulation of sediment transport as an erodible sediment pool is depleted: San Francisco Bay, 1999. *Estuaries and Coasts,* 34(5), pp. 885-899.

Scott, S. H., 2009. *South San Francisco Bay Shoreline Study, Sediment Transport and Fate from South Bay Streams,* Vicksburg, MS: Coastal and Hydraulics Laboratory, ERDC, USACE.

SCVWD, 1983. *Report on flooding and flood related damages, Santa Clara County, January 1 to April 30, 1983,* San Jose, CA: Santa Clara Valley Water District.

SCVWD, 2007. *San Francisquito Creek Hydrology Study,* San Jose, CA: Santa Clara Valley Water District.

Smith, J. M., 2009. *Short-Wave modeling for South San Francisco Bay Shoreline Study, draft,* Vicksburg, MS: Coastal and Hydraulics Laboratory, ERDC, USACE.

Teeter, A. M. et al., 2001. Hydrodynamic and sediment transport modeling with emphasis on shallow-water vegetated areas (lakes, reservoirs, estuaries and lagoons). *Hydroniologia,* Volume 444, pp. 1-23.

USACE, 1977. *Hydrologic Engineering Office Report, Guadalupe River and Coyote Creek, Santa Clara County, California,* San Francisco District, CA: San Francisco District.

USACE, 1984. *Tidal Stage versus Frequency Study,* San Francisco, CA: San Francisco District.

USACE, 1988. *Office Report, Southern Alamenda and Santa Clara Counties, Interim San Francisco Bay Shoreline Study,* San Francisco, CA: San Francisco District.

USACE, 1991. *Guadalupe River, General Deisgn Memorandum, Volume 1 of 2,* San Francisco, CA: San Francisco District.

USACE, 1996. *Risk-Based Analysis for Flood Damage Reduction Studies, EM 1110-2-1619,* Washington, DC: Headquarters.

USACE, 2001. *Coyote Creek at Rock Springs Road, Review of Existing Hydrology,* San Francisco, CA: San Francisco District.

USACE, 2004. *South San Francisco Bay Shoreline Project, Section 905(b) (WRDA 86) Analysis,* San Francisco, CA: San Francisco District.

USACE, 2006. *Risk analysis for flood damage reduction studies, ER 1005-2-101,* Washington, DC: Headquarters.

USACE, 2009. *Guadalupe Watershed Hydrologic Assessment,* San Francisco, CA: San Francisco District.

USACE, 2010. *Standards and Procedures for Referencing Project Evaluation Grades to Nationwide Vertical Datums, EM 1110-2-6056,* Washington, DC: Headquarters.

USACE, 2011a. *Memorandum for Commander, South Pacific Division (CESPD-PD), Subject: Issue Resolution Plan for the South San Francisco Bay Shoreline Study, California.* Washington, DC: Headquarters.

USACE, 2011b. *Sea-Level Change Considerations for Civil Works Programs, EC 1165-2-212,* Washington, DC: Headquarters.

USACE, 2013. *Incorporating Sea Level Change in Civil works Programs, ER 1100-2-8162,* Washington, DC: Headquarters.

USGS, 2005. *South Bay Salt Pond Restoration project short-term data needs, 2003 - 2005,* Vallejo, CA: U. S. Geological Survey.

Walters, R. A., Cheng, R. T. & Conomos, T. J., 1985. Time scales of circulation and mixing processes of San Francisco Bay waters. *Hydrobiologia,* pp. 13-36.

Zervas, C., 2009. *Sea Level Variations of the United States 1854–2006, NOAA Technical Report NOS CO-OPS 053,* Silver Spring, MD: NOAA.

Zoulas, J., 2013. *A sediment budget for the San Francisco Bay, and implications for regional sediment management,* San Francisco, CA: USACE, San Francisco District.

ANNEX 1: RIVERINE HYDRAULICS

South San Francisco Bay Shoreline Study
Santa Clara County & Alameda County, California

RIVERINE HYDRAULICS

U.S. Army Engineer District, San Francisco
Corps of Engineers
San Francisco, California
May 2013

Due to its large size, Annex 1 of Appendix D1 of the South San Francisco Bay Shoreline Study, Phase 1, Alviso Economic Impact Area report, will be provided under its own separate cover.

ANNEX 2: DOCUMENTATION OF STORM DATA ANALYSIS

14 January 2008

CESPN-ET-EW

Memorandum for Record

Subject: South San Francisco Bay Shoreline Study, Documentation of Data Analysis

Introduction

The purpose of this memo is to document coastal data analysis related to the risk-based statistical and uncertainty analyses of coastal flood stages. Most of the analyses summarized below address tasks D2, D3, and A5 of the "South San Francisco Bay Shoreline Study Scope of Work & Related Documents" (McAdory, 2006) and the recommendations of "South San Francisco Bay Shoreline Study Review of Proposed Technical Approach" (Collins, Dean, and Divoky, 2006). This memo includes background information on coastal flood forcing parameters, discussion of the statistical analysis of tide and wind data, and discussion of the application of different statistical approaches for flood stage frequency analysis.

Background information in Section 1.0 provides a general sense (order of magnitude) of the contributions of each forcing parameter to coastal flood elevation. Section 2.0 summarizes the collection of tide and wind data and the derivation of their related recurrent frequency curves using different statistical approaches. These curves were compared against each other to determine appropriate criteria for the selection of extreme events to be used for stage frequency analysis. Statistical approaches using historical data alone and using synthesized data were applied to estimate flood stage frequencies at a tide gage in San Francisco. Both annual peak and conditional sampling methods were adopted to select extreme events for stage frequency analysis at this tide gage.

Section 3.0 summarizes the development of flood stage frequency curves for a tide gage near the Dumbarton Bridge—the closest gage to the project site with a sufficient length of tide data records—using two different statistical approaches. In the first approach,

selected San Francisco gage historical data was transferred to Dumbarton Bridge based on assumptions supported by the tide data and by hydrodynamics for the establishment of preliminary flood stage frequencies. The other statistical approach, using synthesized data and employing the Joint Probability Method, was fully developed for this study and the computational procedures were exercised to combine predicted tide and residual tide (tide parameters that are defined in Section 1.0) for stage frequency analysis at Dumbarton Bridge. The results developed from both statistical approaches are in good agreement and will be useful in future computation plan development. Further analysis and integration of a complete set of coastal flood forcing parameters, including in-bay wind set-up and wave set-up, will be carried out at a later stage of this study.

1.0 Background Information

(A) High predicted (or astronomical) tide, tidal residual, and wind have been identified as primary contributors to coastal floods in South San Francisco Bay. A linear process was assumed to decouple the measured (verified) tide into two components, predicted tide and residual. The residual is primarily generated by offshore storm systems due to its central and peripheral barometric pressure difference. Additional El Niño effects due to ocean water expansion could also contribute to the residual.

(B) The predicted tide at the project site in South Bay is approximated by amplifying flood tide stage at the San Francisco (Presidio) tide gage by a factor of 1.31 to 1.59, values derived using data available at NOAA's Tides and Currents website. This gives the project site a tide range of about 7.6 to 9.3 feet between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW). The amplification can be attributed to water depth and geometry effects of the South Bay. The residual is a long wave with durations ranging from 2 to 8 days and peak heights ranging from 0.8 to 3.7 feet at the Presidio. The effect of El Niño on the total residual is about 0.5 to 1.0 foot at the Presidio. The range of peak heights of the residual at the project site is expected to be the same as or slightly reduced from the range at the Presidio. Two other variables at the project site, the storm duration (or residual duration) and the residual's phase relationship with predicted tide, are also expected to either remain unchanged or have slight changes from what is

observed at San Francisco. A 0.4-foot wind-induced setup at Alviso, calculated by a FEMA-recommended 1-D wind setup model under a 40 mile-per-hour (mph) uniform northwest (NW) wind, has been reported.

(C) A significant event has been characterized as the combination of high predicted tide (heights exceeding neap tide, or about 5.4 feet MLLW), large residual (heights exceeding 1.5 feet), and strong bay winds (larger than 20 mph). It is estimated that the ranges of contributions of predicted tide, residual, and wind setup to the total surge at the project site are about 3 to 4 feet, 1.5 to 3 feet, and 0.5 to 1 foot, respectively, above Mean Tide Level (MTL). The corresponding wave height is about 3 to 4 feet and wave period is about 6 to 7 seconds. The wave induced setup could be on the order of 1 foot or smaller.

(D) Once the response functions at the project site are generated, either by numerical simulation or by analysis of measured data, one can apply joint probability method (JPM), Monte Carlo simulation (MCS), and empirical simulation technique (EST) to estimate coastal flood statistics. Fluvial flood statistics will be estimated through hydrologic and hydraulic analysis and modeling. The combined flood statistics in the area affected by fluvial and coastal flood events will also be estimated through statistical analysis or computer modeling approaches.

2.0 Statistical Analysis of Tide and Wind Data

Analysis of Tide Data at San Francisco (Presidio) Gage

Statistical analysis was performed on tide data collected at the San Francisco gage (Station 9414290). Two sets of data were available at NOAA's Tides and Currents webpage: verified (or measured) data and predicted data. A third set of data, residual data, was calculated by subtracting, at a given time, the predicted data from the verified data. Data from 1901 to 2005 (a span of 105 years) was collected. The annual peak values of all 105 years are shown in Plate 2-1.

Plate 2-1 shows that a sizable number of the annual peak verified data values fall below the annual peak predicted data values for their respective years, with some numbers significantly lower than the predicted data value. Plotting the annual mean values for hourly verified, predicted, and residual data (Plate 2-2) shows that a trend exists in both the verified and residual data but not in the predicted data. This trend corresponds to the rise in sea level at the San Francisco gage.

In order to achieve more reliable statistical analysis, the water level trend was removed from both the annual mean verified data and the annual mean residual data, in a manner similar to the mean sea level trend adjustment done by Knutti (1995). The predicted data was left unchanged. The year 2005 was assumed as the year not needing trend adjustment. Plate 2-3 shows the results of this treatment. The new annual mean verified and annual mean residual data have trend lines that are a constant height above the datum used (MLLW, 1983-2001 Tidal Datum Epoch).

The adjustments in mean verified and mean residual values for each year were then applied to all tide data used in this statistical analysis. Plate 2-4 shows adjusted annual peak values. Table 2-1 shows the unadjusted annual peak tide values selected, the adjustment increment applied to each year's tide values, and the adjusted annual peak values, with water level trend removed (it was not necessary to adjust predicted tide data).

The following statistical analyses were performed on the tide data:

(A) A return period curve based on annual peak verified data was produced. Annual peak verified values with the water level trend removed were used to produce Normal, Weibull, and Gumbel cumulative distribution functions (CDFs), which were converted into the return period curves shown in Plate 2-5.

(B) The annual peak sampling method may create error and uncertainty for extreme probabilistic analysis in that it may fail to capture multiple significant events occurring in a given year (i.e. only the greatest event in a year is sampled). If an event were to produce tide levels that are not the peak of the year, but exceed the peaks of other years, it would not be sampled by the annual peak method. This is especially problematic during El Niño years, which occur every 7 to 14 years along the west coast of the United States and have historically shown the tendency to produce multiple significant events within a given year, as observed in the tide

data at the San Francisco gage. The conditional sampling method can address the deficiencies of annual peak sampling and improve the accuracy of statistical analysis in the lower recurrent frequency range (larger return period) by capturing the most significant events regardless of calendar year.

The conditional sampling method was used to select significant events for coastal flood stage analysis. In general, high predicted tide, residual, wind set-up, wave set-up and run-up, and river discharge are the forcing parameters contributing to coastal floods at the project site (wind speed is not considered a parameter because its generated wind set-up is negligible in the deep water area). High predicted tide and residual are generated offshore and propagate into the project site, while wind set-up and wave run-up are generated inside the South Bay and contribute to flood levels in the shallow water area. River discharge has been tested by computer simulation and concluded to be negligible in the coastal area. Therefore, high predicted tide and residual at the San Francisco gage were the two parameters considered for the selection of significant events.

Conditional sampling was done on the 105 years of tide data at San Francisco to select extreme events for statistical analysis. In order to focus on more extreme tide events, two conditions—predicted data exceeding 4.5 feet MLLW and residual data exceeding 1.5 feet MLLW—were used to capture tide data where high residual events coincided with high tides. Selected tide data occurring at adjacent times were grouped together, and 11-day tide time series of predicted and residual tide data were plotted across these groupings, producing 37 time series graphs (Plates 2-6 to 2-15). From examination of these 37 graphs, 47 high residual events (pulses along the residual time series) were identified, and 3-day time series were plotted across them. Maximum verified, predicted, and residual values were collected within each of these 47 3-day time series (Table 2-2), and three return period curves based on the 47 maximum verified values (Plate 2-16) were produced for comparison.

(C) An additional condition was added to the conditional sampling analysis performed in (B) to ensure that, for each event, the sum of the maximum predicted tide and maximum residual was larger than the minimum annual peak predicted tide at the San Francisco gage during the 105 years. Looking at the values in Table 2-1, the range of annual peak predicted tide at the San Francisco gage is 6.9 to 7.26 feet MLLW. The addition of this condition was done to reduce the previously selected 47 events to a smaller size of sample in order to minimize computation efforts for

statistical analysis. The sampled events, however, had to maintain sufficient characteristics to represent the system under study.

All tide data in Table 2-2 associated with verified values below 6.9 feet MLLW was eliminated. This reduced the number of time series in Table 2-2 from 47 to 33 (Table 2-3). Three return period curves derived from the 33 verified values (Plate 2-17) were produced for comparison.

Plate 2-17 shows that the Gumbel curve fits the data well in the lower recurrent frequency range (larger return period range) and will be applied for any future related analysis. Comparison of the Gumbel curves developed from 47 events and 33 events and the stage frequency curve generated from annual peak tide (Plate 2-18) shows close alignment in the return period range of 5 to 100 years. This would confirm that the selected 33 extreme events is representative of the system.

(D) To further analyze the tide data, the phase relationship between predicted tide and residual tide time series (the positioning of the residual time series in relation to the predicted time series) was studied. Tests were done by taking a residual time series and shifting it along the predicted time series, thereby changing the phase of the residual data to observe its effects. Phase-shift decay factors (ratios of the maximum tide stage at a given phase to the maximum tide stage for all phases) were derived by creating 2-day, 3-day, 4-day, 5-day, 6-day, and 8-day synthetic residual events and phase-shifting them across real predicted tide time series, starting the peak residual of an event at a peak tide and then shifting the peak residual 3, 4, 5, 6, 7, 8, 17, 18, and 21 hours ahead along the time series (see Plate 2-19), obtaining the maximum tide stage (sum of the predicted and residual values) at each of these phase shifts, then dividing each of these nine tide stage values by the largest tide stage value to obtain the decay factor for each phase shift (Table 2-4).

(E) The Joint Probability Method assumes that each forcing parameter in a system is independent, and that the combined probability function is equal to the product of the individual probability functions. In this study, four parameters were identified for joint probability analysis: predicted tide, residual tide, residual phase shift, and residual event duration (storm duration). This gave the joint probability for flood stage the following formula:

$$P = P_p \times P_r \times P_d \times P_s$$

Where P = joint probability for flood stage

P_p = probability for predicted tide elevation

P_r = probability for residual tide height

P_d = probability for residual event (storm event) duration

P_s = probability for residual phase shift

Using the tide data from 33 high residual events (Table 2-3), the product of probability functions for predicted tide and residual tide was computed by convolution integration (via Fast Fourier Transform, or FFT) of two Gumbel probability density functions (PDFs), one for the 33 maximum predicted values and the other for the 33 maximum residual values. The convolution result represents the statistical sum of the peak values of predicted tide and residual tide within their respective time series (i.e. $P_{p+r} = P_p \times P_r$). Thus the convolved function can be multiplied by probability functions for residual phase shift and residual event duration to obtain a resultant joint probability function of predicted tide and residual tide. The return period was calculated after applying a rate of occurrence factor to the results of the joint probability computation, to account for the less than one-to-one ratio of the number of events sampled (33) to the number of years sampled (105).

Plate 2-20 shows flood stage return period curves at the San Francisco gage determined by three methods: the annual peak sampling method, the conditional sampling method, and the joint probability method. The curves appear to be in relative proximity to each other, providing some confidence in the reliability of the joint probability method.

Analysis of Wind Data at San Francisco Airport

Statistical analysis was performed on wind data collected at San Francisco Airport (SFO). Hourly SFO wind speed and direction data between 1948 and 2007 was collected from NOAA's National Climatic Data Center website. Then the data was conditionally sampled,

first by eliminating all data not occurring between November and April of any given year, then selecting speed and direction data from times at which the wind speed exceeded 35 mph. Wind events were identified by grouping together data occurring at adjacent times. The maximum wind speed and associated wind direction were recorded for each of these events. A total of 257 sets of speed and direction values were recorded.

For these 257 maximum wind speeds, the Normal, Weibull, and Gumbel PDFs and CDFs were produced (Plate 2-21), and the CDFs were used to create return period curves (Plate 2-22). A separate set of maximum wind speeds was also created, with only those speeds occurring in the northwest direction (290 to 330 degrees). Normal, Weibull, and Gumbel PDFs and CDFs were also produced for this separate set of 59 values (Plate 2-23), and the CDFs used to create another set of return period curves (Plate 2-24). The Gumbel return period curves for wind speeds in all directions and wind speeds in the northwest direction are shown in Plate 2-25.

Wind direction distribution for the maximum wind speeds in all directions was determined by creating a histogram of the 257 events of wind direction values. This histogram is shown in Plate 2-26.

3.0 Methods for Determining Dumbarton Tide Stage Frequency Curve

Because of the scarcity of tide data at the South Bay gages, it was necessary to rely on the long record of data available at the San Francisco gage and adjust it for South Bay analysis. In order to "transfer" the data from San Francisco to the gages in the South Bay, tide amplification factors were found and used. Two methods were developed to perform this transfer and derive a flood stage frequency curve at Dumbarton Bridge.

First Method: Direct Transfer/Amplification of Tide Data from Selected High Residual Events at San Francisco

A tide stage frequency curve was developed for the Dumbarton tide gage by "transferring" to that location the data for 33 high residual events (Table 2-3) observed at the San Francisco gage (see Section 2.0 (B) and (C) for a description of how the events were

selected). The transfer was done specifically by amplifying predicted tide data.

First, each maximum verified tide value in Table 2-3 was "decoupled" by finding the predicted tide elevation and residual tide height corresponding to the time at which the verified maximum occurred. One time series, for February 6 to 9, 1998, was excluded from this exercise because it had an identical verified maximum value (occurring at the identical time) to the one for the time series between February 4 and 6, 1998. As a result, 32 predicted and 32 residual tide values were found for each verified maximum (Table 3-1).

Next, the zero means of the 32 predicted values were determined by subtracting 3.18 feet from each of them, a value representing the mean of predicted tide elevations at San Francisco and obtained from the NOAA website (by subtracting the station's Mean Tide Level and Mean Lower Low Water datum elevations). Then this new array of 32 zero-meaned predicted values was multiplied by 1.46, a value approximating the amplification factor of tides from San Francisco to Dumbarton and obtained from the NOAA website. Then the amplified predicted values were raised by 4.53 feet, a value for the mean of predicted tide elevations at Dumbarton, resulting in an array of 32 values for maximum predicted tide elevation relative to local MLLW at Dumbarton coinciding with 32 high residual events at San Francisco (Table 3-2, Column 7).

The maximum residual tide height at Dumbarton for each high residual event at San Francisco was assumed to be equal to the one-hour lag of (the residual value occurring one hour prior to) the decoupled residual value at San Francisco. The 32 Dumbarton residual values are shown in Table 3-3.

Finally, the 32 Dumbarton predicted values were added to the 32 Dumbarton residual values to produce 32 overall values representing maximum tide stages at Dumbarton occurring within the 32 high residual events at San Francisco (Table 3-4). These 32 values were then used to create a return period curve for Dumbarton tide stages based on Gumbel (maximum) analysis (Plate 3-1).

Second Method: Joint Probability of Four San Francisco Tide Parameters

Another tide stage frequency curve was derived for the Dumbarton tide gage by determining a joint probability of the probabilities at San Francisco for four parameters:

predicted tide, residual tide, residual phase shift, and residual event duration. The following is a walkthrough of the steps involved in the joint probability procedure, followed by a description of the procedure as it was exercised.

(A) Walkthrough of the Joint Probability Procedure

Steps:

1) Assumptions: All tides are larger than neap tides. Wind statistics are for in-bay wind.

2) The following criteria apply to the selection of significant tide events: (1) predicted tide is greater than 4.5 feet MLLW, (2) residual height is greater than 1.5 feet MLLW, and (3) measured (verified) tide is greater than 6.9 feet MLLW.

3) Thirty-three events are selected based on Step 2 (See Section 2.0 (B) and (C) for discussion of how events were selected).

4) At the NOAA website, verified (measured) tide data is subtracted by predicted tide data to obtain time series of residual data.

5) The duration of residual tide, which ranges from 2 days to 8 days, is the response of storm duration in water. The phase relationship between peak tide and peak residual is measured by the phase difference, in hours, within a 24-hour interval (1-day tide cycle).

6) Peak tides range from 5.4 to 7.2 feet MLLW and peak residuals range from 1.5 to 3.1 feet in the database developed in Step 3. PDFs and CDFs of peak tide and peak residual are developed. (See Section 2.0-(C)) Further analysis will be carried out regarding the development of appropriate PDFs of tide and residual for JPM and MCS.

7) Probability distribution of duration at Presidio

Duration (Day)	2	3	4	5	6	8	SUM	
Without El Niño	1	6	6	3	4	2	22	
With El Niño (+0.5')		1	1	2		1		5
With El Niño (+1.0')		1	2	2		1		6
		3	9	10	3	6	2	33

Probability distribution of phase relationship at Presidio

Phase difference (Hour)	0	3	4	5	6	8	17	18	21	SUM	
			3	1	4	2	5	2	1	13	2	33

8) Simulation conditions of tide, residual, duration and phase are selected to establish response functions. For instance, four cases are chosen for tide (5.4, 6.0, 6.6, and 7.2 feet), four cases for residual (1.5, 2.0, 2.5, and 3.1 feet) with 2-day duration and 6.6-foot tide plus residuals with 0 phase as boundary conditions, and an additional 26 cases (8 for 2-day, 9 for 3-day, 9 for 6-day) for a total of 34 cases.

Phase(hr)	2-day	2-day+0.5' base	2-day+1.0' base
0	1	1	1
6	1	1	1
18	1	1	1

More analysis will be needed before the final selection of simulation runs.

9) Synthesized events are developed based on the combination of tide (5.4 to 7.2 feet +), residual (1.5 to 3.1 feet +), duration (2-day to 8-day, with and without El Niño effect) and phase (0 to 21 hours).

10) Establish PDF and CDF of surge elevation based on response functions developed in Step 8. This process can be simplified by convolving PDFs of peak tide and peak residual and resampling with different residual durations and phase relationship to form a new population within the range of 6.9 feet to 10.3 feet for statistical analysis.

11) Establish PDFs and CDFs of wind statistics at SFO. (See Section 2.0)

12) Require computer model simulations of long wave, short wave and wave run-up in order to establish wind set-up, wave height & period and wave run-up for carrying out the complete set of statistical analysis.

(B) Application of the Joint Probability Procedure

The following describes the application of steps 1 to 10 of the joint probability procedure outlined in part (A). Because of the availability of a long record of tide data at the San Francisco gage, step 8 was modified so that the response function was developed using actual data, rather than simulated data.

<u>Derivation of PDF/CDF for the convolution of amplified SF predicted tide PDF with SF residual tide PDF</u>

Maximum verified, predicted, and residual tide data for 33 high residual events at San Francisco were used (Table 2-3). The zero means of the predicted values were calculated by subtracting 3.18 feet from each of the 33 values (mean of San Francisco predicted tide elevations relative to MLLW). The resulting values were then multiplied by 1.46 (amplification of tides from San Francisco to Dumbarton)

and then raised by 4.53 feet (mean of Dumbarton predicted tide elevations relative to local MLLW) to produce an array of 33 values representing maximum predicted tide elevations at Dumbarton occurring within the 33 high residual events at San Francisco. The maximum residual tide heights at Dumbarton were assumed to be the same as the residual tide heights at San Francisco during the 33 high residual events. Then two PDFs were created, one for the 33 Dumbarton predicted values and the other for the 33 Dumbarton residual values. The two PDFs were convolved (via FFT) to produce a PDF and a CDF at Dumbarton for 33 high residual events occurring at San Francisco (Plate 3-2).

Derivation of probabilities for different combinations of synthetic residual phase shift and synthetic residual event duration

Each of the 33 time series at San Francisco was examined to determine the probability for each possible residual phase shift and residual event duration shown in Table 2-4. The probabilities are shown in orange in Table 3-5, with the phase shift probabilities in the column to the right of the column of phase shifts (blue column), and the event duration probabilities in the row below the row of event durations (green rows). Probabilities were then determined for different combinations of synthetic residual phase shift and synthetic residual event duration (Table 3-5).

Joint probability of Dumbarton tide stage based on probabilities for Dumbarton predicted tide elevation, residual tide height, residual phase shift, and residual event duration

Using the Dumbarton PDF curve from Step 1 (Plate 3-2), probabilities for the combination of Dumbarton predicted tide elevation and residual tide height were determined at 0.2-foot intervals (Table 3-6). Then the probabilities for all combinations of Dumbarton predicted tide elevation, residual tide height, synthetic residual phase shift, and synthetic residual event duration were calculated, resulting in a column of joint probabilities (Table 3-7, Column 8). Decay factors from Table 2-4 were also applied to the tide stage intervals (Table 3-7, Column 4). The joint probabilities were sorted and grouped into intervals of tide stages (Table 3-8) and were then used to produce a return period curve (Plate 3-3).

John Cheng

Hydraulic Engineer

San Francisco District, USACE

Frank Wu, Ph.D., P.E.

Regional Technical Specialist

Estuarine Hydrodynamics

San Francisco District, USACE

Reference

Collins, J. Ian, Robert Dean and David Divoky. (2006). "South San Francisco Bay Shoreline Study Review of Proposed Technical Approach."

Knutti, Kevin. (1995). "Extreme Tide Prediction for San Francisco Bay."

McAdory, Robert. (2006). "South San Francisco Bay Shoreline Study Scope of Work and Related Documents."

Annual peak values based on hourly tide data at San Francisco gage (Station 9414290), for years 1901-2005 (105 years, includes data from 10 years with incomplete hourly records)

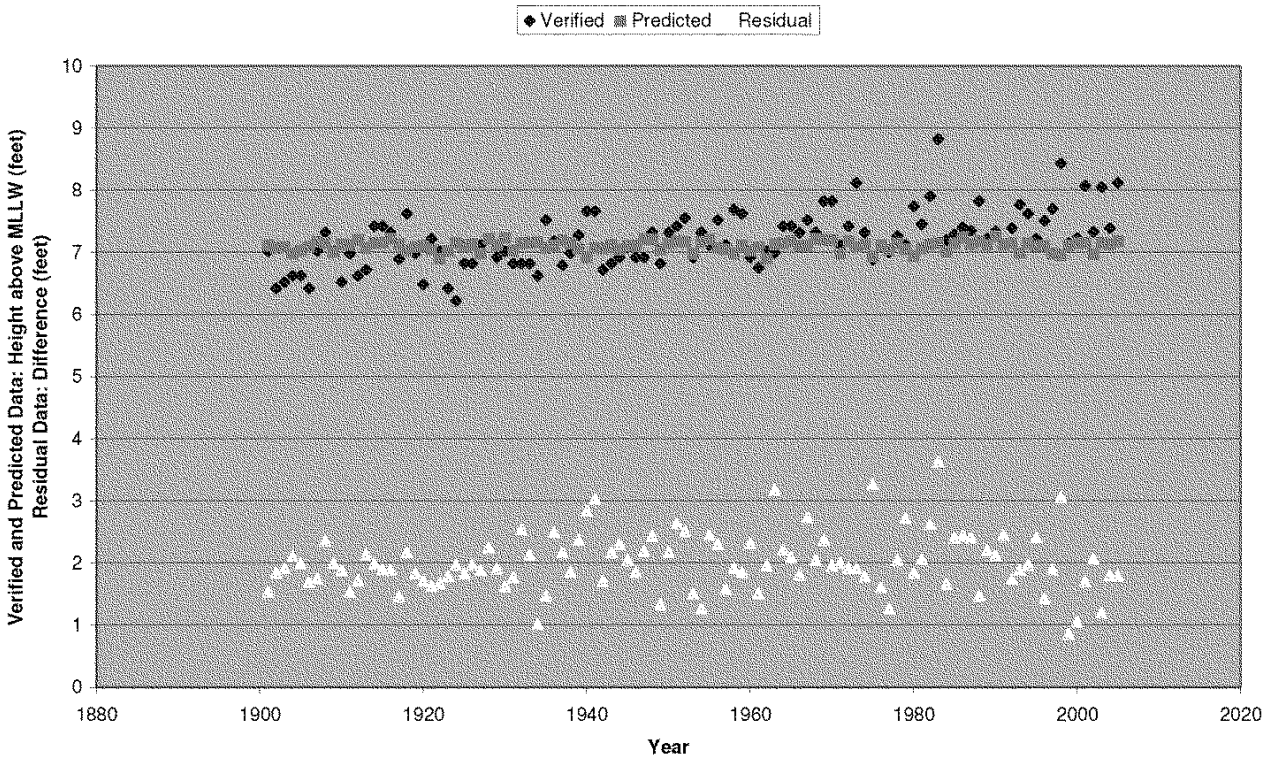


Plate 2-1

Annual mean values based on hourly tide data at San Francisco gage (Station 9414290), for years 1901-2005 (105 years, includes data from 10 years with incomplete hourly records)

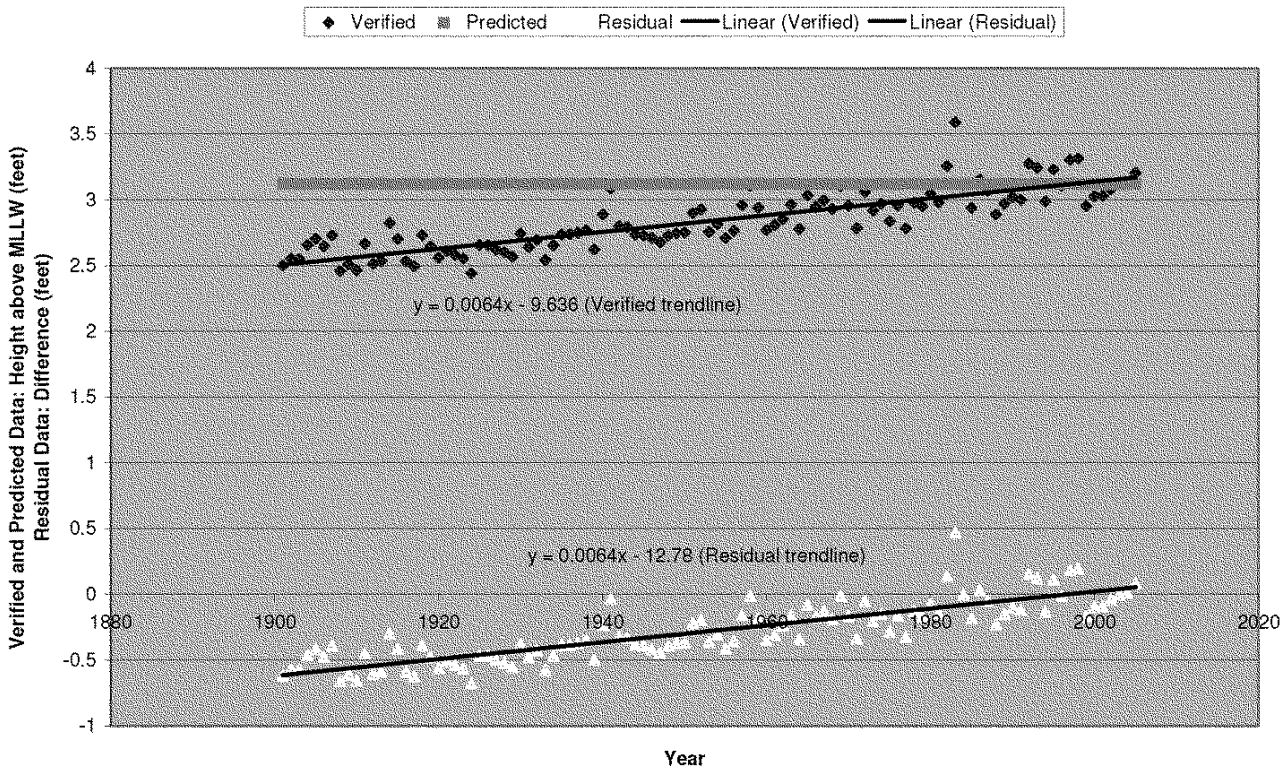


Plate 2-2

Annual mean values based on hourly tide data at San Francisco gage (Station 9414290), for years 1901-2005 (105 years, includes data from 10 years with incomplete hourly records)

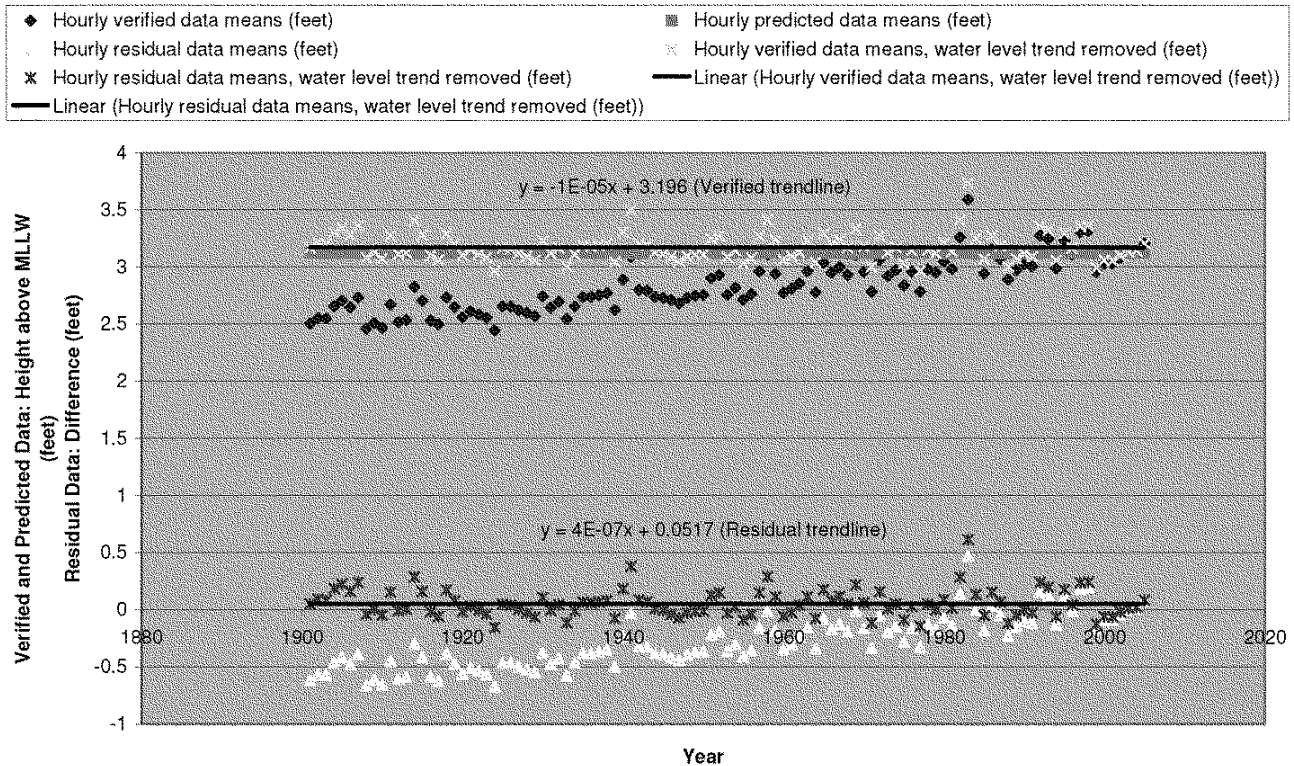


Plate 2-3

Annual peak values based on hourly tide data at San Francisco gage (Station 9414290), for years 1901-2005 (105 years, includes data from 10 years with incomplete hourly records, annual mean water level trend removed from verified and residual data)

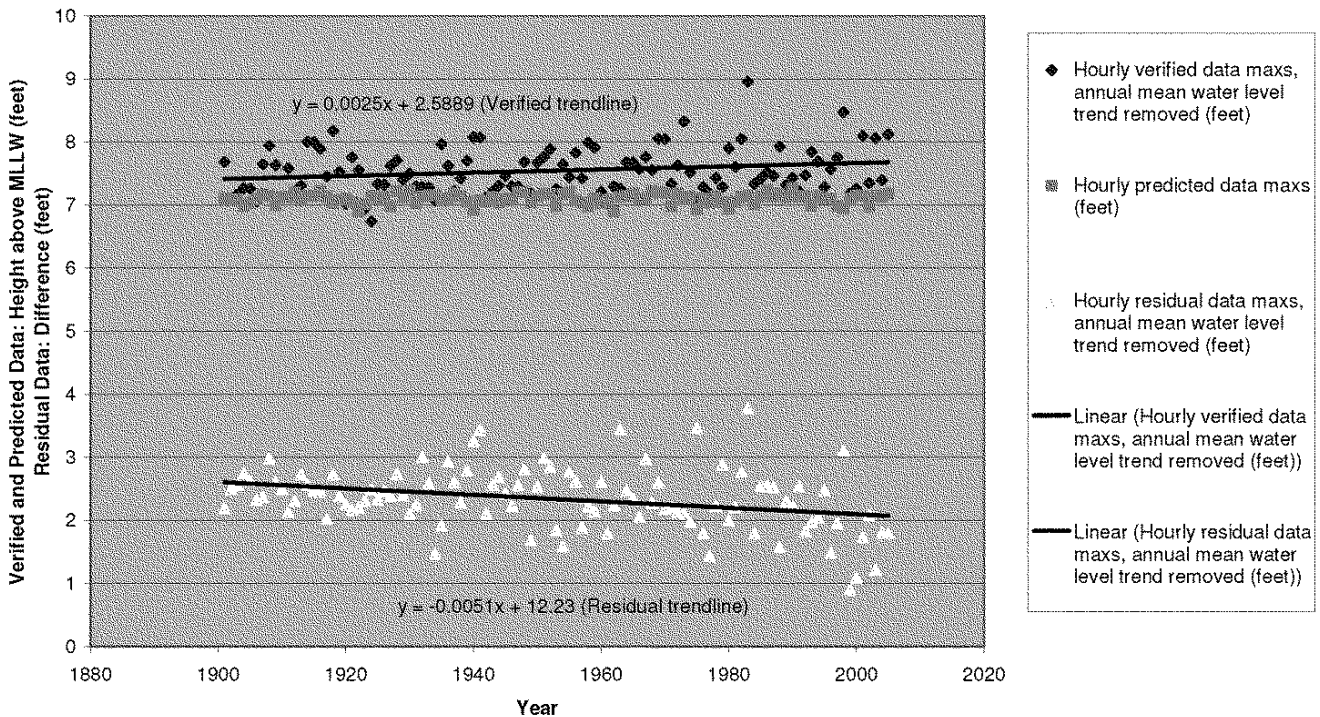


Plate 2-4

Year	Annual peak values of hourly verified data (feet MLLW)	Annual peak values of hourly predicted data (feet MLLW)	Annual peak values of hourly residual data (feet MLLW)	Annual adjustment in verified data mean (feet MLLW)	Annual adjustment in residual data mean (feet MLLW)	Annual peak values of hourly verified data, with annual mean water level trend removed (feet MLLW)	Annual peak values of hourly residual data, with annual mean water level trend removed (feet MLLW)
1901	7.02	7.11	1.53	0.6656	0.6656	7.6856	2.1956
1902	6.42	7.07	1.84	0.6592	0.6592	7.0792	2.4992
1903	6.52	7.09	1.91	0.6528	0.6528	7.1728	2.5628
1904	6.62	6.98	2.1	0.6464	0.6464	7.2664	2.7464
1905	6.62	7.03	1.99	0.64	0.64	7.26	2.63
1906	6.42	7.09	1.69	0.6336	0.6336	7.0536	2.3236
1907	7.02	7.17	1.75	0.6272	0.6272	7.6472	2.3772
1908	7.32	7.15	2.36	0.6208	0.6208	7.9408	2.9808
1909	7.02	7	2	0.6144	0.6144	7.6344	2.6144
1910	6.52	7.13	1.88	0.608	0.608	7.128	2.488
1911	6.98	7.12	1.53	0.6016	0.6016	7.5816	2.1316
1912	6.62	7.2	1.71	0.5952	0.5952	7.2152	2.3052
1913	6.72	7.07	2.14	0.5888	0.5888	7.3088	2.7288
1914	7.42	7.15	1.98	0.5824	0.5824	8.0024	2.5624
1915	7.42	7.15	1.9	0.576	0.576	7.996	2.476
1916	7.32	7.22	1.89	0.5696	0.5696	7.8896	2.4596
1917	6.89	7.13	1.46	0.5632	0.5632	7.4532	2.0232
1918	7.62	7.03	2.17	0.5568	0.5568	8.1768	2.7268
1919	6.98	7.08	1.83	0.5504	0.5504	7.5304	2.3804
1920	6.48	7.1	1.71	0.544	0.544	7.024	2.254
1921	7.22	7.05	1.63	0.5376	0.5376	7.7576	2.1676
1922	7.02	6.9	1.67	0.5312	0.5312	7.5512	2.2012
1923	6.42	7.02	1.78	0.5248	0.5248	6.9448	2.3048
1924	6.22	7.15	1.97	0.5184	0.5184	6.7384	2.4884
1925	6.82	7.11	1.82	0.512	0.512	7.332	2.332
1926	6.82	7.13	1.97	0.5056	0.5056	7.3256	2.4756
1927	7.12	6.98	1.88	0.4992	0.4992	7.6192	2.3792
1928	7.22	7.22	2.24	0.4928	0.4928	7.7128	2.7328

1929	6.92	7.12	1.91	0.4864	0.4864	7.4064	2.3964
1930	7.02	7.23	1.62	0.48	0.48	7.5	2.1
1931	6.82	7.03	1.77	0.4736	0.4736	7.2936	2.2436
1932	6.82	7.14	2.54	0.4672	0.4672	7.2872	3.0072
1933	6.82	7.15	2.13	0.4608	0.4608	7.2808	2.5908
1934	6.62	7.16	1.02	0.4544	0.4544	7.0744	1.4744
1935	7.52	7.07	1.47	0.448	0.448	7.968	1.918
1936	7.18	7.11	2.49	0.4416	0.4416	7.6216	2.9316
1937	6.79	7.19	2.17	0.4352	0.4352	7.2252	2.6052
1938	6.99	7.14	1.86	0.4288	0.4288	7.4188	2.2888
1939	7.28	7.06	2.37	0.4224	0.4224	7.7024	2.7924
1940	7.66	6.92	2.84	0.416	0.416	8.076	3.256

Table 2-1: Annual peak tide values selected, adjustments to peak values, and adjusted annual peak tide values

Year	Annual peak values of hourly verified data (feet MLLW)	Annual peak values of hourly predicted data (feet MLLW)	Annual peak values of hourly residual data (feet MLLW)	Annual adjustment in verified data mean (feet MLLW)	Annual adjustment in residual data mean (feet MLLW)	Annual peak values of hourly verified data, with annual mean water level trend removed (feet MLLW)	Annual peak values of hourly residual data, with annual mean water level trend removed (feet MLLW)
1941	7.66	7.07	3.03	0.4096	0.4096	8.0696	3.4396
1942	6.72	7.06	1.71	0.4032	0.4032	7.1232	2.1132
1943	6.82	7.12	2.17	0.3968	0.3968	7.2168	2.5668
1944	6.92	7.04	2.3	0.3904	0.3904	7.3104	2.6904
1945	7.08	7.1	2.05	0.384	0.384	7.464	2.434
1946	6.92	7.11	1.85	0.3776	0.3776	7.2976	2.2276
1947	6.92	7.21	2.19	0.3712	0.3712	7.2912	2.5612
1948	7.32	7.21	2.44	0.3648	0.3648	7.6848	2.8048
1949	6.82	7.04	1.33	0.3584	0.3584	7.1784	1.6884
1950	7.32	7.14	2.18	0.352	0.352	7.672	2.532
1951	7.42	7.18	2.64	0.3456	0.3456	7.7656	2.9856
1952	7.55	7.17	2.51	0.3392	0.3392	7.8892	2.8492
1953	6.92	6.98	1.51	0.3328	0.3328	7.2528	1.8428
1954	7.32	7.17	1.26	0.3264	0.3264	7.6464	1.5864
1955	7.12	7.21	2.45	0.32	0.32	7.44	2.77
1956	7.52	7.07	2.3	0.3136	0.3136	7.8336	2.6136
1957	7.12	7.04	1.58	0.3072	0.3072	7.4272	1.8872
1958	7.69	6.98	1.92	0.3008	0.3008	7.9908	2.2208
1959	7.62	7.11	1.85	0.2944	0.2944	7.9144	2.1444
1960	6.92	7.03	2.32	0.288	0.288	7.208	2.608
1961	6.75	7.08	1.51	0.2816	0.2816	7.0316	1.7916
1962	7.02	6.9	1.96	0.2752	0.2752	7.2952	2.2352
1963	6.99	7.13	3.18	0.2688	0.2688	7.2588	3.4488
1964	7.42	7.14	2.21	0.2624	0.2624	7.6824	2.4724
1965	7.42	7.18	2.09	0.256	0.256	7.676	2.346
1966	7.32	7.1	1.81	0.2496	0.2496	7.5696	2.0596
1967	7.52	7.11	2.73	0.2432	0.2432	7.7632	2.9732
1968	7.32	7.22	2.05	0.2368	0.2368	7.5568	2.2868

1969	7.82	7.2	2.37	0.2304	0.2304	8.0504	2.6004
1970	7.82	7.19	1.96	0.224	0.224	8.044	2.184
1971	7.12	6.98	2	0.2176	0.2176	7.3376	2.2176
1972	7.42	7.18	1.92	0.2112	0.2112	7.6312	2.1312
1973	8.12	7.09	1.91	0.2048	0.2048	8.3248	2.1148
1974	7.32	7.13	1.78	0.1984	0.1984	7.5184	1.9784
1975	6.88	6.93	3.27	0.192	0.192	7.072	3.462
1976	7.1	7.11	1.61	0.1856	0.1856	7.2856	1.7956
1977	7	7.04	1.26	0.1792	0.1792	7.1792	1.4392
1978	7.26	7.14	2.05	0.1728	0.1728	7.4328	2.2228
1979	7.12	7.05	2.72	0.1664	0.1664	7.2864	2.8864
1980	7.74	6.94	1.84	0.16	0.16	7.9	2

Table 2-1 (continued): Annual peak tide values selected, adjustments to peak values, and adjusted annual peak tide values

Year	Annual peak values of hourly verified data (feet MLLW)	Annual peak values of hourly predicted data (feet MLLW)	Annual peak values of hourly residual data (feet MLLW)	Annual adjustment in verified data mean (feet MLLW)	Annual adjustment in residual data mean (feet MLLW)	Annual peak values of hourly verified data, with annual mean water level trend removed (feet MLLW)	Annual peak values of hourly residual data, with annual mean water level trend removed (feet MLLW)
1981	7.45	7.06	2.06	0.1536	0.1536	7.6036	2.2136
1982	7.9	7.13	2.62	0.1472	0.1472	8.0472	2.7672
1983	8.82	7.15	3.63	0.1408	0.1408	8.9608	3.7708
1984	7.2	7.01	1.66	0.1344	0.1344	7.3344	1.7944
1985	7.29	7.14	2.41	0.128	0.128	7.418	2.538
1986	7.4	7.24	2.43	0.1216	0.1216	7.5216	2.5516
1987	7.35	7.13	2.41	0.1152	0.1152	7.4652	2.5252
1988	7.82	7.18	1.47	0.1088	0.1088	7.9288	1.5788
1989	7.22	7.12	2.2	0.1024	0.1024	7.3224	2.3024
1990	7.34	7.26	2.12	0.096	0.096	7.436	2.216
1991	7.13	7.13	2.45	0.0896	0.0896	7.2196	2.5396
1992	7.39	7.14	1.74	0.0832	0.0832	7.4732	1.8232
1993	7.77	6.99	1.89	0.0768	0.0768	7.8468	1.9668
1994	7.62	7.14	1.97	0.0704	0.0704	7.6904	2.0404
1995	7.22	7.1	2.41	0.064	0.064	7.284	2.474
1996	7.51	7.1	1.43	0.0576	0.0576	7.5676	1.4876
1997	7.7	6.98	1.9	0.0512	0.0512	7.7512	1.9512
1998	8.43	6.95	3.06	0.0448	0.0448	8.4748	3.1048
1999	7.15	7.11	0.86	0.0384	0.0384	7.1884	0.8984
2000	7.23	7.15	1.06	0.032	0.032	7.262	1.092
2001	8.07	7.15	1.71	0.0256	0.0256	8.0956	1.7356
2002	7.33	6.97	2.07	0.0192	0.0192	7.3492	2.0892
2003	8.05	7.15	1.2	0.0128	0.0128	8.0628	1.2128
2004	7.39	7.13	1.8	0.0064	0.0064	7.3964	1.8064
2005	8.12	7.18	1.8	0	0	8.12	1.8

Table 2-1 (continued): Annual peak tide values selected, adjustments to peak values, and adjusted annual peak tide value

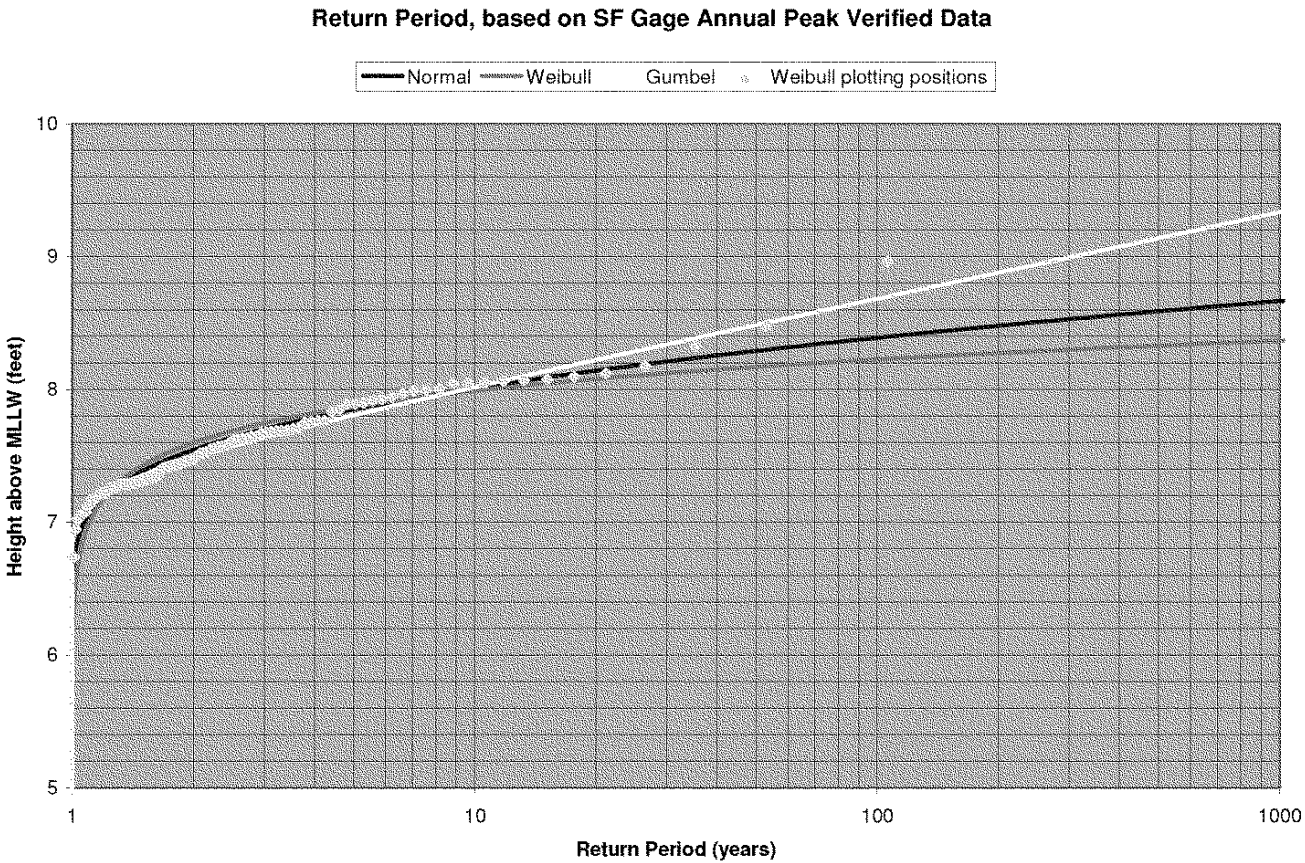

Return Period, based on SF Gage Annual Peak Verified Data
Normal
Weibull
Gumbel
Weibull plotting positions
Height above MLLW (feet)
10
9
8
7
6
5
1
10
100
1000
Return Period (years)

Plate 2-5

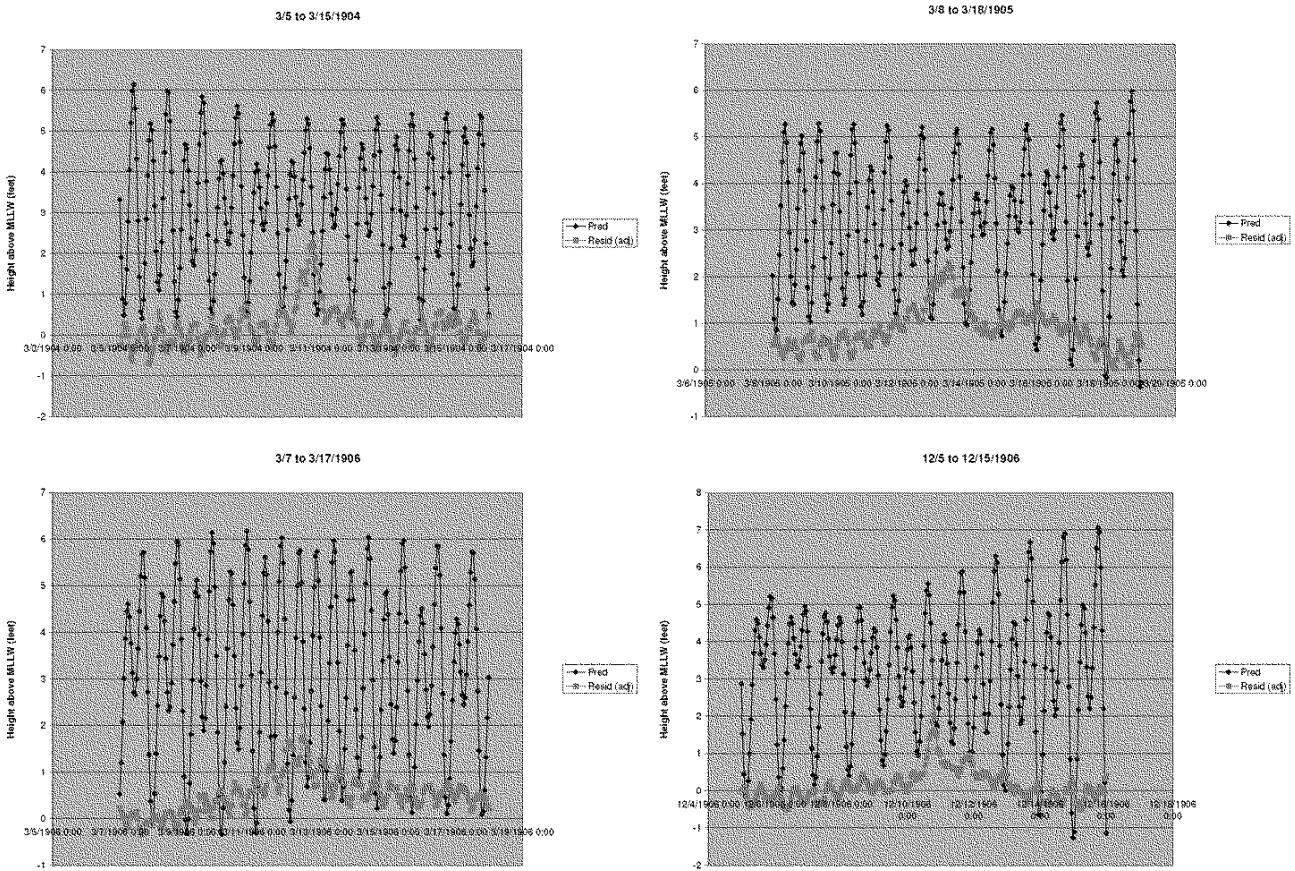


Plate 2-6: Time series of predicted and residual tide data

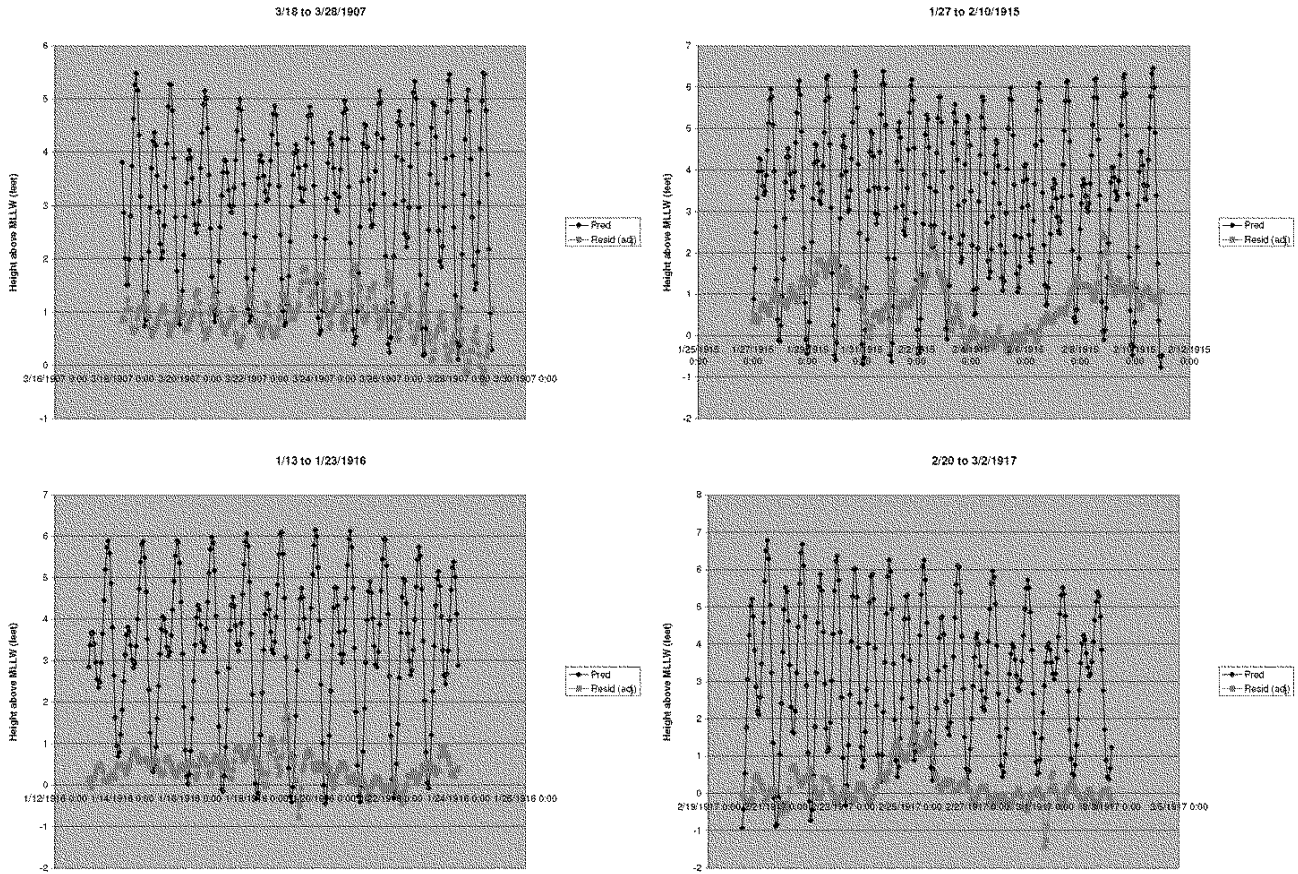


Plate 2-7: Time series of predicted and residual tide data

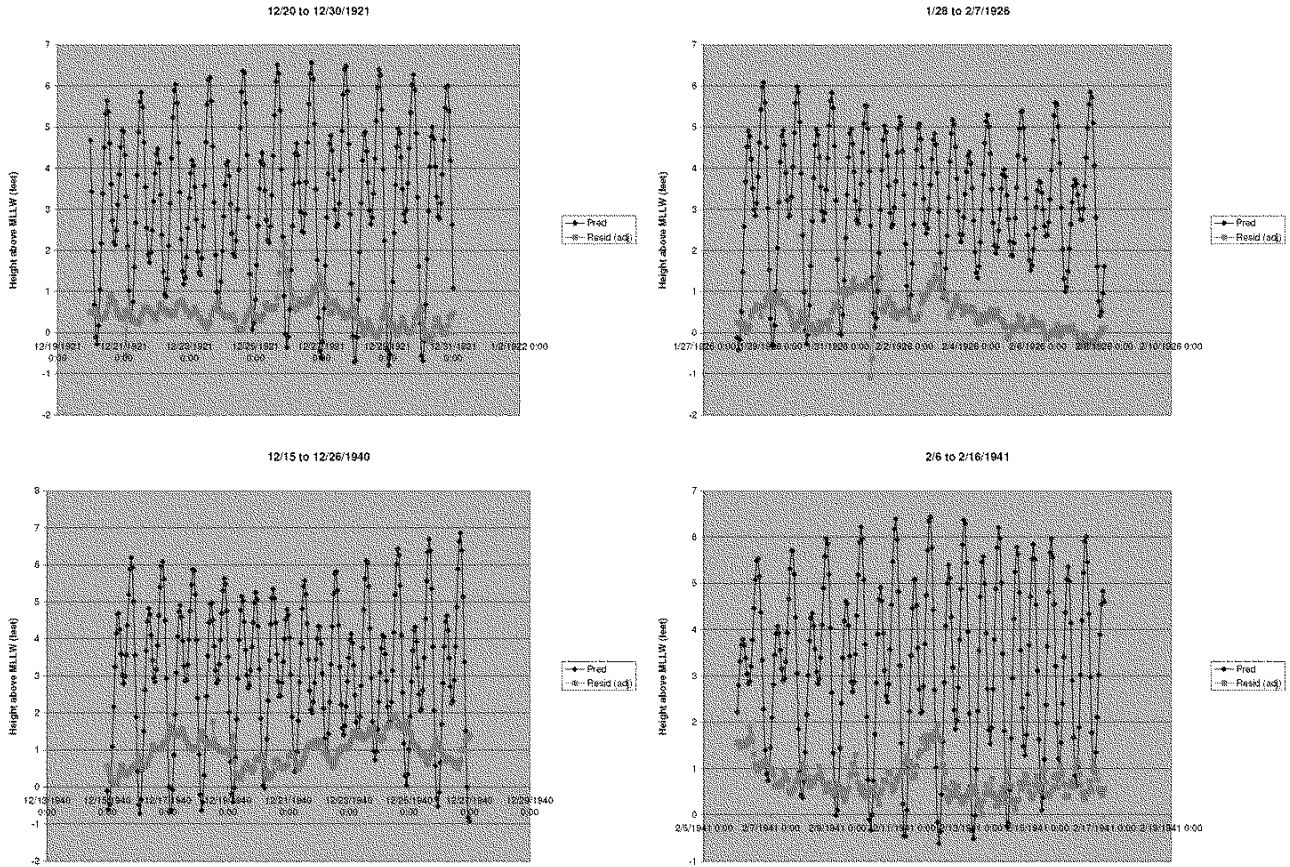


Plate 2-8: Time series of predicted and residual tide data

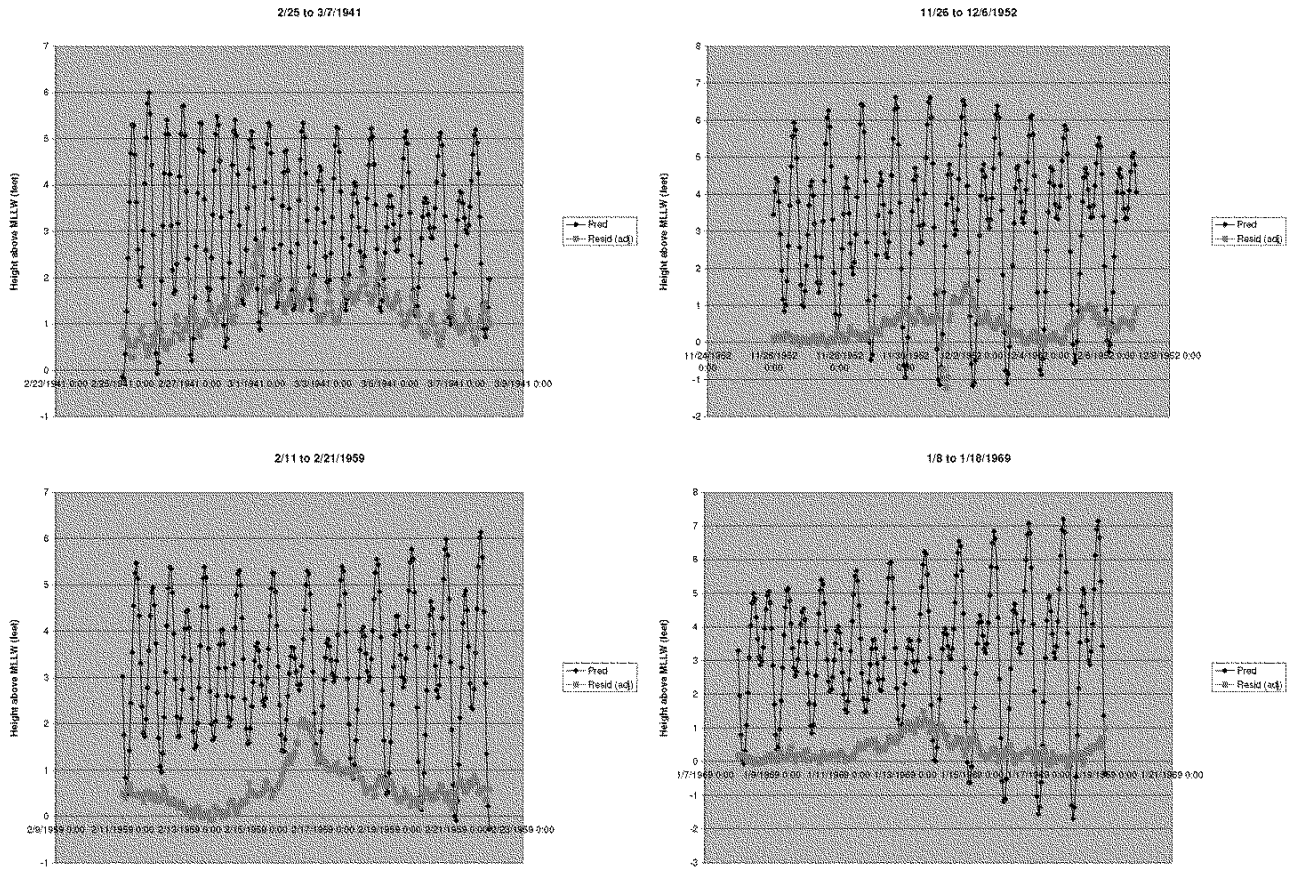
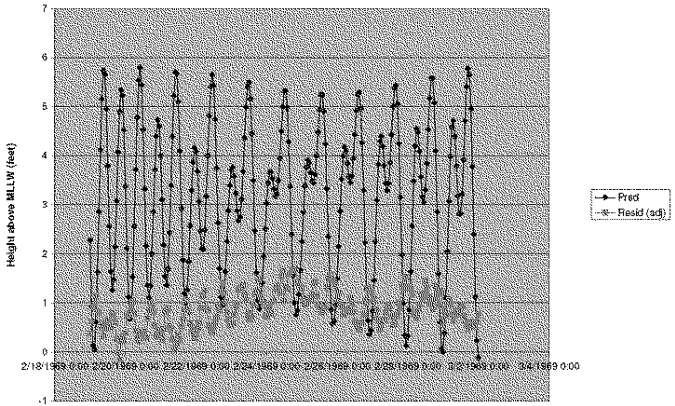
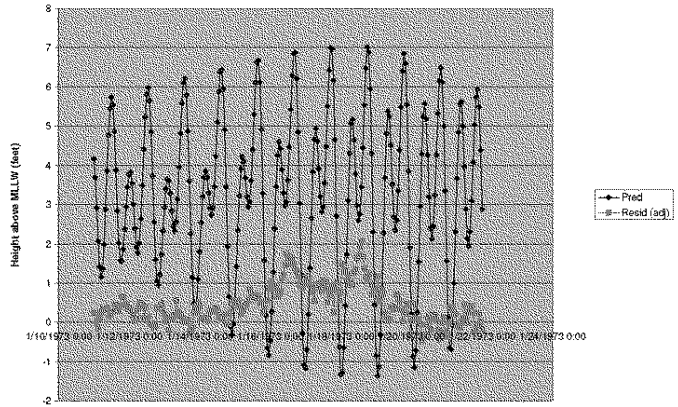


Plate 2-9: Time series of predicted and residual tide data

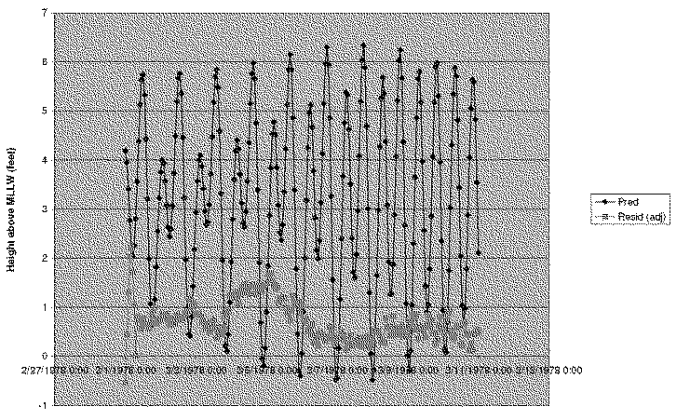
2/19 to 3/1/1969



1/11 to 1/21/1973



3/1 to 3/10/1978



11/13 to 11/23/1982

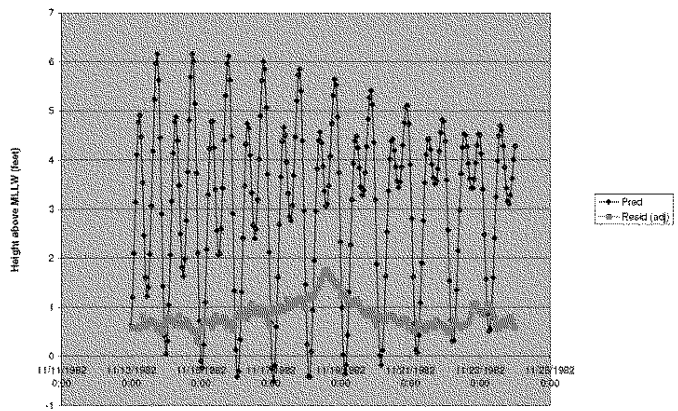
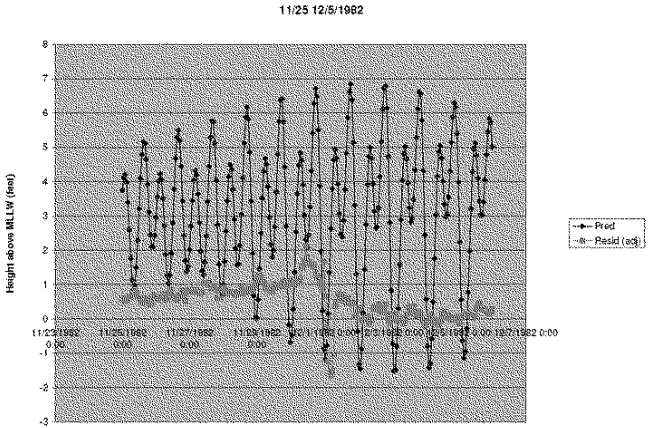
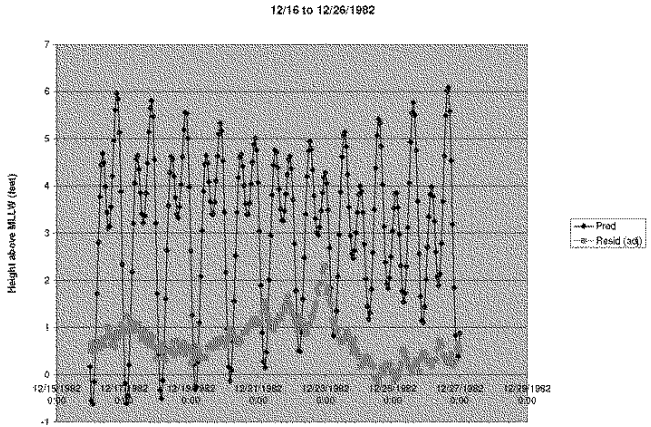
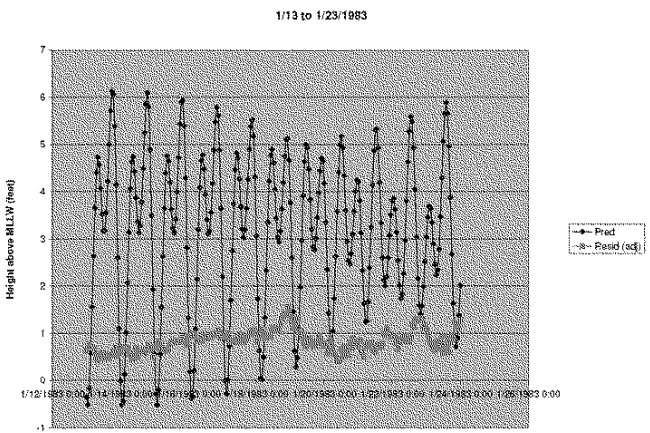


Plate 2-10: Time series of predicted and residual tide data







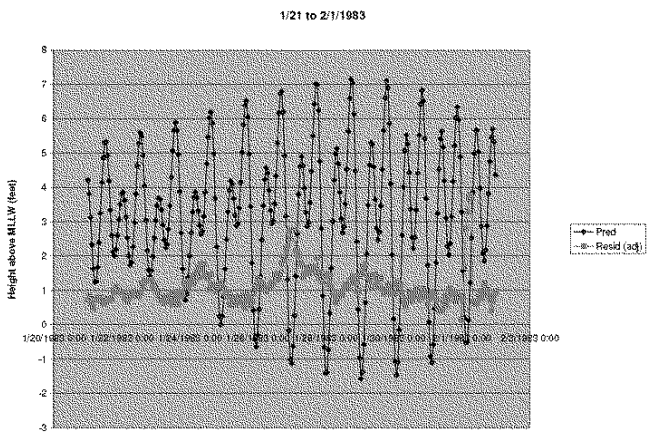
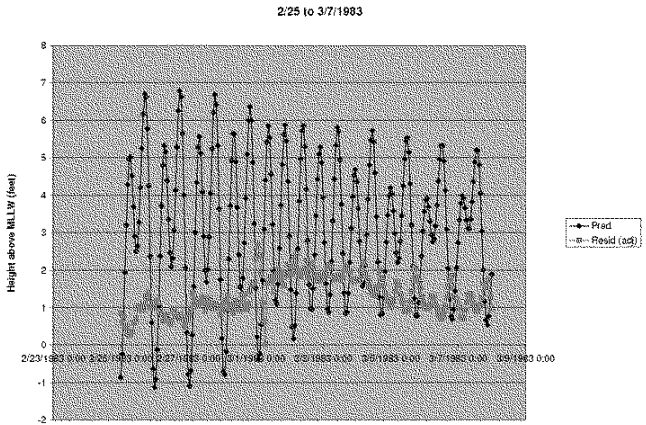
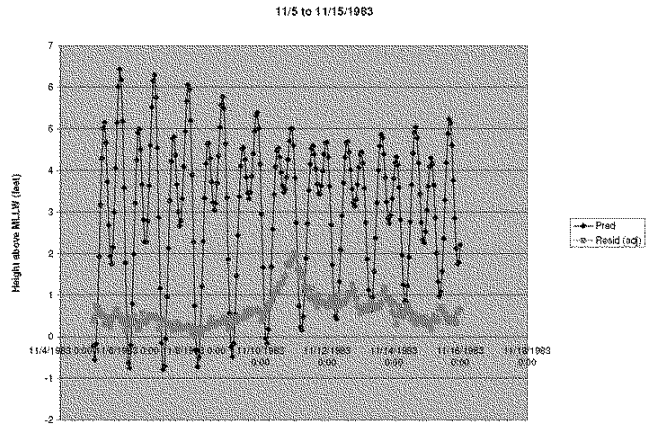
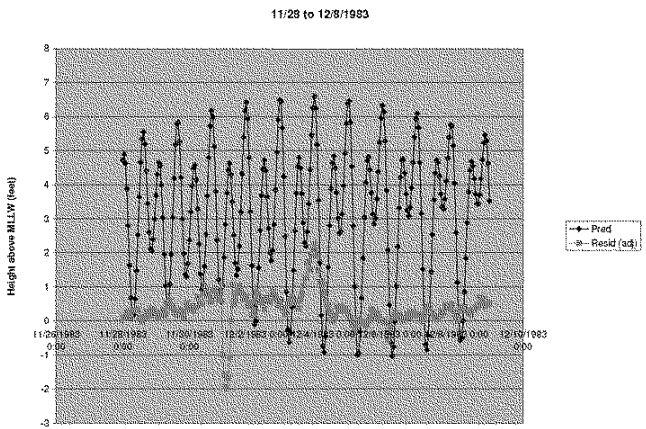


Plate 2-11: Time series of predicted and residual tide data







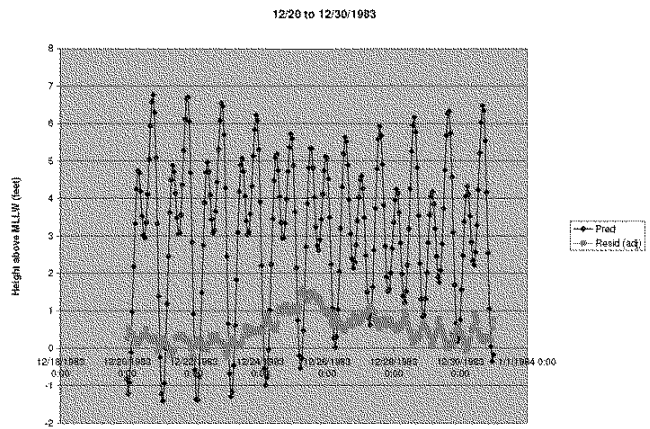
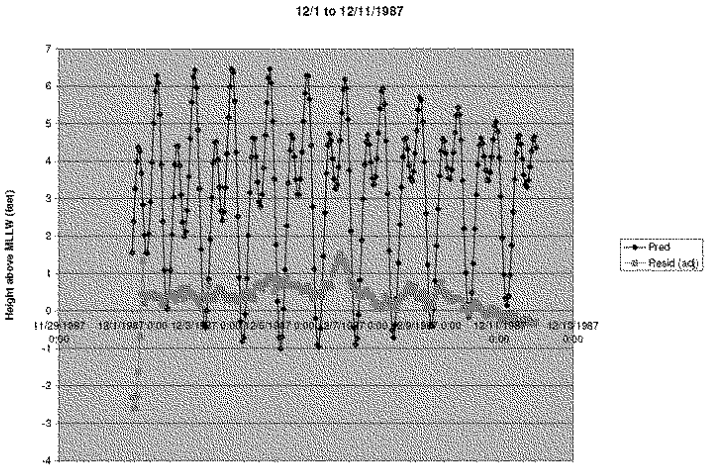
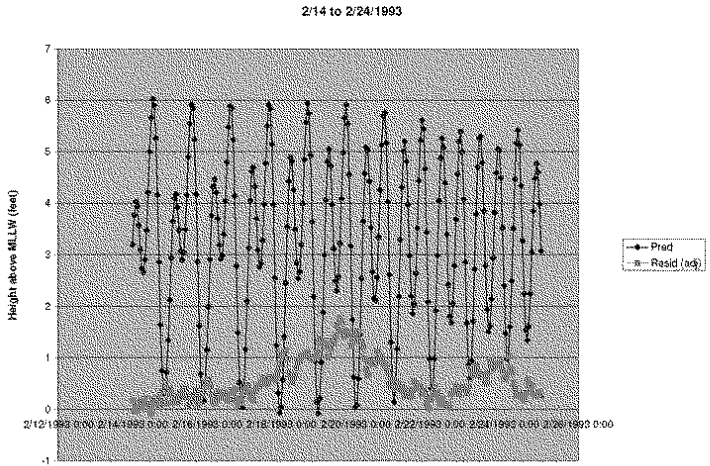
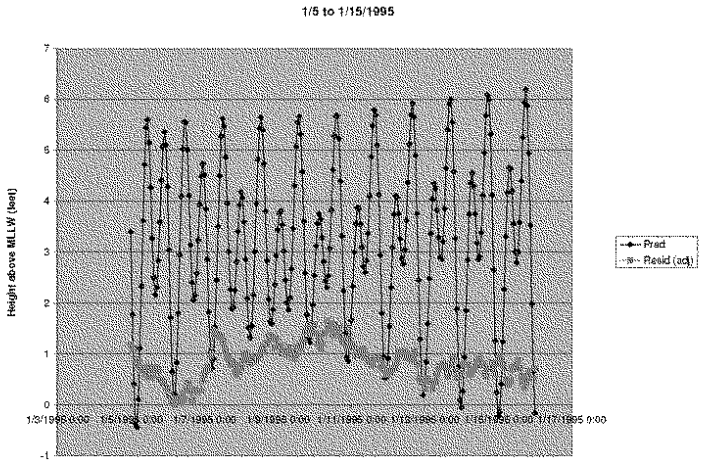


Plate 2-12: Time series of predicted and residual tide data







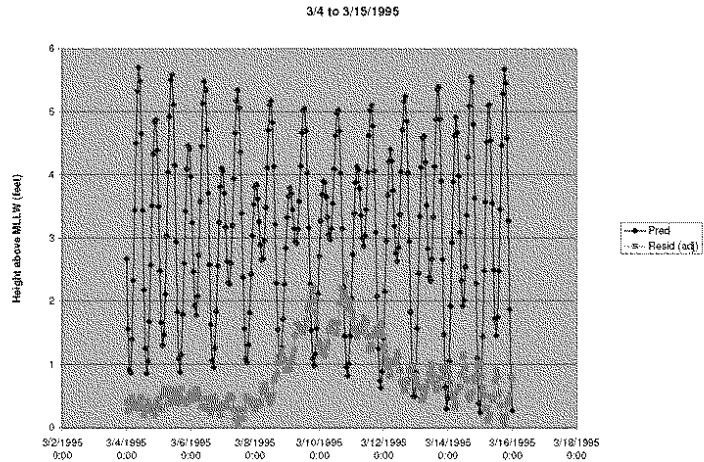


Plate 2-13: Time series of predicted and residual tide data

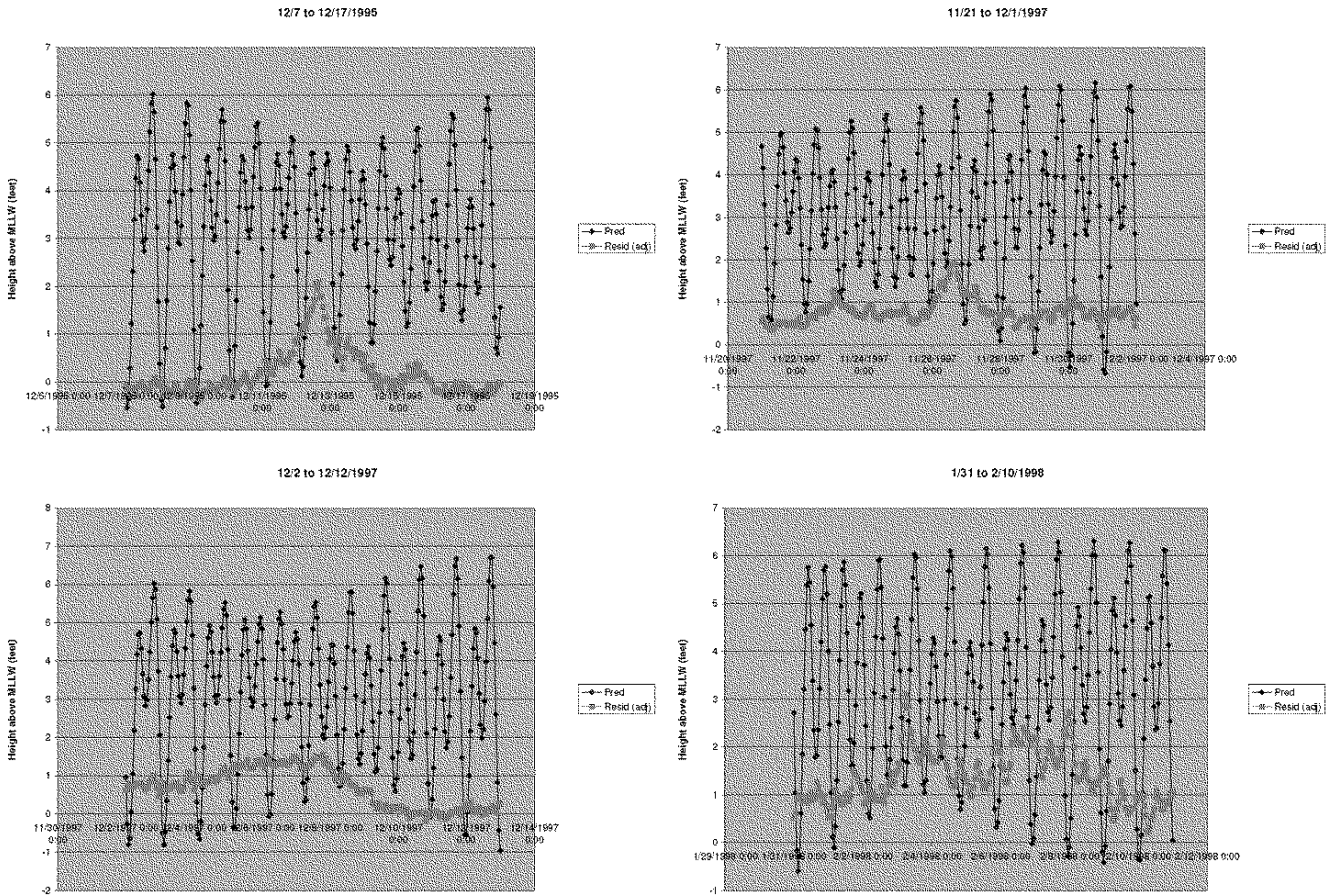


Plate 2-14: Time series of predicted and residual tide data

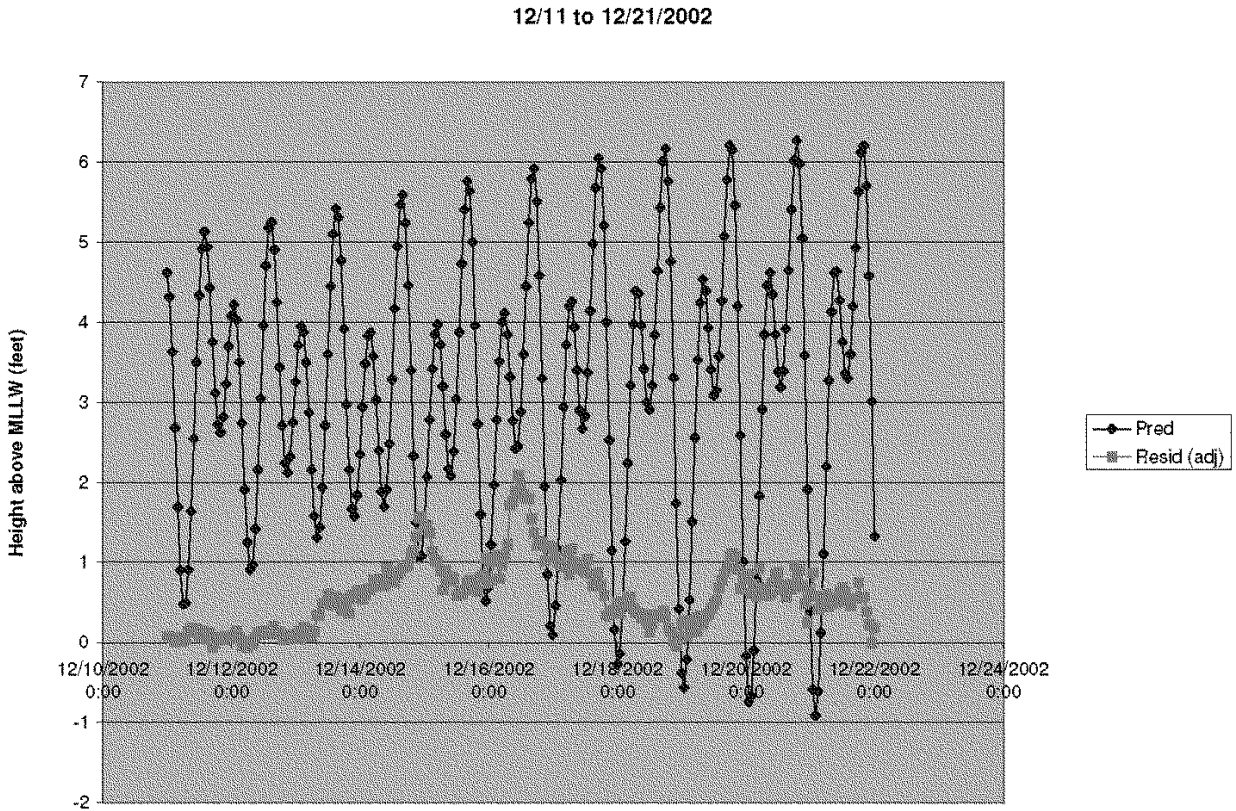


Plate 2-15: Time series of predicted and residual tide data

47 Time Series with High Residual Events				
Beginning of Time Series	End of Time Series	Maximum predicted tide data value during time series (feet MLLW)	Maximum verified tide data value during time series, adjusted for sea level rise (feet MLLW)	Maximum residual tide data value during time series, adjusted for sea level rise (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	5.42	6.97	2.26
3/12/1905 0:00	3/15/1905 0:00	5.21	6.86	2.30
3/11/1906 0:00	3/14/1906 0:00	6.03	7.05	1.99
12/10/1906 0:00	12/13/1906 0:00	6.3	6.65	2.03
3/23/1907 0:00	3/26/1907 0:00	5.15	6.25	1.88
1/28/1915 0:00	1/31/1915 0:00	6.37	8.00	1.89
2/1/1915 0:00	2/4/1915 0:00	6.18	7.30	2.36
2/7/1915 0:00	2/10/1915 0:00	6.31	7.40	2.48
1/17/1916 0:00	1/20/1916 0:00	6.15	6.79	1.91
2/23/1917 0:00	2/26/1917 0:00	6.25	7.45	1.76
12/25/1921 0:00	12/28/1921 0:00	6.56	7.76	2.17
1/30/1926 0:00	2/2/1926 0:00	5.83	6.73	1.59
2/2/1926 0:00	2/5/1926 0:00	5.29	6.23	1.66
12/16/1940 0:00	12/19/1940 0:00	6.09	7.28	1.77
12/23/1940 0:00	12/26/1940 0:00	6.69	8.08	1.94
2/10/1941 0:00	2/13/1941 0:00	6.43	8.07	1.93
2/28/1941 0:00	3/3/1941 0:00	5.4	7.07	2.73
3/3/1941 0:00	3/6/1941 0:00	5.25	6.67	2.29
11/30/1952 0:00	12/3/1952 0:00	6.61	7.89	1.56
2/15/1959 0:00	2/18/1959 0:00	5.39	7.31	2.09
1/12/1969 0:00	1/15/1969 0:00	6.55	7.55	1.50
2/23/1969 0:00	2/26/1969 0:00	5.49	6.65	1.69
1/15/1973 0:00	1/18/1973 0:00	7	8.32	1.75
1/17/1973 0:00	1/20/1973 0:00	7.01	8.12	2.07
3/3/1978 0:00	3/6/1978 0:00	6.15	7.43	1.68
11/17/1982 0:00	11/20/1982 0:00	5.85	7.17	1.76
11/29/1982 0:00	12/2/1982 0:00	6.85	8.05	2.13
12/21/1982 0:00	12/24/1982 0:00	5.14	6.59	2.31
1/17/1983 0:00	1/20/1983 0:00	5.52	6.68	1.56
1/22/1983 0:00	1/25/1983 0:00	6.2	7.67	1.77
1/26/1983 0:00	1/29/1983 0:00	7.15	8.96	2.77
1/28/1983 0:00	1/31/1983 0:00	7.15	8.42	1.74
3/1/1983 0:00	3/4/1983 0:00	5.88	7.83	2.68
11/10/1983 0:00	11/13/1983 0:00	5	6.89	2.02
12/2/1983 0:00	12/5/1983 0:00	6.59	8.85	2.26
12/24/1983 0:00	12/27/1983 0:00	5.72	6.85	1.58
12/5/1987 0:00	12/8/1987 0:00	6.28	7.47	1.54
2/18/1993 0:00	2/21/1993 0:00	5.94	7.44	1.77
1/8/1995 0:00	1/11/1995 0:00	5.68	7.19	1.64
3/9/1995 0:00	3/12/1995 0:00	5.1	6.67	2.42
12/11/1995 0:00	12/14/1995 0:00	5.11	6.36	2.09
11/25/1997 0:00	11/28/1997 0:00	5.89	7.61	1.94
12/5/1997 0:00	12/8/1997 0:00	5.53	7.03	1.57
2/2/1998 0:00	2/5/1998 0:00	6.1	7.99	3.10
2/4/1998 0:00	2/7/1998 0:00	6.22	8.47	2.40
2/6/1998 0:00	2/9/1998 0:00	6.31	8.47	2.74
12/14/2002 0:00	12/17/2002 0:00	5.92	7.34	2.09

Table 2-2. Selected events based on conditions applied to predicted and residual data

33 Time Series with High Residual Events				
Beginning of Time Series	End of Time Series	Maximum predicted tide data value during time series (feet MLLW)	Maximum verified tide data value during time series, adjusted for sea level rise (feet MLLW)	Maximum residual tide data value during time series, adjusted for sea level rise (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	5.42	6.9664	2.2564
3/11/1906 0:00	3/14/1906 0:00	6.03	7.0536	1.9936
1/28/1915 0:00	1/31/1915 0:00	6.37	7.996	1.886
2/1/1915 0:00	2/4/1915 0:00	6.18	7.296	2.356
2/7/1915 0:00	2/10/1915 0:00	6.31	7.396	2.476
2/23/1917 0:00	2/26/1917 0:00	6.25	7.4532	1.7632
12/25/1921 0:00	12/28/1921 0:00	6.56	7.7576	2.1676
12/16/1940 0:00	12/19/1940 0:00	6.09	7.276	1.766
12/23/1940 0:00	12/26/1940 0:00	6.69	8.076	1.936
2/10/1941 0:00	2/13/1941 0:00	6.43	8.0696	1.9296
2/28/1941 0:00	3/3/1941 0:00	5.4	7.0696	2.7296
11/30/1952 0:00	12/3/1952 0:00	6.61	7.8892	1.5592
2/15/1959 0:00	2/18/1959 0:00	5.39	7.3144	2.0944
1/12/1969 0:00	1/15/1969 0:00	6.55	7.5504	1.5004
1/15/1973 0:00	1/18/1973 0:00	7	8.3248	1.7548
1/17/1973 0:00	1/20/1973 0:00	7.01	8.1248	2.0748
3/3/1978 0:00	3/6/1978 0:00	6.15	7.4328	1.6828
11/17/1982 0:00	11/20/1982 0:00	5.85	7.1672	1.7572
11/29/1982 0:00	12/2/1982 0:00	6.85	8.0472	2.1272
1/22/1983 0:00	1/25/1983 0:00	6.2	7.6708	1.7708
1/26/1983 0:00	1/29/1983 0:00	7.15	8.9608	2.7708
1/28/1983 0:00	1/31/1983 0:00	7.15	8.4208	1.7408
3/1/1983 0:00	3/4/1983 0:00	5.88	7.8308	2.6808
12/2/1983 0:00	12/5/1983 0:00	6.59	8.8508	2.2608
12/5/1987 0:00	12/8/1987 0:00	6.28	7.4652	1.5352
2/18/1993 0:00	2/21/1993 0:00	5.94	7.4368	1.7668
1/8/1995 0:00	1/11/1995 0:00	5.68	7.194	1.644
11/25/1997 0:00	11/28/1997 0:00	5.89	7.6112	1.9412
12/5/1997 0:00	12/8/1997 0:00	5.53	7.0312	1.5712
2/2/1998 0:00	2/5/1998 0:00	6.1	7.9948	3.1048
2/4/1998 0:00	2/7/1998 0:00	6.22	8.4748	2.4048
2/6/1998 0:00	2/9/1998 0:00	6.31	8.4748	2.7448
12/14/2002 0:00	12/17/2002 0:00	5.92	7.3392	2.0892

Table 2-3. Selected events based on conditions applied to predicted and residual data

Return Period, based on SF Gage Peak Verified Data from 47 High Residual Events (events w/ predicted data above 4.5' and residual data above 1.5')

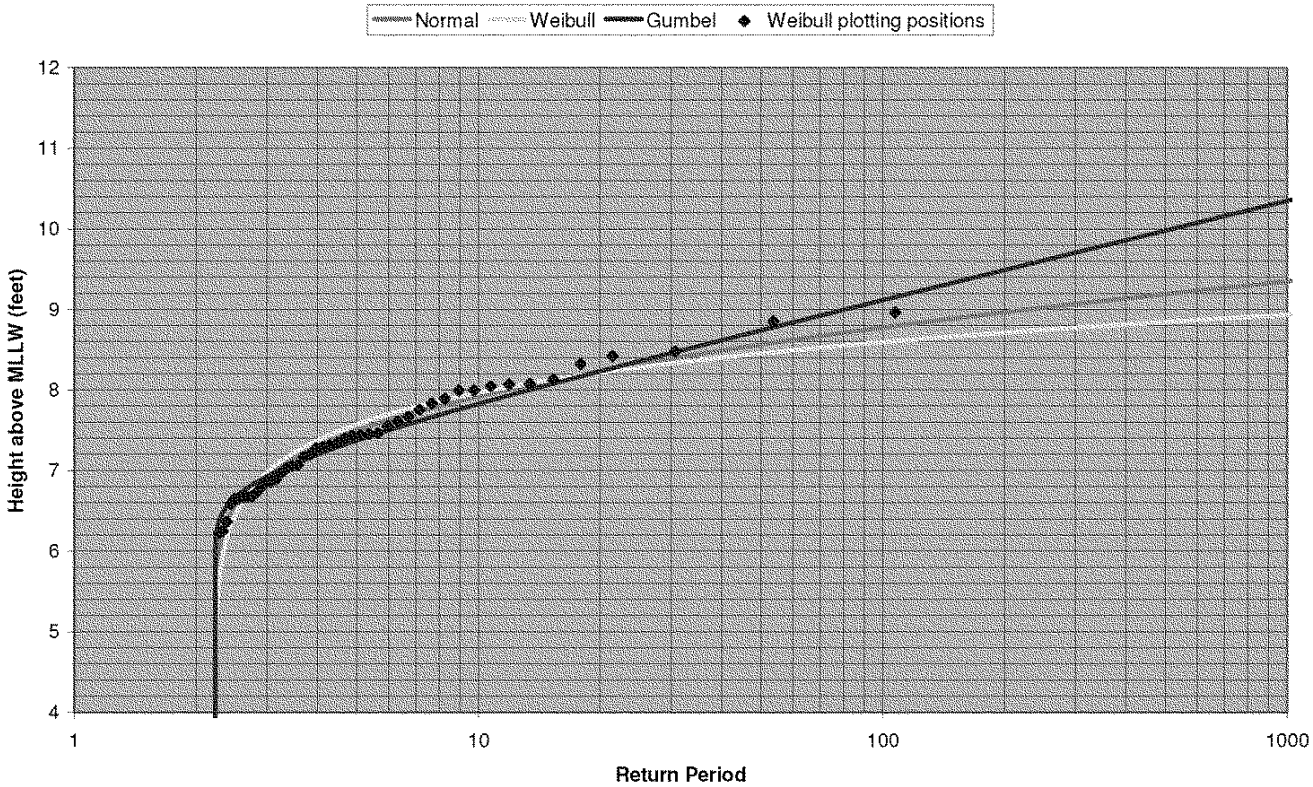


Plate 2-16

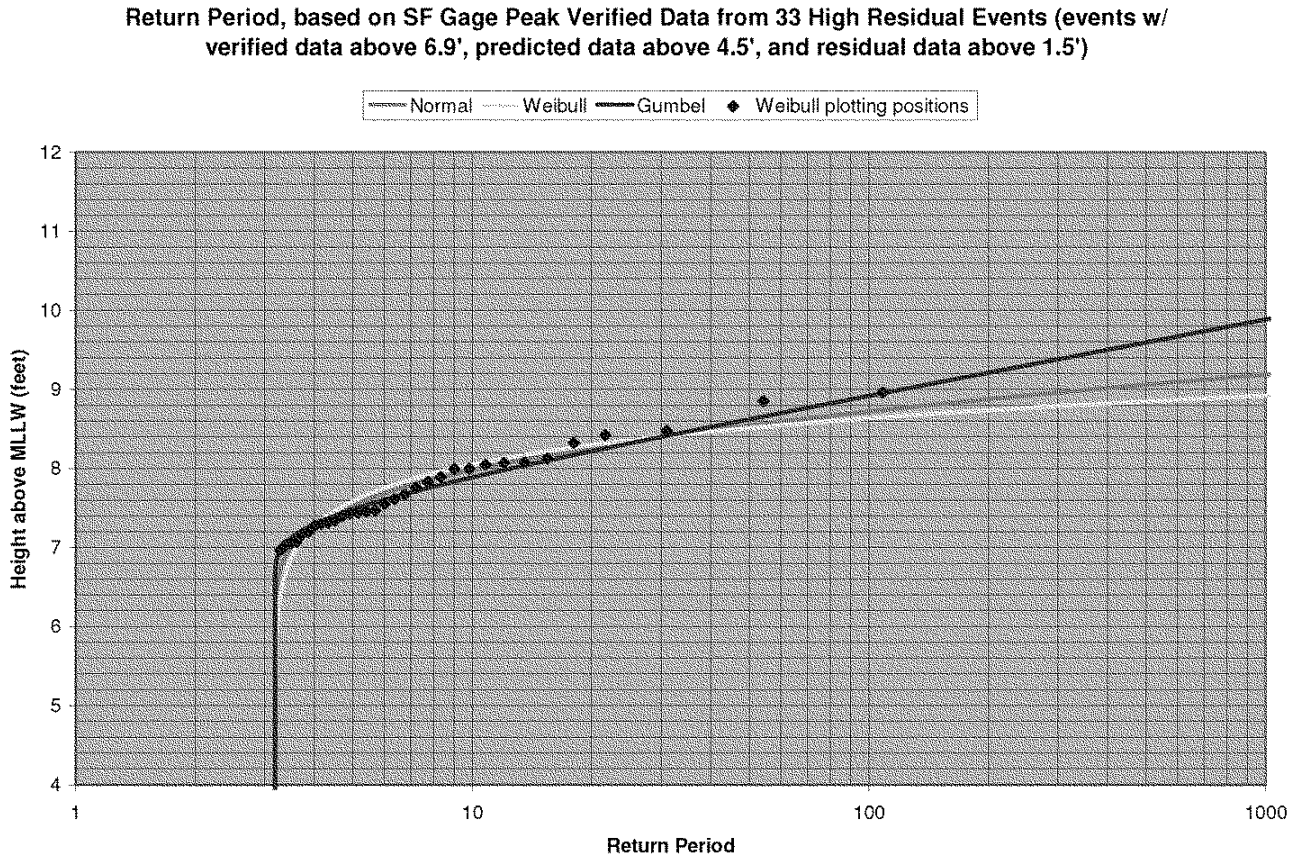

Return Period, based on SF Gage Peak Verified Data from 33 High Residual Events (events w/ verified data above 6.9', predicted data above 4.5', and residual data above 1.5')
Normal
Weibull
Gumbel
Weibull plotting positions
Height above MLLW (feet)
12
11
10
9
8
7
6
5
4
1
10
100
1000
Return Period

Plate 2-17

SF Gage Frequency Curves

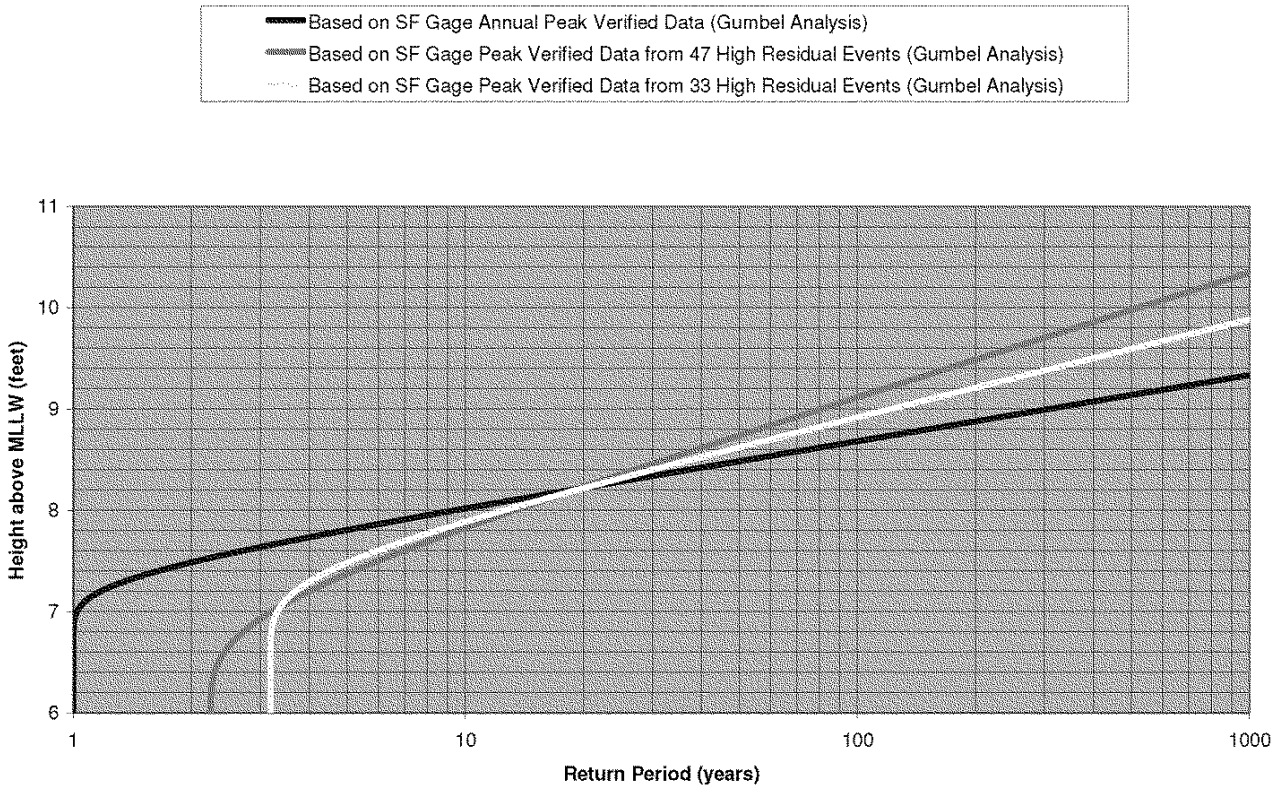


Plate 2-18

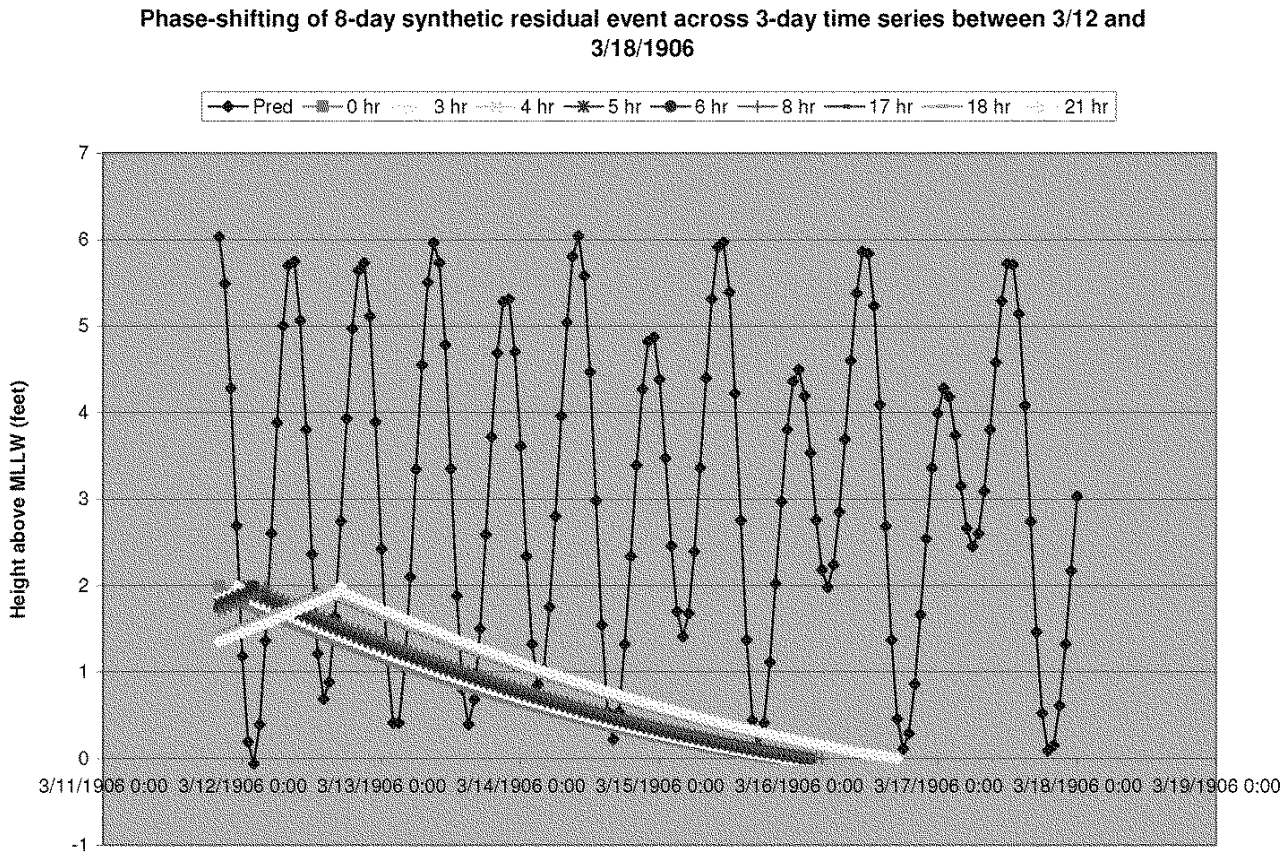

Phase-shifting of 8-day synthetic residual event across 3-day time series between 3/12 and 3/18/1906
Pred
0 hr
3 hr
4 hr
5 hr
6 hr
8 hr
17 hr
18 hr
21 hr
Height above MLLW (feet)
7
6
5
4
3
2
1
0
-1
3/11/1906 0:00
3/12/1906 0:00
3/13/1906 0:00
3/14/1906 0:00
3/15/1906 0:00
3/16/1906 0:00
3/17/1906 0:00
3/18/1906 0:00
3/19/1906 0:00

Plate 2-19

SF Gage Frequency Curves

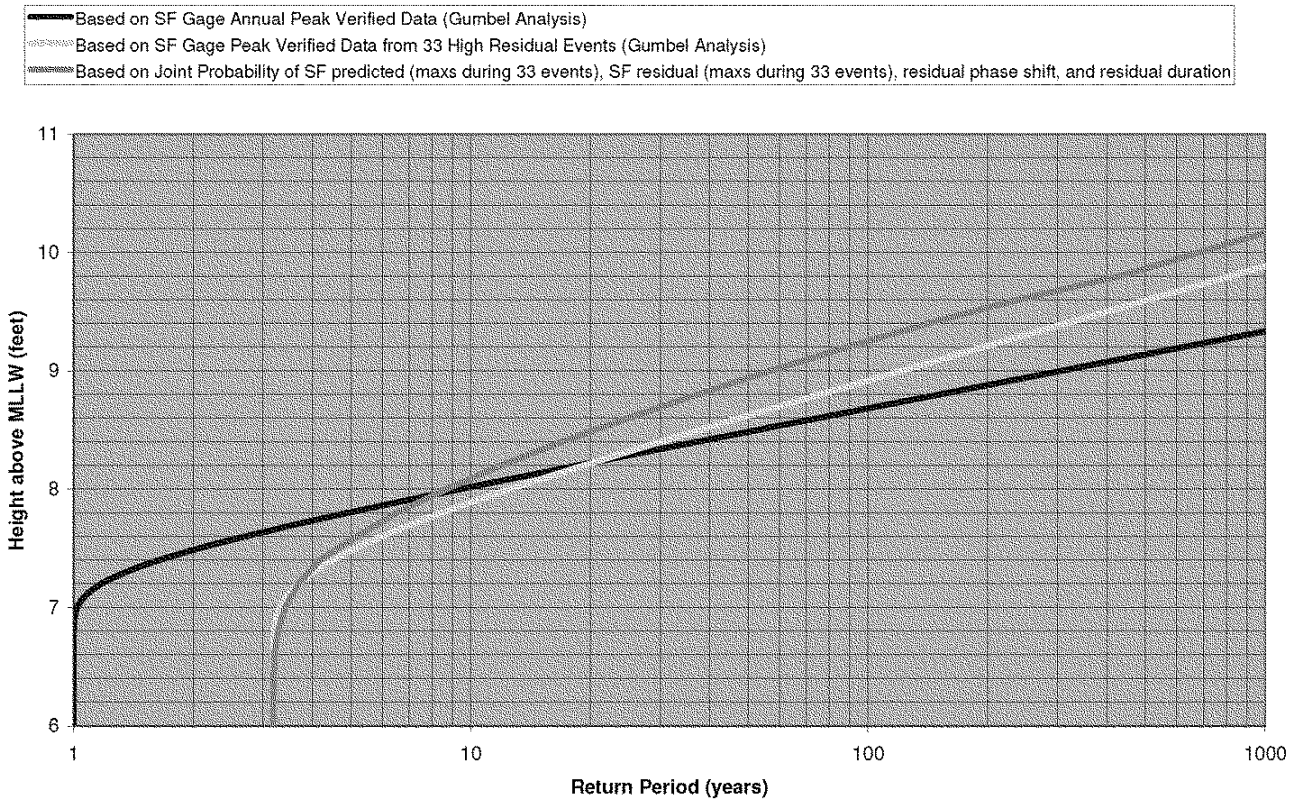


Plate 2-20

phase (hours)	Synthetic residual event duration									
	2-day (12/6/1987)	3-day (3/10/1904)	3-day (12/3/1983)	4-day (2/2/1915)	4-day (1/13/1969)	5-day (12/2/1952)	5-day (2/19/1993)	6-day (2/9/1915)	8-day (3/12/1906)	8-day (12/24/1940)
0	1	1	1	1	1	1	1	1	1	1
3	0.9734	0.9657	0.96948	0.9791	0.9703	0.98623	0.9823	0.99298	0.981	0.987202
4	0.9605	0.9549	0.96014	0.9709	0.9703	0.9817	0.9771	0.98738	0.9774	0.983952
5	0.9481	0.9443	0.95095	0.9628	0.9703	0.97723	0.972	0.9818	0.9738	0.98072
6	0.9362	0.9339	0.94192	0.9548	0.9703	0.9728	0.9669	0.97633	0.9703	0.977504
8	0.91375	0.9136	0.92434	0.9391	0.9703	0.9641	0.957	0.96546	0.9632	0.983056
17	0.89176	0.898	0.9105	0.8977	0.98766	0.94679	0.9531	0.97697	0.9425	1.010897
18	0.90224	0.908	0.9193	0.9056	0.99353	0.95112	0.958	0.98239	0.9389	1.014078
21	0.93657	0.9393	0.94688	0.9299	1.01181	0.9644	0.9732	0.99889	0.94	1.023724

phase (hours)	Synthetic residual event duration (with 0.5' base residual)		
	2-day (1/29/1983)	3-day (1/27/1983)	6-day (11/18/1982)
0	1	1	1
3	0.9748	0.96962	0.9907
4	0.9675	0.96101	0.9876
5	0.9605	0.95254	0.9845
6	0.9536	0.94423	0.9814
8	0.94034	0.92803	0.9752
17	0.93584	0.958	0.952
18	0.94237	0.9662	0.9551
21	0.96302	0.99156	0.9645

phase (hours	Synthetic residual event duration with 1.0' base residual		
	2-day (2/8/1998)	3-day (2/3/1998)	4-day (3/2/1983)
0	1	1	1
3	0.9677	0.9745	0.9749
4	0.9574	0.9654	0.9703
5	0.9473	0.9564	0.9658
6	0.9375	0.9477	0.9614
8	0.9187	0.9307	0.9526
17	0.922	0.9501	0.9153
18	0.9313	0.9587	0.9114
21	0.9607	0.9856	0.9162

Table 2-4. Decay factor due to phase shift between predicted tide and residual tide for various residual durations

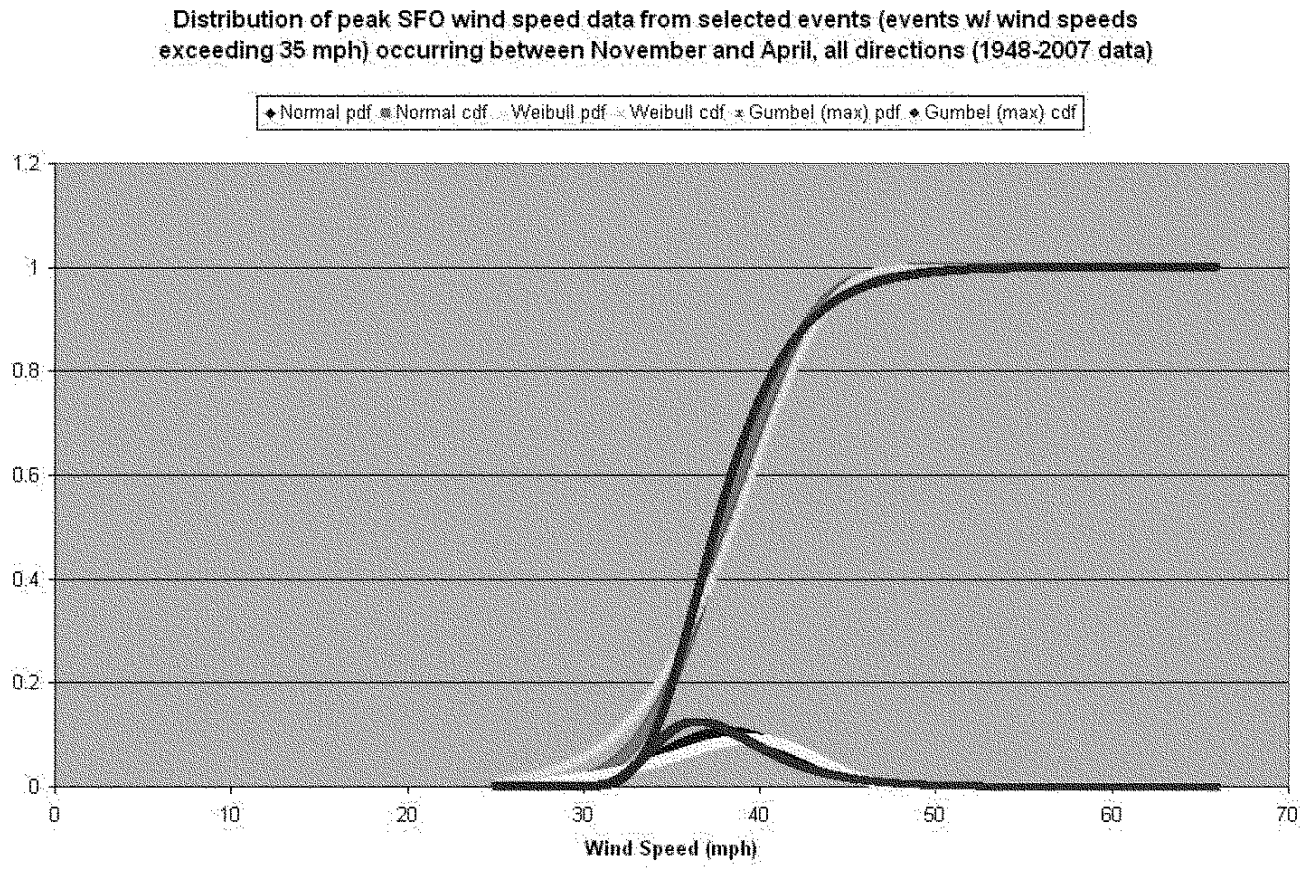

Distribution of peak SFO wind speed data from selected events (events w/ wind speeds exceeding 35 mph) occurring between November and April, all directions (1948-2007 data)
Normal pdf
Normal cdf
Weibull pdf
Weibull cdf
Gumbel (max) pdf
Gumbel (max) cdf
1.2
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
60
70
Wind Speed (mph)

Plate 2-21

Return Period (All Directions), based on maximum SFO wind speed data from selected events (events w/ wind speeds exceeding 35 mph) occurring between November and April (1948-2007 data)

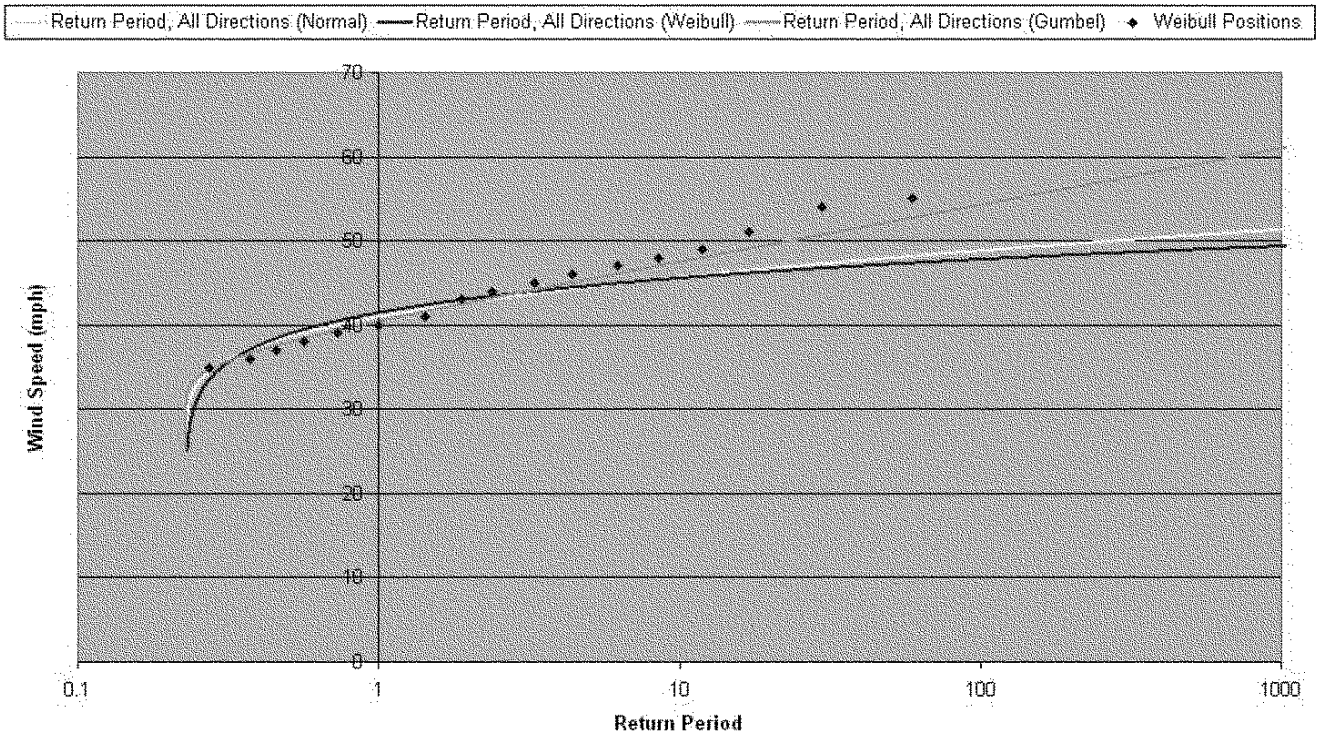


Plate 2-22

Distribution of peak SFO wind speed data from selected events (events w/ wind speeds exceeding 35 mph) occurring between November and April, NW direction (290-330 deg) (1948-2007 data)

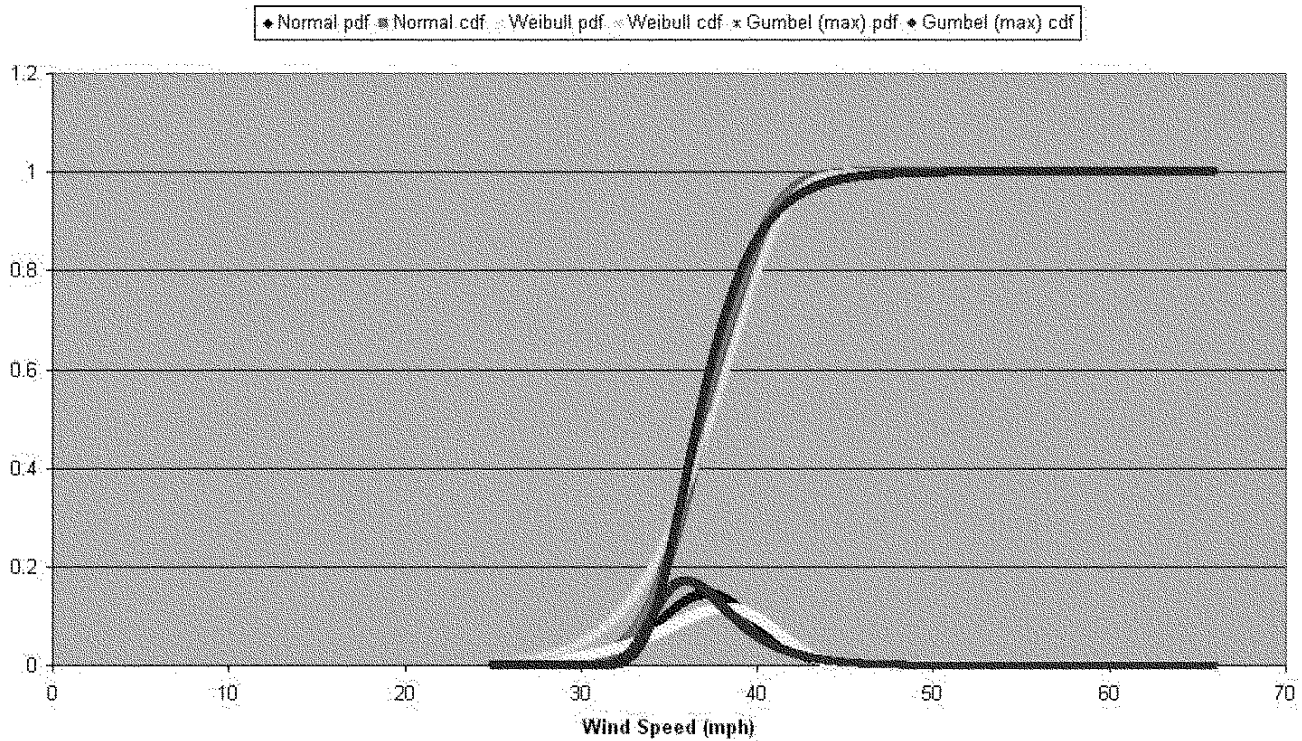


Plate 2-23

Return Period (NW Direction), based on peak SFO wind speed data from selected events (events w/ wind speeds exceeding 35 mph) occurring between November and April (1948-2007 data)

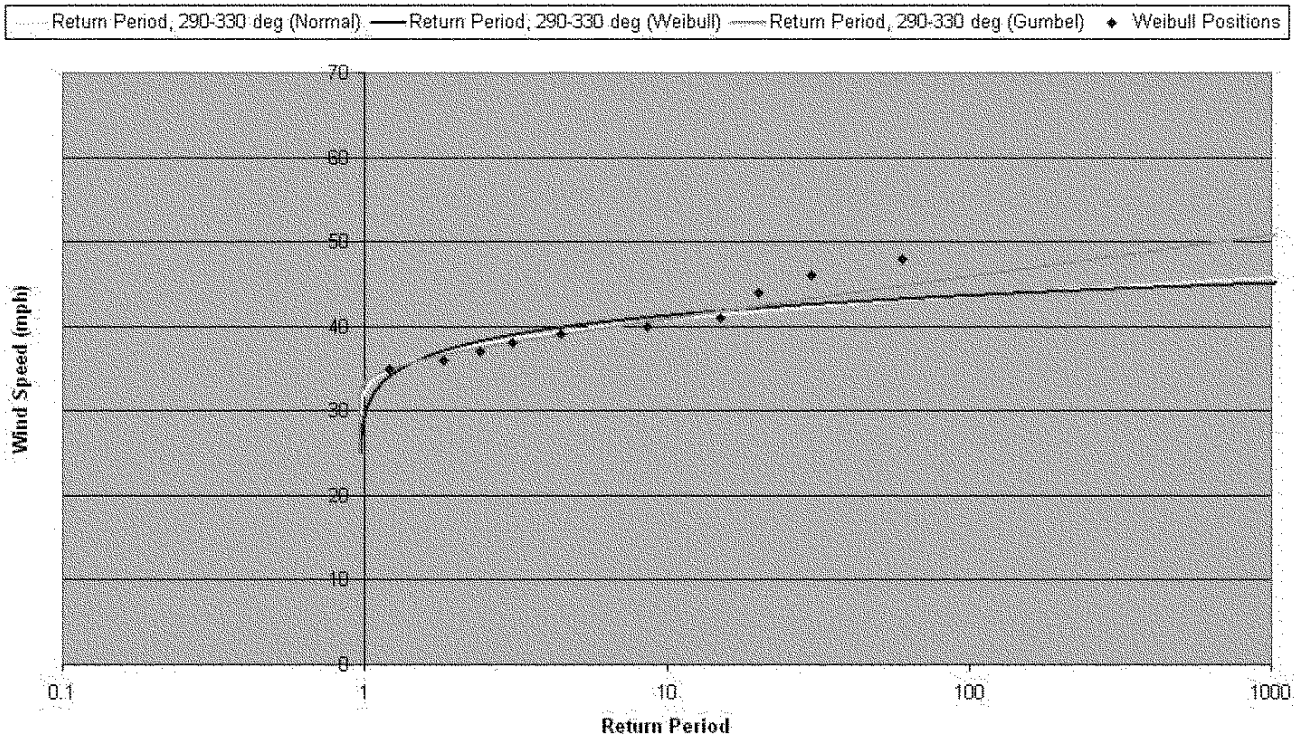


Plate 2-24

Return Period, based on peak SFO wind speed data from selected events (events w/ wind speeds exceeding 35 mph) occurring between November and April (1948-2007 data)

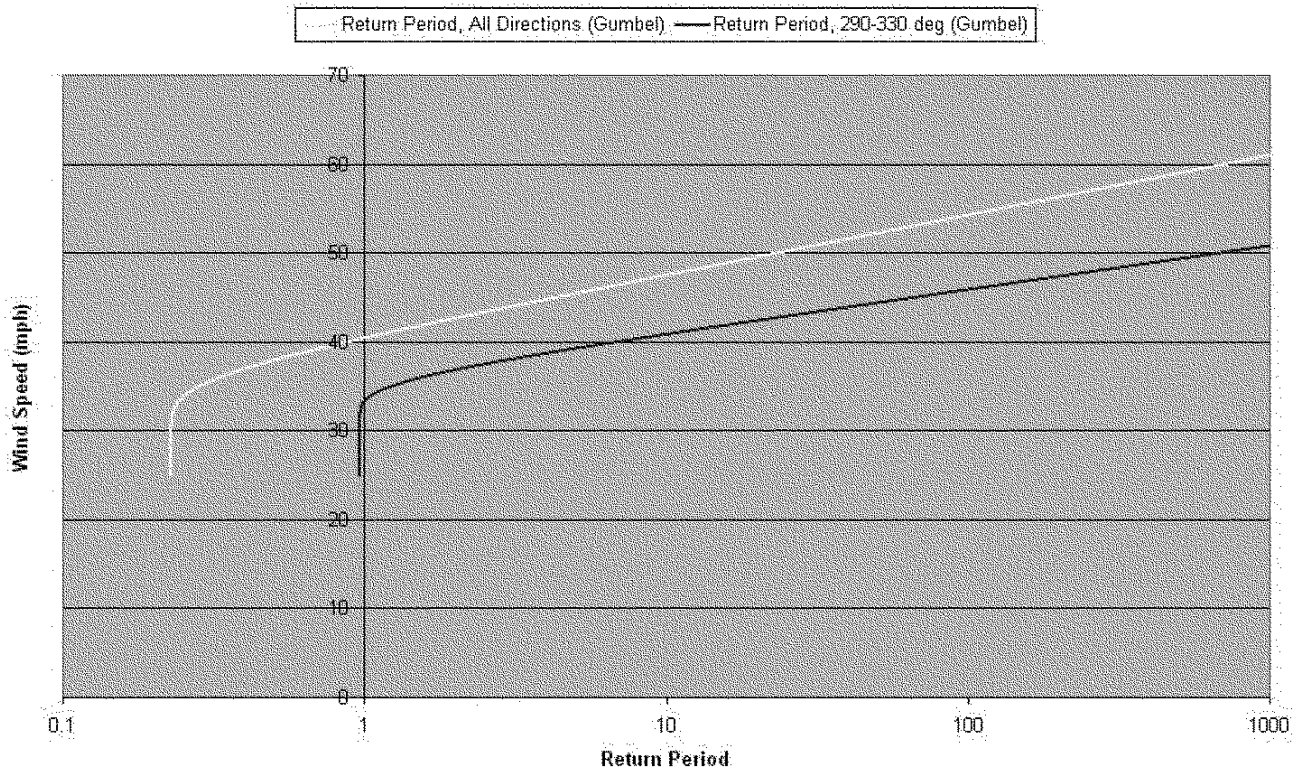


Plate 2-25

Distribution of SFO Wind Directions Coinciding with Conditionally Sampled Peak Wind Speeds

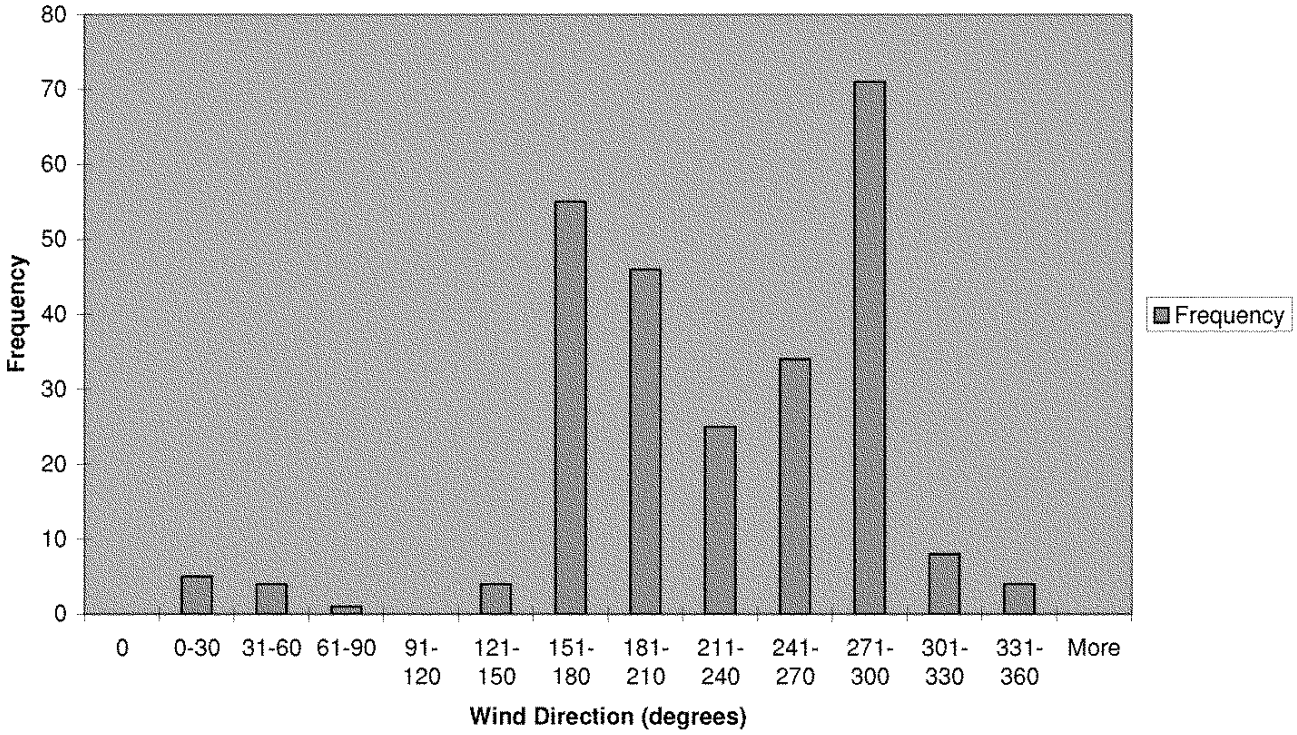


Plate 2-26

Tide Data at San Francisco for 32 Time Series with High Residual Events					
Begin Date	End Date	Maximum verified data value, adjusted for sea level rise (feet MLLW)	Time at which maximum verified value occurred	Predicted data value at this time (feet MLLW)	Residual data value at this time, adjusted for sea level rise (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	6.9664	3/10/1904 15:00	5.17	1.7964
3/11/1906 0:00	3/14/1906 0:00	7.0536	3/12/1906 9:00	5.75	1.3036
1/28/1915 0:00	1/31/1915 0:00	7.996	1/29/1915 18:00	6.28	1.716
2/1/1915 0:00	2/4/1915 0:00	7.296	2/2/1915 20:00	5.76	1.536
2/7/1915 0:00	2/10/1915 0:00	7.396	2/9/1915 14:00	6.24	1.156
2/23/1917 0:00	2/26/1917 0:00	7.4532	2/25/1917 10:00	6.25	1.2032
12/25/1921 0:00	12/28/1921 0:00	7.7576	12/25/1921 17:00	6.3	1.4576
12/16/1940 0:00	12/19/1940 0:00	7.276	12/16/1940 20:00	6.09	1.186
12/23/1940 0:00	12/26/1940 0:00	8.076	12/24/1940 15:00	6.43	1.646
2/10/1941 0:00	2/13/1941 0:00	8.0696	2/11/1941 18:00	6.35	1.7196
2/28/1941 0:00	3/3/1941 0:00	7.0696	2/28/1941 21:00	5.15	1.9196
11/30/1952 0:00	12/3/1952 0:00	7.8892	12/1/1952 18:00	6.53	1.3592
2/15/1959 0:00	2/18/1959 0:00	7.3144	2/16/1959 13:00	5.3	2.0144
1/12/1969 0:00	1/15/1969 0:00	7.5504	1/13/1969 14:00	6.23	1.3204
1/15/1973 0:00	1/18/1973 0:00	8.3248	1/16/1973 16:00	6.85	1.4748
1/17/1973 0:00	1/20/1973 0:00	8.1248	1/18/1973 18:00	7.01	1.1148
3/3/1978 0:00	3/6/1978 0:00	7.4328	3/4/1978 15:00	5.98	1.4528
11/17/1982 0:00	11/20/1982 0:00	7.1672	11/18/1982 20:00	5.65	1.5172
11/29/1982 0:00	12/2/1982 0:00	8.0472	11/30/1982 18:00	6.71	1.3372
1/22/1983 0:00	1/25/1983 0:00	7.6708	1/24/1983 15:00	6.2	1.4708
1/26/1983 0:00	1/29/1983 0:00	8.9608	1/27/1983 18:00	7	1.9608
1/28/1983 0:00	1/31/1983 0:00	8.4208	1/28/1983 19:00	7.05	1.3708
3/1/1983 0:00	3/4/1983 0:00	7.8308	3/2/1983 10:00	5.86	1.9708
12/2/1983 0:00	12/5/1983 0:00	8.8508	12/3/1983 18:00	6.59	2.2608
12/5/1987 0:00	12/8/1987 0:00	7.4652	12/6/1987 19:00	6.18	1.2852
2/18/1993 0:00	2/21/1993 0:00	7.4368	2/19/1993 18:00	5.91	1.5268
1/8/1995 0:00	1/11/1995 0:00	7.194	1/10/1995 14:00	5.67	1.524
11/25/1997 0:00	11/28/1997 0:00	7.6112	11/26/1997 17:00	5.75	1.8612
12/5/1997 0:00	12/8/1997 0:00	7.0312	12/7/1997 14:00	5.53	1.5012
2/2/1998 0:00	2/5/1998 0:00	7.9948	2/3/1998 12:00	6.03	1.9648
2/4/1998 0:00	2/7/1998 0:00	8.4748	2/6/1998 16:00	6.07	2.4048
12/14/2002 0:00	12/17/2002 0:00	7.3392	12/16/2002 16:00	5.79	1.5492

Table 3-1

Calculation of Dumbarton Predicted Tide Levels for 32 Time Series with High Residual Events at San Francisco						
1	2	3	4	5	6	7
Begin Date	End Date	Time at which maximum verified value occurred	Predicted data value at this time (feet MLLW)	Zero mean of predicted SF value [(Column 4) - 3.18] (feet MLLW)	Amplification to Dumbarton of SF zero mean predicted [(Column 5) x 1.46] (feet MLLW)	Dumbarton predicted data values [(Column 6) + 4.53] (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	3/10/1904 15:00	5.17	1.99	2.9054	7.4354
3/11/1906 0:00	3/14/1906 0:00	3/12/1906 9:00	5.75	2.57	3.7522	8.2822
1/28/1915 0:00	1/31/1915 0:00	1/29/1915 18:00	6.28	3.1	4.526	9.056
2/1/1915 0:00	2/4/1915 0:00	2/2/1915 20:00	5.76	2.58	3.7668	8.2968
2/7/1915 0:00	2/10/1915 0:00	2/9/1915 14:00	6.24	3.06	4.4676	8.9976
2/23/1917 0:00	2/26/1917 0:00	2/25/1917 10:00	6.25	3.07	4.4822	9.0122
12/25/1921 0:00	12/28/1921 0:00	12/25/1921 17:00	6.3	3.12	4.5552	9.0852
12/16/1940 0:00	12/19/1940 0:00	12/16/1940 20:00	6.09	2.91	4.2486	8.7786
12/23/1940 0:00	12/26/1940 0:00	12/24/1940 15:00	6.43	3.25	4.745	9.275
2/10/1941 0:00	2/13/1941 0:00	2/11/1941 18:00	6.35	3.17	4.6282	9.1582
2/28/1941 0:00	3/3/1941 0:00	2/28/1941 21:00	5.15	1.97	2.8762	7.4062
11/30/1952 0:00	12/3/1952 0:00	12/1/1952 18:00	6.53	3.35	4.891	9.421
2/15/1959 0:00	2/18/1959 0:00	2/16/1959 13:00	5.3	2.12	3.0952	7.6252
1/12/1969 0:00	1/15/1969 0:00	1/13/1969 14:00	6.23	3.05	4.453	8.983
1/15/1973 0:00	1/18/1973 0:00	1/16/1973 16:00	6.85	3.67	5.3582	9.8882
1/17/1973 0:00	1/20/1973 0:00	1/18/1973 18:00	7.01	3.83	5.5918	10.1218
3/3/1978 0:00	3/6/1978 0:00	3/4/1978 15:00	5.98	2.8	4.088	8.618
11/17/1982 0:00	11/20/1982 0:00	11/18/1982 20:00	5.65	2.47	3.6062	8.1362
11/29/1982 0:00	12/2/1982 0:00	11/30/1982 18:00	6.71	3.53	5.1538	9.6838
1/22/1983 0:00	1/25/1983 0:00	1/24/1983 15:00	6.2	3.02	4.4092	8.9392
1/26/1983 0:00	1/29/1983 0:00	1/27/1983 18:00	7	3.82	5.5772	10.1072
1/28/1983 0:00	1/31/1983 0:00	1/28/1983 19:00	7.05	3.87	5.6502	10.1802
3/1/1983 0:00	3/4/1983 0:00	3/2/1983 10:00	5.86	2.68	3.9128	8.4428
12/2/1983 0:00	12/5/1983 0:00	12/3/1983 18:00	6.59	3.41	4.9786	9.5086
12/5/1987 0:00	12/8/1987 0:00	12/6/1987 19:00	6.18	3	4.38	8.91
2/18/1993 0:00	2/21/1993 0:00	2/19/1993 18:00	5.91	2.73	3.9858	8.5158
1/8/1995 0:00	1/11/1995 0:00	1/10/1995 14:00	5.67	2.49	3.6354	8.1654
11/25/1997 0:00	11/28/1997 0:00	11/26/1997 17:00	5.75	2.57	3.7522	8.2822
12/5/1997 0:00	12/8/1997 0:00	12/7/1997 14:00	5.53	2.35	3.431	7.961
2/2/1998 0:00	2/5/1998 0:00	2/3/1998 12:00	6.03	2.85	4.161	8.691
2/4/1998 0:00	2/7/1998 0:00	2/6/1998 16:00	6.07	2.89	4.2194	8.7494
12/14/2002 0:00	12/17/2002 0:00	12/16/2002 16:00	5.79	2.61	3.8106	8.3406

Table 3-2

One-Hour Residual Lag for 32 Time Series with High Residual Events at San Francisco					
Begin Date	End Date	Time at which maximum verified value occurred	Residual data value at this time, adjusted for sea level rise (feet MLLW)	Time corresponding to one-hour residual tide phase lag	Residual data value at one-hour lag, adjusted for sea level rise (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	3/10/1904 15:00	1.7964	3/10/1904 14:00	1.5664
3/11/1906 0:00	3/14/1906 0:00	3/12/1906 9:00	1.3036	3/12/1906 8:00	1.1536
1/28/1915 0:00	1/31/1915 0:00	1/29/1915 18:00	1.716	1/29/1915 17:00	1.586
2/1/1915 0:00	2/4/1915 0:00	2/2/1915 20:00	1.536	2/2/1915 19:00	1.546
2/7/1915 0:00	2/10/1915 0:00	2/9/1915 14:00	1.156	2/9/1915 13:00	1.126
2/23/1917 0:00	2/26/1917 0:00	2/25/1917 10:00	1.2032	2/25/1917 9:00	1.1732
12/25/1921 0:00	12/28/1921 0:00	12/25/1921 17:00	1.4576	12/25/1921 16:00	0.8476
12/16/1940 0:00	12/19/1940 0:00	12/16/1940 20:00	1.186	12/16/1940 19:00	1.016
12/23/1940 0:00	12/26/1940 0:00	12/24/1940 15:00	1.646	12/24/1940 14:00	1.866
2/10/1941 0:00	2/13/1941 0:00	2/11/1941 18:00	1.7196	2/11/1941 17:00	1.4596
2/28/1941 0:00	3/3/1941 0:00	2/28/1941 21:00	1.9196	2/28/1941 20:00	1.7996
11/30/1952 0:00	12/3/1952 0:00	12/1/1952 18:00	1.3592	12/1/1952 17:00	1.1992
2/15/1959 0:00	2/18/1959 0:00	2/16/1959 13:00	2.0144	2/16/1959 12:00	1.9144
1/12/1969 0:00	1/15/1969 0:00	1/13/1969 14:00	1.3204	1/13/1969 13:00	1.5004
1/15/1973 0:00	1/18/1973 0:00	1/16/1973 16:00	1.4748	1/16/1973 15:00	1.6348
1/17/1973 0:00	1/20/1973 0:00	1/18/1973 18:00	1.1148	1/18/1973 17:00	1.1448
3/3/1978 0:00	3/6/1978 0:00	3/4/1978 15:00	1.4528	3/4/1978 14:00	1.4628
11/17/1982 0:00	11/20/1982 0:00	11/18/1982 20:00	1.5172	11/18/1982 19:00	1.5372
11/29/1982 0:00	12/2/1982 0:00	11/30/1982 18:00	1.3372	11/30/1982 17:00	1.5172
1/22/1983 0:00	1/25/1983 0:00	1/24/1983 15:00	1.4708	1/24/1983 14:00	1.0408
1/26/1983 0:00	1/29/1983 0:00	1/27/1983 18:00	1.9608	1/27/1983 17:00	1.5308
1/28/1983 0:00	1/31/1983 0:00	1/28/1983 19:00	1.3708	1/28/1983 18:00	1.2308
3/1/1983 0:00	3/4/1983 0:00	3/2/1983 10:00	1.9708	3/2/1983 9:00	1.9508
12/2/1983 0:00	12/5/1983 0:00	12/3/1983 18:00	2.2608	12/3/1983 17:00	2.0908
12/5/1987 0:00	12/8/1987 0:00	12/6/1987 19:00	1.2852	12/6/1987 18:00	1.3652
2/18/1993 0:00	2/21/1993 0:00	2/19/1993 18:00	1.5268	2/19/1993 17:00	1.4168
1/8/1995 0:00	1/11/1995 0:00	1/10/1995 14:00	1.524	1/10/1995 13:00	1.574
11/25/1997 0:00	11/28/1997 0:00	11/26/1997 17:00	1.8612	11/26/1997 16:00	1.9012
12/5/1997 0:00	12/8/1997 0:00	12/7/1997 14:00	1.5012	12/7/1997 13:00	1.3812
2/2/1998 0:00	2/5/1998 0:00	2/3/1998 12:00	1.9648	2/3/1998 11:00	2.1148
2/4/1998 0:00	2/7/1998 0:00	2/6/1998 16:00	2.4048	2/6/1998 15:00	2.0648
12/14/2002 0:00	12/17/2002 0:00	12/16/2002 16:00	1.5492	12/16/2002 15:00	1.7992

Table 3-3

Maximum Tide Stage at Dumbarton for 32 Time Series with High Residual Events at San Francisco				
Begin Date	End Date	Predicted tide elevations from Table III-2 (feet MLLW)	Residual Tide Heights from Table III-3 (feet MLLW)	Dumbarton Tidal Stage (feet MLLW)
3/9/1904 0:00	3/12/1904 0:00	7.4354	1.5664	9.0018
3/11/1906 0:00	3/14/1906 0:00	8.2822	1.1536	9.4358
1/28/1915 0:00	1/31/1915 0:00	9.056	1.586	10.642
2/1/1915 0:00	2/4/1915 0:00	8.2968	1.546	9.8428
2/7/1915 0:00	2/10/1915 0:00	8.9976	1.126	10.1236
2/23/1917 0:00	2/26/1917 0:00	9.0122	1.1732	10.1854
12/25/1921 0:00	12/28/1921 0:00	9.0852	0.8476	9.9328
12/16/1940 0:00	12/19/1940 0:00	8.7786	1.016	9.7946
12/23/1940 0:00	12/26/1940 0:00	9.275	1.866	11.141
2/10/1941 0:00	2/13/1941 0:00	9.1582	1.4596	10.6178
2/28/1941 0:00	3/3/1941 0:00	7.4062	1.7996	9.2058
11/30/1952 0:00	12/3/1952 0:00	9.421	1.1992	10.6202
2/15/1959 0:00	2/18/1959 0:00	7.6252	1.9144	9.5396
1/12/1969 0:00	1/15/1969 0:00	8.983	1.5004	10.4834
1/15/1973 0:00	1/18/1973 0:00	9.8882	1.6348	11.523
1/17/1973 0:00	1/20/1973 0:00	10.1218	1.1448	11.2666
3/3/1978 0:00	3/6/1978 0:00	8.618	1.4628	10.0808
11/17/1982 0:00	11/20/1982 0:00	8.1362	1.5372	9.6734
11/29/1982 0:00	12/2/1982 0:00	9.6838	1.5172	11.201
1/22/1983 0:00	1/25/1983 0:00	8.9392	1.0408	9.98
1/26/1983 0:00	1/29/1983 0:00	10.1072	1.5308	11.638
1/28/1983 0:00	1/31/1983 0:00	10.1802	1.2308	11.411
3/1/1983 0:00	3/4/1983 0:00	8.4428	1.9508	10.3936
12/2/1983 0:00	12/5/1983 0:00	9.5086	2.0908	11.5994
12/5/1987 0:00	12/8/1987 0:00	8.91	1.3652	10.2752
2/18/1993 0:00	2/21/1993 0:00	8.5158	1.4168	9.9326
1/8/1995 0:00	1/11/1995 0:00	8.1654	1.574	9.7394
11/25/1997 0:00	11/28/1997 0:00	8.2822	1.9012	10.1834
12/5/1997 0:00	12/8/1997 0:00	7.961	1.3812	9.3422
2/2/1998 0:00	2/5/1998 0:00	8.691	2.1148	10.8058
2/4/1998 0:00	2/7/1998 0:00	8.7494	2.0648	10.8142
12/14/2002 0:00	12/17/2002 0:00	8.3406	1.7992	10.1398

Table 3-4

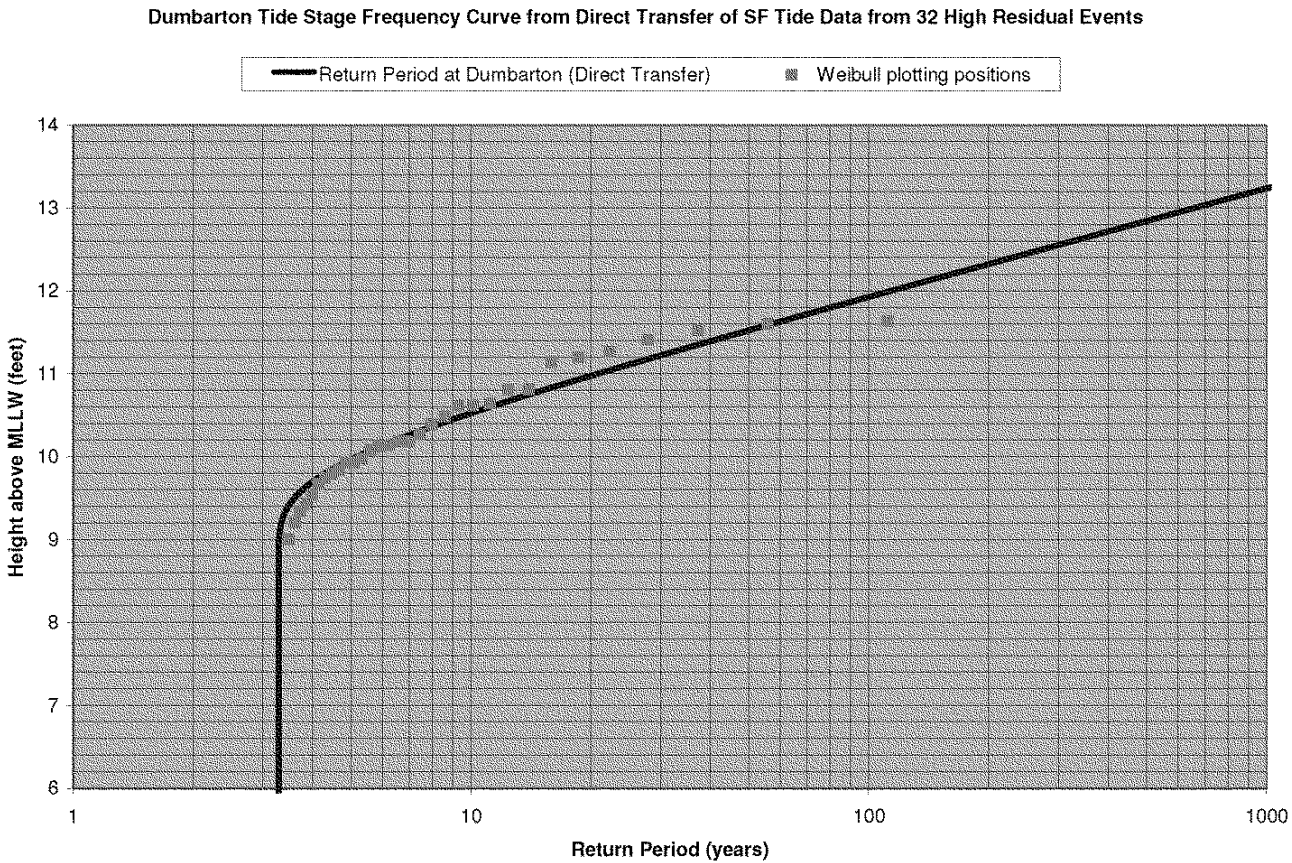

Dumbarton Tide Stage Frequency Curve from Direct Transfer of SF Tide Data from 32 High Residual Events
Return Period at Dumbarton (Direct Transfer)
Weibull plotting positions
Height above MLLW (feet)
14
13
12
11
10
9
8
7
6
1
10
100
1000
Return Period (years)

Plate 3-1

Statistical distribution of the convolution of amplified SF predicted tide and SF residual tide from 33 high residual events

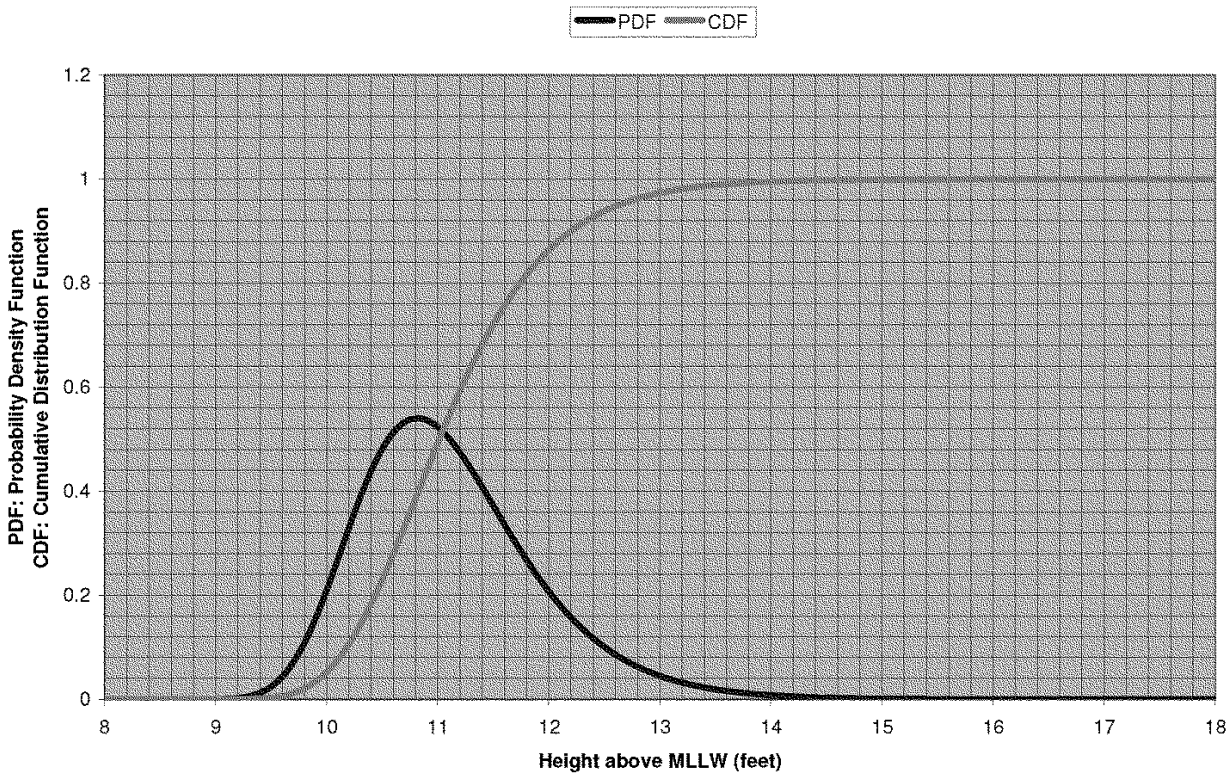


Plate 3-2

Probabilities for different combinations of synthetic residual phase shift and synthetic residual event duration																
Phase Shift		Event Duration (days)														
		2	3	4	5	6	8	2'	3'	4'	6'	2"	3"	4"	6"	
(hours)	probability	1/33	6/33	6/33	3/33	4/33	2/33	1/33	1/33	2/33	1/33	1/33	2/33	2/33	1/33	33/33
0	3/33	3/1089	18/1089	18/1089	9/1089	12/1089	6/1089	3/1089	3/1089	6/1089	3/1089	3/1089	6/1089	6/1089	3/1089	
3	1/33	1/1089	6/1089	6/1089	3/1089	4/1089	2/1089	1/1089	1/1089	2/1089	1/1089	1/1089	2/1089	2/1089	1/1089	
4	4/33	4/1089	24/1089	24/1089	12/1089	16/1089	8/1089	4/1089	4/1089	8/1089	4/1089	4/1089	8/1089	8/1089	4/1089	
5	2/33	2/1089	12/1089	12/1089	6/1089	8/1089	4/1089	2/1089	2/1089	4/1089	2/1089	2/1089	4/1089	4/1089	2/1089	
6	5/33	5/1089	30/1089	30/1089	15/1089	20/1089	10/1089	5/1089	5/1089	10/1089	5/1089	5/1089	10/1089	10/1089	5/1089	
8	2/33	2/1089	12/1089	12/1089	6/1089	8/1089	4/1089	2/1089	2/1089	4/1089	2/1089	2/1089	4/1089	4/1089	2/1089	
17	1/33	1/1089	6/1089	6/1089	3/1089	4/1089	2/1089	1/1089	1/1089	2/1089	1/1089	1/1089	2/1089	2/1089	1/1089	
18	13/33	13/1089	78/1089	78/1089	39/1089	52/1089	26/1089	13/1089	13/1089	26/1089	13/1089	13/1089	26/1089	26/1089	13/1089	
21	2/33	2/1089	12/1089	12/1089	6/1089	8/1089	4/1089	2/1089	2/1089	4/1089	2/1089	2/1089	4/1089	4/1089	2/1089	
	33/33															

' = add 0.5 feet to residual tide data
" = add 1 foot to residual tide data

Table 3-5

Dumbarton Probabilities for the Convolution of Amplified SF Predicted Tide and SF Residual Tide		
1	2	3
Elevation (feet MLLW)	Probability value read from Dumbarton pdf in Plate III-2	Probability at this elevation [(Column 2) x 0.2]
8.1	0	0
8.3	2.97427E-10	5.94853E-11
8.5	5.48082E-08	1.09616E-08
8.7	3.24191E-06	6.48383E-07
8.9	7.76332E-05	1.55266E-05
9.1	0.000905275	0.000181055
9.3	0.005953936	0.001190787
9.5	0.024824115	0.004964823
9.7	0.072005405	0.014401081
9.9	0.156456654	0.031291331
10.1	0.270087989	0.054017598
10.3	0.388164758	0.077632952
10.5	0.482043661	0.096408732
10.7	0.532807483	0.106561497
10.9	0.536654418	0.107330884
11.1	0.501878645	0.100375729
11.3	0.442347228	0.088469446
11.5	0.371837037	0.074367407
11.7	0.300943642	0.060188728
11.9	0.236291816	0.047258363
12.1	0.181080089	0.036216018
12.3	0.136098525	0.027219705
12.5	0.100711825	0.020142365
12.7	0.073603999	0.0147208
12.9	0.053259707	0.010651941
13.1	0.038233244	0.007646649
13.3	0.027272534	0.005454507
13.5	0.01935579	0.003871158
13.7	0.013681873	0.002736375
13.9	0.009640251	0.00192805
14.1	0.006775267	0.001355053
14.3	0.004752138	0.000950428
14.5	0.003327814	0.000665563
14.7	0.002327459	0.000465492
14.9	0.001626199	0.00032524
15.1	0.001135339	0.000227068
15.3	0.000792156	0.000158431
15.5	0.000552441	0.000110488
15.7	0.000385121	7.70242E-05
15.9	0.000268398	5.36797E-05
16.1	0.000187009	3.74017E-05
16.3	0.000130276	2.60552E-05
16.5	9.07416E-05	1.81483E-05
16.7	6.31976E-05	1.26395E-05
16.9	4.40106E-05	8.80211E-06
17.1	3.06468E-05	6.12935E-06
17.3	2.13398E-05	4.26795E-06
17.5	1.48586E-05	2.97172E-06
17.7	1.03455E-05	2.0691E-06

Table 3-6

1	2	3	4	5	6	7	8
Dumbarton tide stage (w/o decay factor)	Probability for the convolution of amplified SF predicted tide and SF residual tide (from Table III-6)	Decay factor	Dumbarton stage (w/ decay factor)	Duration (days)	Phase shift (hours)	Prob(Duration) x Prob(Phase) (from Table III-5)	Joint probability of amplified SF predicted tide, SF residual tide, synthetic residual phase shift, and synthetic residual event duration [(Column 2) x (Column 7)]
10.7	0.106561497	1	10.7	3"	0	6/1089	0.000587116
10.7	0.106561497	0.97	10.379	3"	3	2/1089	0.000195705
10.7	0.106561497	0.97	10.379	3"	4	8/1089	0.000782821
10.7	0.106561497	0.96	10.272	3"	5	4/1089	0.00039141
10.7	0.106561497	0.95	10.165	3"	6	10/1089	0.000978526
10.7	0.106561497	0.93	9.951	3"	8	4/1089	0.00039141
10.7	0.106561497	0.95	10.165	3"	17	2/1089	0.000195705
10.7	0.106561497	0.96	10.272	3"	18	26/1089	0.002544168
10.7	0.106561497	0.98	10.486	3"	21	4/1089	0.00039141
10.7	0.106561497	1	10.7	4"	0	6/1089	0.000587116
10.7	0.106561497	0.97	10.379	4"	3	2/1089	0.000195705
10.7	0.106561497	0.97	10.379	4"	4	8/1089	0.000782821
10.7	0.106561497	0.97	10.379	4"	5	4/1089	0.00039141
10.7	0.106561497	0.96	10.272	4"	6	10/1089	0.000978526
10.7	0.106561497	0.95	10.165	4"	8	4/1089	0.00039141
10.7	0.106561497	0.92	9.844	4"	17	2/1089	0.000195705
10.7	0.106561497	0.91	9.737	4"	18	26/1089	0.002544168
10.7	0.106561497	0.92	9.844	4"	21	4/1089	0.00039141
10.7	0.106561497	1	10.7	6"	0	3/1089	0.000293558
10.7	0.106561497	0.98	10.486	6"	3	1/1089	9.78526E-05
10.7	0.106561497	0.98	10.486	6"	4	4/1089	0.00039141
10.7	0.106561497	0.98	10.486	6"	5	2/1089	0.000195705
10.7	0.106561497	0.97	10.379	6"	6	5/1089	0.000489263
10.7	0.106561497	0.97	10.379	6"	8	2/1089	0.000195705
10.7	0.106561497	0.96	10.272	6"	17	1/1089	9.78526E-05
10.7	0.106561497	0.96	10.272	6"	18	13/1089	0.001272084
10.7	0.106561497	0.96	10.272	6"	21	2/1089	0.000195705
10.9	0.107330884	1	10.9	2	0	3/1089	0.000295677
10.9	0.107330884	0.97	10.573	2	3	1/1089	9.85591E-05
10.9	0.107330884	0.96	10.464	2	4	4/1089	0.000394236
10.9	0.107330884	0.95	10.355	2	5	2/1089	0.000197118
10.9	0.107330884	0.94	10.246	2	6	5/1089	0.000492796
10.9	0.107330884	0.91	9.919	2	8	2/1089	0.000197118
10.9	0.107330884	0.89	9.701	2	17	1/1089	9.85591E-05
10.9	0.107330884	0.9	9.81	2	18	13/1089	0.001281269
10.9	0.107330884	0.94	10.246	2	21	2/1089	0.000197118
10.9	0.107330884	1	10.9	3	0	18/1089	0.001774064
10.9	0.107330884	0.97	10.573	3	3	6/1089	0.000591355
10.9	0.107330884	0.96	10.464	3	4	24/1089	0.002365419
10.9	0.107330884	0.95	10.355	3	5	12/1089	0.001182709

Table 3-7. Partial table demonstrating the calculation of joint probabilities for Dumbarton tide stage

Dumbarton Tide Stage Return Period from Joint Probability of Amplified SF Predicted Tide, SF Residual Tide, Synthetic Residual Phase Shift, and Synthetic Residual Event Duration					
Elevation Range	Elevation	PDF	CDF	Exceedance Probability	Return Period
7.1-7.3	7.2	0	0	1	3.181818182
7.3-7.5	7.4	7.64733E-13	7.64733E-13	1	3.181818182
7.5-7.7	7.6	1.48186E-10	1.48951E-10	1	3.181818182
7.7-7.9	7.8	9.68944E-09	9.83839E-09	0.99999999	3.181818213
7.9-8.1	8	9.43944E-07	9.53782E-07	0.999999046	3.181821217
8.1-8.3	8.2	1.07475E-05	1.17013E-05	0.999988299	3.181855414
8.3-8.5	8.4	7.94625E-05	9.11639E-05	0.999908836	3.182108275
8.5-8.7	8.6	0.000404481	0.000495644	0.999504356	3.183396014
8.7-8.9	8.8	0.001530922	0.002026566	0.997973434	3.188279441
8.9-9.1	9	0.005201633	0.007228199	0.992771801	3.204984447
9.1-9.3	9.2	0.016277134	0.023505333	0.976494667	3.258408151
9.3-9.5	9.4	0.028108332	0.051613666	0.948386334	3.354981052
9.5-9.7	9.6	0.051722701	0.103336367	0.896663633	3.548508118
9.7-9.9	9.8	0.075524678	0.178861045	0.821138955	3.874883978
9.9-10.1	10	0.087322177	0.266183222	0.733816778	4.335984508
10.1-10.3	10.2	0.101560688	0.36774391	0.63225609	5.032483251
10.3-10.5	10.4	0.102019486	0.469763396	0.530236604	6.00075166
10.5-10.7	10.6	0.099598661	0.569362057	0.430637943	7.388615501
10.7-10.9	10.8	0.089311501	0.658673558	0.341326442	9.321921147
10.9-11.1	11	0.076515152	0.73518871	0.26481129	12.01541738
11.1-11.3	11.2	0.063309623	0.798498333	0.201501667	15.79053029
11.3-11.5	11.4	0.059012506	0.857510839	0.142489161	22.33024717
11.5-11.7	11.6	0.037321293	0.894832132	0.105167868	30.2546609
11.7-11.9	11.8	0.028385684	0.923217816	0.076782184	41.43953748
11.9-12.1	12	0.021213967	0.944431783	0.055568217	57.25967778
12.1-12.3	12.2	0.015751837	0.96018362	0.03981638	79.91229157
12.3-12.5	12.4	0.01135094	0.97153456	0.02846544	111.7782895
12.5-12.7	12.6	0.008433354	0.979967914	0.020032086	158.8360884
12.7-12.9	12.8	0.005799931	0.985767845	0.014232155	223.5654537
12.9-13.1	13	0.004647	0.990414845	0.009585155	331.95272
13.1-13.3	13.2	0.002793948	0.993208793	0.006791207	468.5202723
13.3-13.5	13.4	0.001955583	0.995164376	0.004835624	657.9953989
13.5-13.7	13.6	0.001376448	0.996540825	0.003459175	919.8198325
13.7-13.9	13.8	0.000987223	0.997528047	0.002471953	1287.16801
13.9-14.1	14	0.000671275	0.998199322	0.001800678	1767.011249
14.1-14.3	14.2	0.000472253	0.998671575	0.001328425	2395.180415
14.3-14.5	14.4	0.000366567	0.999038142	0.000961858	3307.990815
14.5-14.7	14.6	0.000217219	0.999255361	0.000744639	4272.965608
14.7-14.9	14.8	0.000151595	0.999406956	0.000593044	5365.227444
14.9-15.1	15	0.000105749	0.999512705	0.000487295	6529.552333
15.1-15.3	15.2	8.0468E-05	0.999593173	0.000406827	7821.059816
15.3-15.5	15.4	4.93548E-05	0.999642528	0.000357472	8900.882374
15.5-15.7	15.6	3.5124E-05	0.999677652	0.000322348	9870.749325
15.7-15.9	15.8	2.37396E-05	0.999701391	0.000298609	10655.48046
15.9-16.1	16	1.688E-05	0.999718271	0.000281729	11293.91427
16.1-16.3	16.2	1.13951E-05	0.999729667	0.000270333	11769.97417
16.3-16.5	16.4	7.75996E-06	0.999737426	0.000262574	12117.81763
16.5-16.7	16.6	5.37875E-06	0.999742805	0.000257195	12371.23946
16.7-16.9	16.8	3.66209E-06	0.999746467	0.000253533	12549.933
16.9-17.1	17	2.29066E-06	0.999748758	0.000251242	12664.35502
17.1-17.3	17.2	1.35154E-06	0.99975011	0.00024989	12732.8508
17.3-17.5	17.4	7.49223E-07	0.999750859	0.000249141	12771.14131
17.5-17.7	17.6	2.584E-07	0.999751117	0.000248883	12784.4008

Table 3-8

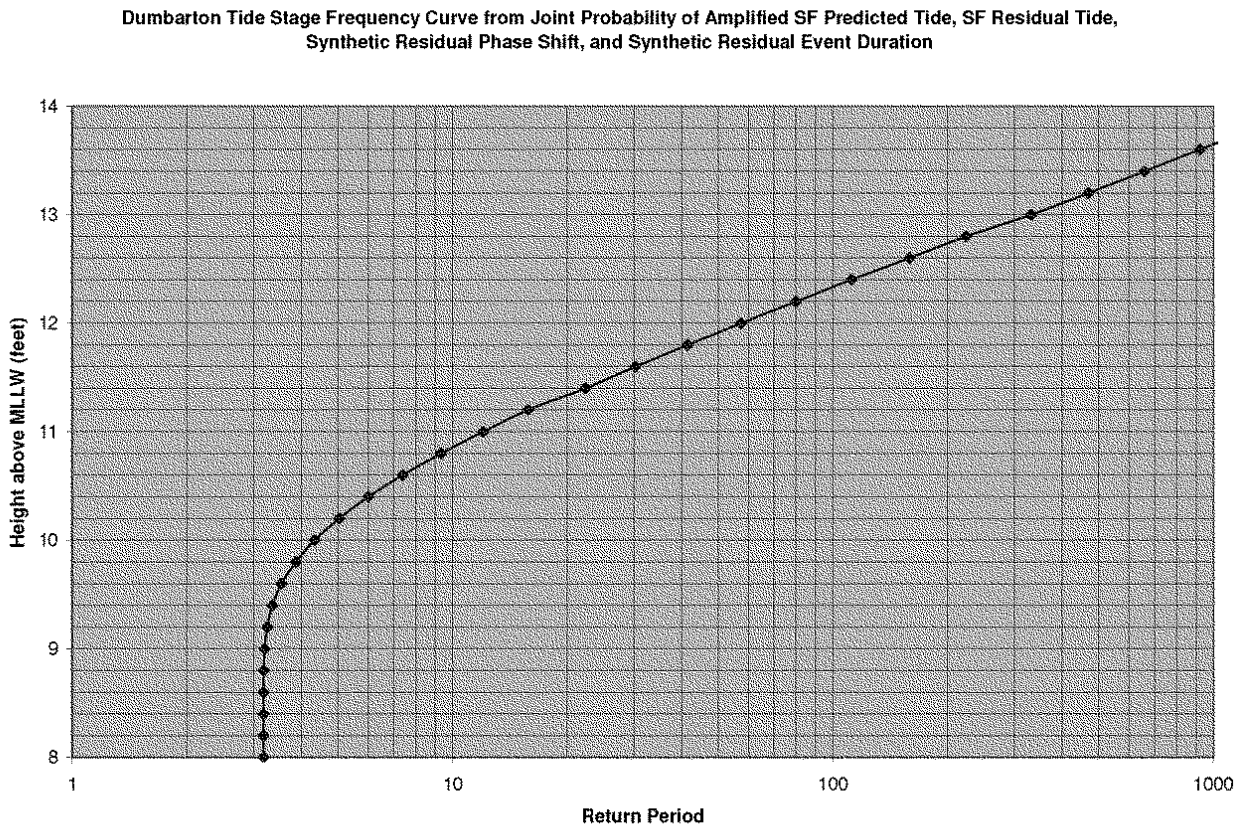
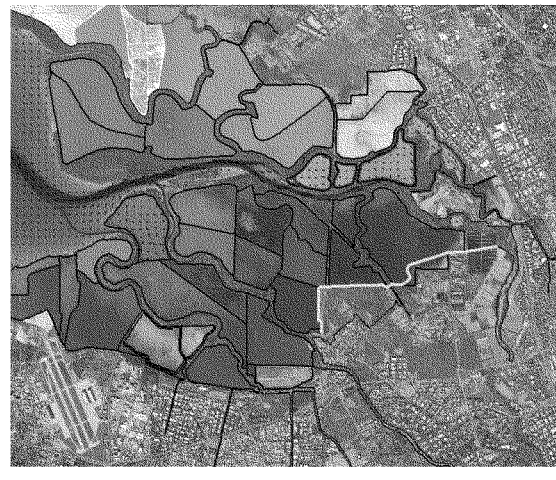

Dumbarton Tide Stage Frequency Curve from Joint Probability of Amplified SF Predicted Tide, SF Residual Tide, Synthetic Residual Phase Shift, and Synthetic Residual Event Duration
Height above MLLW (feet)
14
13
12
11
10
9
8
1
10
100
1000
Return Period

Plate 3-3

ANNEX 3: SOUTH SAN FRANCISCO BAY LONG WAVE MODELING REPORT

SOUTH SAN FRANCISCO BAY SHORELINE STUDY

South San Francisco Bay Long Wave Modeling Report



Prepared For:

U.S. Army Corps of Engineers
San Francisco District

Prepared By:

Michael L. MacWilliams, Ph.D., Nina E. Kilham, Ph.D., Aaron J. Bever, Ph.D.

DELTA MODELING ASSOCIATES

DRAFT REPORT

Due to its large size, Annex 3 of Appendix D1 of the South San Francisco Bay Shoreline Study, Phase 1, Alviso Economic Impact Area report, will be provided under its own separate cover.

ANNEX 4: MONTE CARLO SIMULATION REPORT

Monte Carlo Simulation Under With Project Conditions For South San Francisco Bay Shoreline Study

Final Summary Report

Prepared For:
U.S. Army Corps of Engineers
San Francisco District

Prepared By:
Noble Consultants, Inc.

July 2012

Due to its large size, Annex 4 of Appendix D1 of the South San Francisco Bay Shoreline Study, Phase 1, Alviso Economic Impact Area report, will be provided under its own separate cover.

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U.S. Army Corps of Engineers, San Francisco District

1455 Market Street

San Francisco, CA 94103, USA

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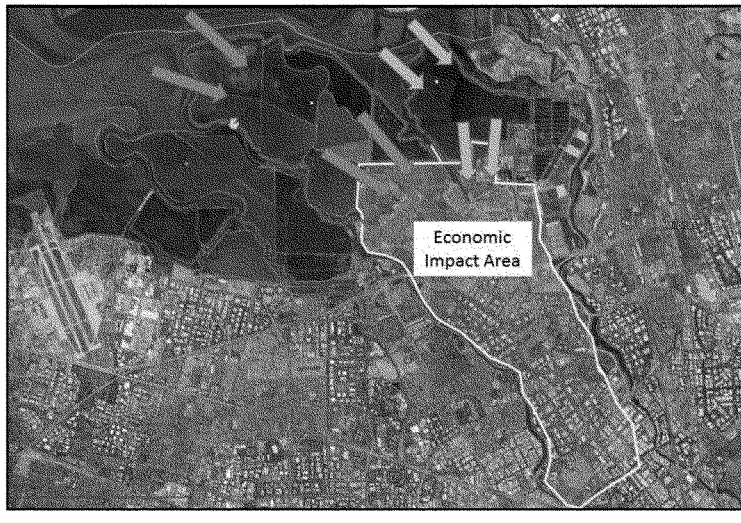
Appendix D2

Tidal Flood Risk Analysis Summary Report

US Army Corps of Engineers®

TIDAL FLOOD RISK ANALYSIS SUMMARY REPORT

South San Francisco Bay Shoreline (SSFBS) Study



September, 2015

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ACRONYMS

ACE	Annual Chance of Exceedance
AEHW	Annual Extreme High Water level
AEP	Annual Exceedance Probability
AFB	Alternative Formulation Briefing
ATR	Agency Technical Review
CDF	Cumulative Distribution Function
CNP	Conditional Non-exceedance Probability
CPT	Cone Penetrometer Test
DTM	Direct Transfer Method
DQC	District Quality Control
EAD	Equivalent (or Expected) Annual Damage
EC	Engineer Circular
EGM	Economic Guidance Memorandum
EIA	Economic Impact Area
EM	Engineer Manual
ENSO	El Nino-Southern Oscillation
ER	Engineer Regulation
ETL	Engineer Technical Letter
FRM	Flood Risk Management
FSM	Feasibility Scoping Meeting
FWOP	Future WithOut Project
FWS	United States Fish and Wildlife Service
GEV	Generalized Extreme Value
HEC-FDA	Hydrologic Engineering Center-Flood Damage reduction Analysis
LMSL	Local Mean Sea Level
MEHW	Monthly Extreme High Water level
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
NAVD88	North American Vertical Datum of 1988
NED	National Economic Development
NOAA	National Oceanographic and Atmospheric Administration

NTDE	National Tidal Datum Epoch
PDO	Pacific Decadal Oscillation
PED	Preconstruction, Engineering and Design
RSLR	Relative Sea Level Rise
SCVWD	Santa Clara Valley Water District
SLC	Sea Level Change
SPT	Standard Penetration Test
SSFBS	South San Francisco Bay Shoreline
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WPCP	Water Pollution Control Plant
WSE	Water Surface Elevation

1.0 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This report was prepared to summarize analyses performed to determine if there is an economically justified (i.e., benefits exceed costs) tidal flood risk management project for the South San Francisco Bay Shoreline (SSFBS) Study under the three sea level change (SLC) scenarios used in U.S. Army Corps of Engineers (USACE) studies. USACE policy, as prescribed by EC 1165-2-212 (USACE, 2011) and ER 1100-2-8162 (USACE, 2013a), require that three specific USACE SLC scenarios be considered when formulating and evaluating plans for a study. The results for this study show that there are significant national net economic benefits of a project under each of the three USACE SLC scenarios, with annual net benefits ranging from approximately $15 million to $37 million. These results by themselves are not intended to determine Federal interest or a recommended plan. The results from this summary report, along with other information, will be used to determine Federal interest and a recommended plan. Federal interest and recommendations for a future project are documented in the Integrated Feasibility Report and Environmental Impact Statement/Report.

This report is organized into seven sections that address the second, third, and fourth questions listed above, regarding the mechanism, consequences, and probability of flooding: this Introduction section, followed by an Overview of the Flood Damage Analysis section, and then the three technical sections feeding into the flood damage analysis (Coastal Engineering Technical Summary, Geotechnical Engineering Technical Summary, and Economics Technical Summary), a Summary section, and References. The results supporting economic justification of a Federal flood risk management project are briefly given in the Overview of the Flood Damage Analysis section, in more detail in the Economics Technical Summary section, and are also summarized in the Summary section.

1.2 BACKGROUND

The SSFBS study is authorized to study the bay shoreline for all of Santa Clara County and large portions of Alameda and San Mateo Counties, California. Due to the enormity of the study area, the study was initially divided into four smaller interim study areas (see Figure 1). The Alviso Ponds and Santa Clara County interim study area is the first interim study to be conducted. As recently as 150 years ago, the study area was dominated by tidal marsh habitat. The open water areas of the bay were very nearly surrounded by broad expanses of tidal mudflats and even broader areas of tidal marsh. Historic tidal marshlands were diked off from bay inundation beginning in the 1930s primarily to create solar salt-harvesting ponds. The tidal marsh was replaced with a series of ponds separated by dikes not designed for flood risk reduction. The system of ponds and dikes (also referred to as pond levees in this report), although not designed or intended as flood risk management structures, have been largely effective in reducing flood damages for an area adjacent to the bay with an elevation that is below mean sea level." Subsidence contributes to the study area's flood risk. The Santa Clara Valley has experienced regional land subsidence since the 1900s, primarily due to large-scale groundwater withdrawals. Subsidence was largely arrested by the mid-1960s, when state water deliveries began to arrive in Santa Clara County, but some areas, such as portions of the community of Alviso, are still several feet below mean sea level.

The SSFBS study analyzed the entire Alviso Ponds and Santa Clara County shoreline for future without-project conditions and initial planning measures through the USACE Feasibility Scoping Meeting (FSM) milestone. The study effort through the FSM milestone was quite extensive, requiring a large investment of time and funds. After the FSM the non-Federal study partners requested that this initial interim feasibility study be re-scoped to a smaller area with high potential flood risk reduction and ecosystem restoration benefits, with other areas being studied in subsequent phases. The community of Alviso and surrounding ponds (the Alviso Economic Impact Area (EIA)) was chosen for this first interim study area. The Alviso EIA is also shown in Figure 1to show the reduction in size for the re-scoped study area.

Initial work under the re-scoping primarily focused on the "USACE High" SLC scenario from EC 1165-2-212 (USACE, 2011); however, the results of that work indicated that further work was necessary to determine economic justification under all three scenarios. Therefore, the analyses summarized in this report cover all three USACE SLC scenarios in sufficient technical detail to determine if there is economic justification for a flood risk reduction plan in the re-scoped study area. The analyses presented herein are a consolidation of tidal flood risk information that is also captured in technical appendices to the Integrated Feasibility Report and Environmental Impact Statement/Report.

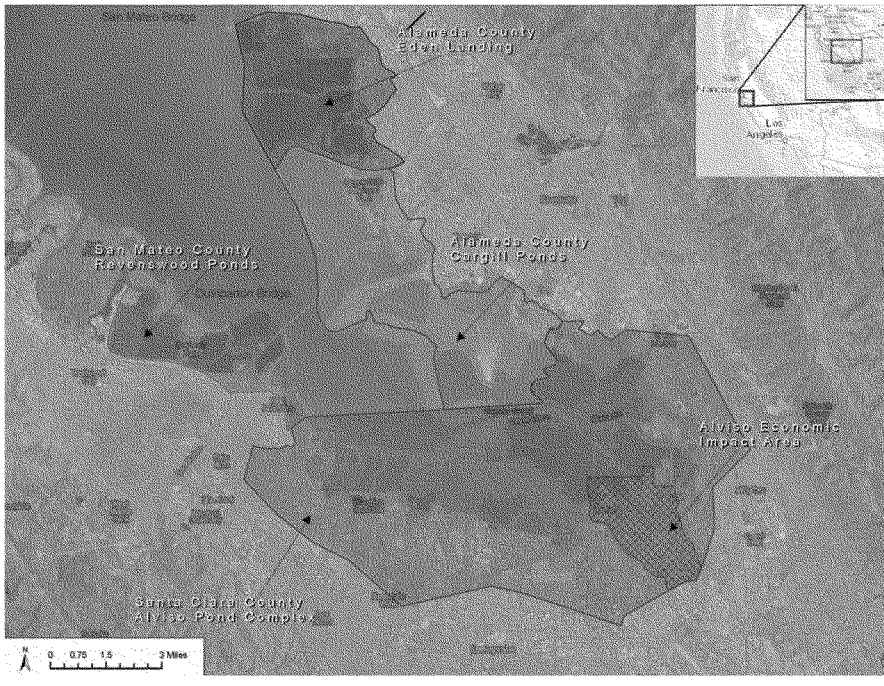


Figure 1: South San Francisco Bay Shoreline Study Areas

1.3 CHARACTERIZING FLOOD RISK

Characterizing flood risk involves the qualitative or quantitative description of the nature, magnitude and likelihood of the adverse effects associated with the flood hazard. The purpose of characterizing flood risk is to support decisions related to reducing the risk to people and property in the floodplain. Characterizing flood risk requires answering four important questions:

1. What can go wrong?
2. How can it happen?
3. What are the consequences?
4. How likely is it to happen?

The goal of the risk analysis that has been completed for the South San Francisco Bay Shoreline Feasibility Study is to answer these four questions in sufficient detail to support decisions that may reduce flood risk in the study area. The study is focused on reducing the risk of coastal flooding, which could happen if water from the bay overtops or breaches the non-engineered pond dikes that currently separate the bay from the community of Alviso and other people and property in the city of San Jose, CA. The consequences of a coastal flood event in the study area would be devastating: the community of Alviso is located at an elevation below mean high tide, and the region's largest water pollution control plant is located adjacent to the town in the floodplain. Thus, the answers to the first three questions posed above are relatively straightforward. The fourth question (likelihood) is the most challenging to answer, and requires the greatest level of effort and analysis.

1.4 CHARACTERIZING THE FLOODPLAIN AND DIKE-POND SYSTEM

The Alviso economic impact area (Figure 1) is located in a flood plain with elevations that are typically at mean lower tide level (0 feet NAVD88). The community is protected from tidal flooding by an array of dikes and ponds that were once part of an integrated system for commercial salt production that was owned and operated by Cargill, Incorporated. The operation and maintenance of the dike pond system was transferred to U.S. Fish and Wildlife Service (FWS) in 2003. The FWS has also made modifications to water control structures and has breached several internal dikes that previously divided ponds to facilitate the development and expansion of habitat in the south bay. Water surface elevations in the managed ponds are at approximately mean sea level.

The dikes are not engineered and were not constructed or operated with the intent of managing flood risk. The dikes were constructed by pioneering into former tidal marsh and incrementally raising grades over time to both increase height, and to counteract loss of grade due to subsidence of soft foundation soils. Crest elevations and section width were maintained by borrowing from adjacent pond bottoms or modifying the dike section (e.g. windrowing and grading). Significant reaches of outer and inner dike would overtop at elevation 10.5 and 7 feet NAVD88, respectively (Figure 2). All dikes are characterized by non-uniform height and width, sparse vegetative cover, variable soil types, and unknown construction quality.

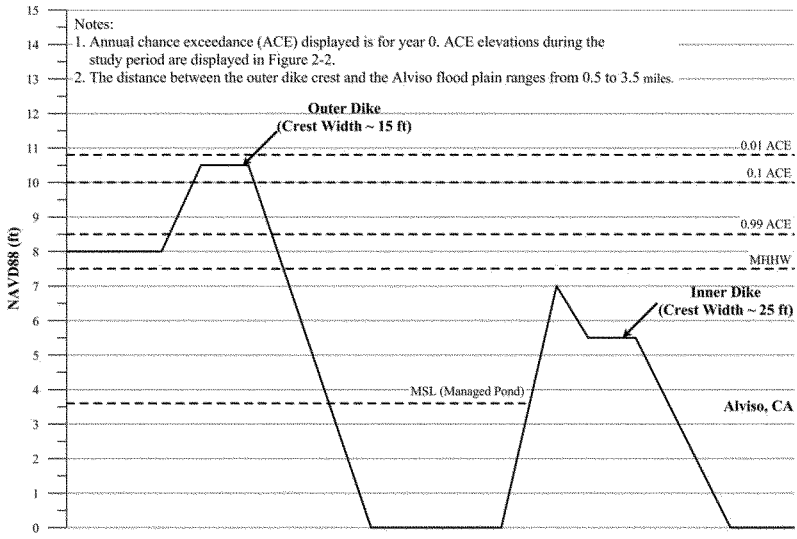


Figure 2: Typical cross-section of dike pond system and relevant elevations.

1.4.1 PAST PERFORMANCE

The community of Alviso could be flooded from both riverine and coastal events. In 1983 significant flooding occurred in Alviso from the Guadalupe River. Flooding in Alviso reached depths of 3 to 7 feet and caused major damage to 362, with lesser damage to 13 homes and 40 businesses (SCVWD 1983). Coincident high tides have been suspected to have contributed to the magnitude of flooding experienced in 1983. Nevertheless, there is no documented flooding from which substantial damages were incurred from purely tidal flood events. In the period 1980 to 2010 tidal water levels are estimated to have exceeded elevation 9 feet NAVD88 seven times, of which elevation 10 feet NAVD88 was exceeded four times.

The past performance against tidal flooding appears to have been excellent; however, the risk of overtopping and breach are judged to be high. There are reaches of the existing outer dike that have narrow (1 to 3 feet) elevated sections of the crest suggesting emergency grading and/or piling of material to prevent overtopping. It is likely several overtopping events may have been narrowly avoided with this type of action.

1.4.2 EXISTING CONDITION

It appears that FWS has maintained the dikes to similar lines and grades as those established by Cargill. No improvements to increase reliability or robustness have been executed or are planned. FWS executes maintenance actions similar to those performed by Cargill to restore height and section width to the outer dike. Maintenance efforts are prioritized and addressed on a reactive basis to maintain functionality of the dikes and managed ponds. Wave and tide conditions have been reasonably mild during the FWS

ownership, which has proportionally reduced the maintenance efforts compared to those experienced under Cargill ownership.

1.4.3 OPERATION AND MAINTENANCE REGIME

FWS has modified a facility designed for salt production to in order to promote and benefit wildlife. FWS has breached multiple internal dikes to create hydraulic connectivity between several, but not all, managed ponds. The historic configuration of the ponds as independent "cells" provided redundancy in that a breach on the outboard dike would present a flood risk to a discrete location in the study area. Restoration activities have presumably nominally increased the likelihood of water reaching the floodplain and decreased the effectiveness of a targeted response to potential outboard dike breaches.

FWS has strived to maintain the same type and strategy of maintenance actions executed under Cargill. The extent of routine maintenance performed by Cargill from 1995 to 2005 is discussed in Section 4.2.1. Maintenance records were compiled mostly from regulatory permits issued by USACE or other regulatory agencies in the bay area. These records may not reflect all the emergency actions taken in advance of predicted storms or flood-fighting that may have occurred. In the ten year period Cargill performed at least 126 actions that covered approximately 47 miles of dike in the study area. Borrow material to support maintenance actions was historically obtained from pond bottoms and supplemented with off-site borrow and adjacent dike reaches with higher/wider sections.

The continuation of the same maintenance paradigm is likely unsustainable beyond the near term. Neither the availability of borrow, or the volume of borrow can be considered static. The ability to harvest from adjacent ponds is encumbered by past maintenance that has diminished available borrow, and, the FWS's ability to disturb potentially critical wildlife habitat within the managed ponds. Likewise, the practice of modifying reaches of dike crest and/or cannibalizing higher reaches to maintain and prevent against overtopping in lower reaches is finite. This paradigm proved successful in the past but its continued use will begin to increase the likelihood of levee failure in newly narrowed or lowered reaches. Lastly, the volume required to maintain equivalent functionality will increase with SLC.

1.5 CONCLUSIONS

The results presented in this report indicated that there is economic justification for a FRM project under all sea level rise scenarios. The analysis also showed that the annual exceedance probability (AEP) or probability of flooding in any given year for the study period is 32%. While the analysis demonstrated high confidence in the economic justification for a project, the high AEP did not correlate with past performance. The high AEP was believed to be associated with uncertainty in modeling inputs, effectiveness and limitations of HEC-FDA at modeling the study area, and assumptions that simplified the failure mode of the dike-pond system. Corrective actions proposed included more advanced modeling, refinement of model inputs, and/or multi-variant sensitivity analyses. However, all strategies were judged unlikely to improve the confidence of a reported AEP, or quantify the impact of the potential sources of error noted above.

A rigorous review of all model inputs was conducted. All inputs were concluded to reflect appropriate professional judgment, with the levee failure function judged to be the most open interpretation. A simplified sensitivity analysis was conducted by augmenting the levee failure function to "prevent" levee failures from occurring below a 10-year event. This analysis showed that there was still strong economic support for an FRM project and that the AEP could be reduced substantially to roughly correspond to past performance of the dike pond system. However, a correlation with past performance could not be achieved without making the outer dike unrealistically reliable at preventing flooding. The levee failure function was confirmed to be reasonable and to reflect sound engineering judgment. It was concluded

uncertainties in all model inputs, the effectiveness of the model as an appropriate tool for diked/leveed communities below the ambient water level, and assumptions applied to the failure mode contributed to lowered confidence in the predicted AEP.

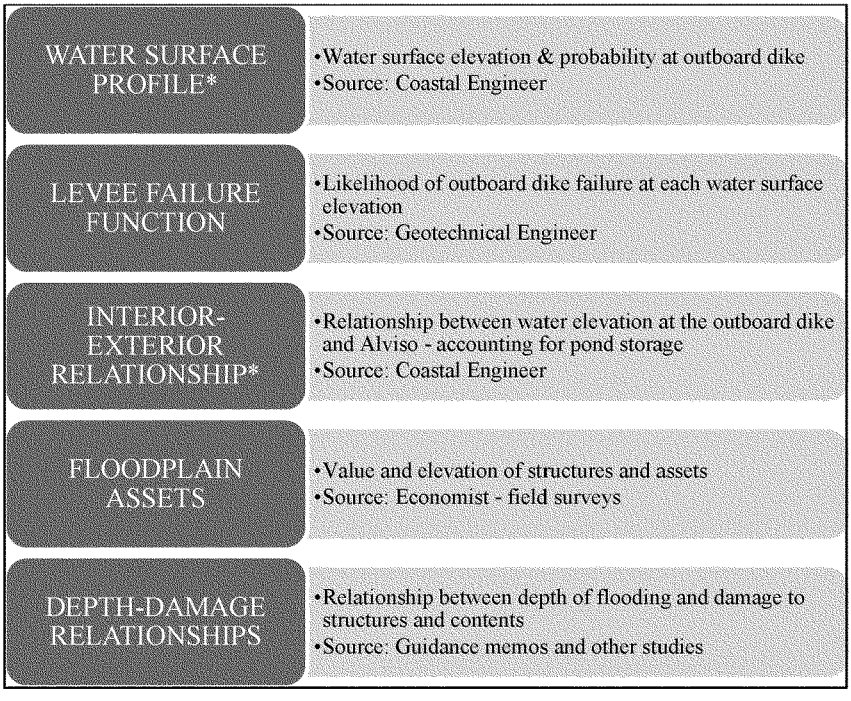
The project delivery team has moved forward with the existing analysis and has acknowledged the risks that remain in communicating flood risk via the tidal flood damage analysis for the existing without and FWOP conditions. The reduced level of confidence in the reported AEP can be attributed to multiple factors that define the complexity of the dike-pond system and floodplain in the study area. While an AEP of 32% may appear to substantially overstate the flood risk for the study period, there is reason to believe that existing flood risk to the Alviso economic impact area is fundamentally different than what past performance would otherwise indicate.

2.0 OVERVIEW OF THE FLOOD DAMAGE ANALYSIS

Most of the key flood risk metrics are an output of the (economic) flood damage analysis model certified for use in USACE feasibility studies – HEC-FDA. These metrics include an estimate of the event-based damages (dollar damage from, for example, a 10% annual chance of exceedance flood event), the expected or equivalent annual damage (EAD), the probability of flooding under the without-project and with-project conditions (annual exceedance probability or AEP), and the likelihood of a levee containing a particular probability flood event (conditional non-exceedance probability (CNP), also called assurance).

The major inputs to the flood damage model and the source of this information are shown in Figure 3 below. They include the water surface profile, levee failure function, interior-exterior flood elevation relationship, value and location of assets in the floodplain, and the relationship between depth of flooding and structure and content damage.

Figure 3: Major Components of the Flood Risk Analysis



**Denotes inputs that change with sea-level rise*

The HEC-FDA program was used to combine water surface profile data and economic data (structure inventory, etc.) in order to derive a stage-damage function and estimate expected annual damage (EAD) at various intervals of time within the study's fifty-year period of analysis (2017 – 2067) for each SLC

scenario. HEC-FDA version 1.2.5a, a USACE certified model, was used and its use complies with the USACE Planning Model Improvement Program for Model Certification.

The consideration of SLC complicates the damage analysis because under each of the SLC scenarios the flood risk is continually increasing into the future. In a typical HEC-FDA model, a base year and a single future year would be entered into the model. The program then assumes a linear relationship between the base year and the future year conditions that have been specified in the model. However, because of the existence of the current system of pond dikes, because future SLC is not expected to be a linear function of time, and because of the need to consider the impact of structure relocations out of the area over the period of analysis, the traditional approach to flood damage modeling in FDA is not appropriate for this analysis. Instead, for this analysis, for each SLC scenario the fifty-year period of analysis (2017 – 2067) was separated into five without-project models – one for each decade of the period of analysis.

The sections below describe each of the major inputs to the flood damage modeling.

2.1 INPUT 1: WATER SURFACE PROFILE AT OUTBOARD DIKE

Updated water surface profile data was developed for each of the three SLC scenarios – USACE Low, Intermediate, and High. The water surface profiles predict how high the water will be for a given likelihood storm event, over the fifty-year period of analysis. To reasonably capture the change in water surface elevations over time as a result of SLC, data was provided for project year zero, or base year (2017) and for every tenth year thereafter over the fifty-year period of analysis. A plot of the USACE Intermediate SLC scenario water elevations over the period of analysis for each probability event is shown in Figure 4 below. More details on the water surface profile development can be found in the Coastal Engineering Technical Summary section of this report.

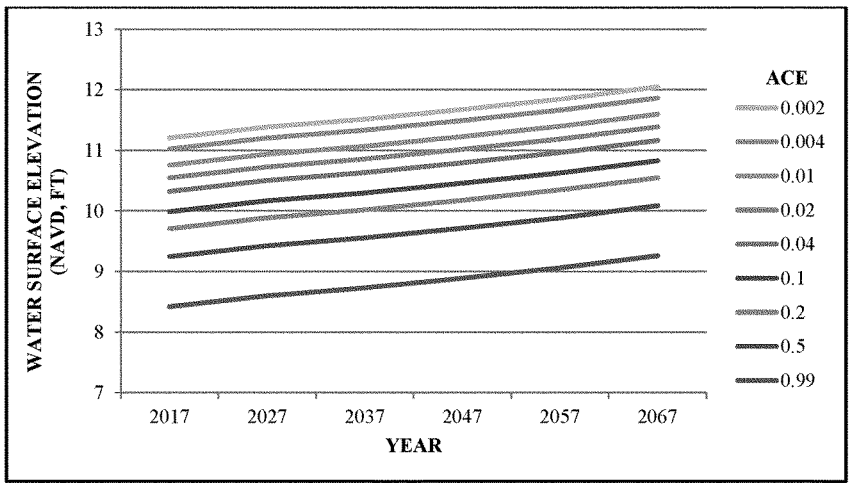


Figure 4: Input 1 (Example) - Water Elevation at Outboard Dike, USACE Intermediate SLC Scenario

2.2 INPUT 2: LEVEE FAILURE FUNCTION

A levee failure function, which indicates the probability of failure given a particular water surface elevation, was developed for the outboard pond dike to be used in the HEC-FDA models. A plot of the data entered into the HEC-FDA models is shown in Figure 5 below. More details on the development of the levee failure function can be found in the Geotechnical Engineering Technical Summary section of this report.

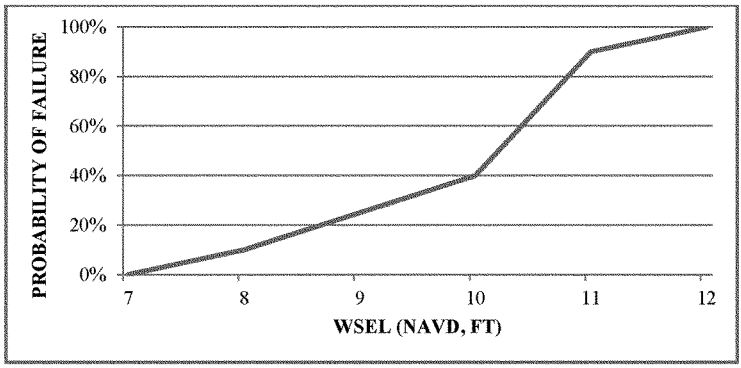


Figure 5: Input 2 - Outboard Dike Failure Function

2.3 INPUT 3: INTERIOR-EXTERIOR WATER SURFACE ELEVATION RELATIONSHIP

A breach of the outboard pond dike would not necessarily result in an equivalent elevation of flood water in the developed area of the basin (i.e., community of Alviso or near the water pollution control plant). The pond system between the outboard dike and the developed area would provide a limited amount of storage. Unless told otherwise, the HEC-FDA model assumes that the flood elevation in the developed area is equivalent to the outboard elevation at the time of dike failure. Not accounting for the storage in the ponds would generally result in an overestimation of the flood elevation and damage. For this reason, it was necessary to develop a relationship between the exterior water elevation at the outboard dike and the interior water elevation in the Alviso EIA in the event of a flood event. This relationship was entered into the HEC-FDA model.

The difference between the exterior and the interior water surface elevation varies over time, by annual chance of exceedance (ACE) flood event, and by SLC scenario, but is generally between zero and two feet. The difference in elevation generally decreases as the events get larger (less likely) because the ponds would fill up faster during larger events. However, there is a scenario in which the interior flood elevation may be greater than the exterior elevation that resulted in the initial dike breach. For example, this can happen when a dike failure occurs at a water surface elevation that is below the astronomical high tide. In this situation the pond storage may be sufficient to keep water from overtopping the inner dike and ponding in the developed area, but because the dike-pond system would then be open to the bay waters, subsequent high tides would be expected to overtop the inner dike (which is considerably lower than the outer dike in some places) and result in flooding in the developed area. For example, an outer dike breach that occurs at an exterior elevation of 7.5 feet would be expected to eventually result in an interior water elevation equivalent to mean high tide (7.8 feet NAVD88) at the base year and increases over time under all future scenarios considered. Likewise an outer dike breach at an exterior elevation of 9.0 feet would eventually equilibrate to an interior water elevation of 7.8 feet. More details on the

development of the interior-exterior water surface elevation relationship can be found in the Coastal Engineering Technical Summary section of this report.

2.4 INPUT 4: FLOODPLAIN ASSETS

The structure inventory was conducted in 2010, and no notable changes in land use have occurred since then. The depreciated replacement values of the structures and contents in the floodplain were updated to 2014 price levels. Table 1 below shows the estimated structure and content value (rounded for presentation purposes) for each of the major structure categories in the 0.2% ACE floodplain. In total, more than $800M of structures and contents are exposed to some level of flood risk by the end of the period of analysis. This value should not be confused with event-based or expected flood damage.

Table 1: Structure & Content Value in the 0.2% ACE Floodplain at 2067, High SLC Scenario

Structure Type	Total Structure Value (1,000s)	Total Content Value (1,000s)
Commercial	$333,038	$297,407
Industrial	$70,615	$47,145
Public	$5,068	$1,841
Residential	$56,753	$27,892
Total	$465,474	$374,285

The analysis incorporates an assumption of structure relocation out of the floodplain over time under the future without-project condition. Using the decadal HEC-FDA models for each scenario, if a structure's first floor elevation was 1.5 feet or more below the 10% ACE event water surface elevation for ten years, then that structure was removed from all future HEC-FDA models. The 10% ACE elevation refers to the annual likelihood of that elevation of water occurring in floodplain when accounting for the combined probability of both a water elevation at the outboard dike and a failure of the outboard dike. The elevation also considers the interior-exterior relationship described in Section 2.3. For residential structures, 1.5 feet of flooding above the first floor elevation corresponds to structure damage equal to between one-quarter and one-third of the value of the structure. Over ten years, the chance of experiencing at least one 10% ACE event is 65%, and the chance of experiencing two or more is 26%. In the absence of specific USACE guidance or policy on relocation determination, the relocation threshold was based on professional judgment that considered both the likelihood of flooding and the expected damage.

Table 2 and Figure 6 below show the relocations over time according to the algorithm specified above and under the intermediate SLC scenario.

Table 2: Structure Relocations over Time - Intermediate SLC Scenario

Structure Type	Year					
	2017	2027	2037	2047	2057	2066
Residential	1035	951	927	884	832	822
Commercial	54	49	48	45	43	42
Industrial	42	22	21	19	15	14
Public	9	5	3	3	2	2
Total Structures	1140	1027	999	951	892	880
Cumulative Relocations	NA	113	141	189	248	260

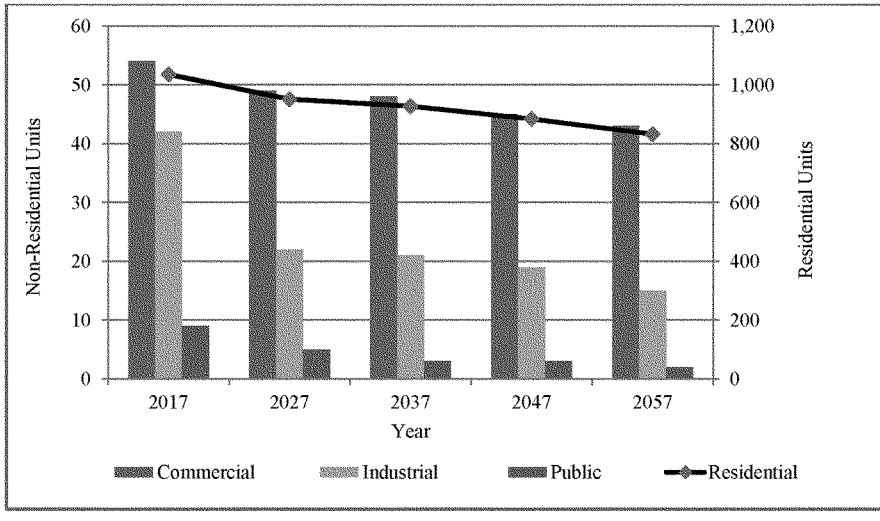


Figure 6: Structure Relocations over Time - Intermediate SLC Scenario

The cost of relocating to similar properties outside of the floodplain was included in the ultimate expected annual damage (EAD) calculations performed outside of the HEC-FDA model. The cost per structure was estimated by USACE Sacramento District Real Estate personnel in 2012.

Located in the study area is the region's largest water pollution control plant (WPCP). The plant has an estimated replacement value of more than $2 billion, and serves 1.4 million people and thousands of businesses. According to the officials at the plant, a flood event at the plant could cause in excess of $100M in damage and could result in the release of untreated sewage into the bay. Because the cost of relocation is expected to be in excess of $2B, it is assumed that the most likely response under the without-project condition would be to construct a ring levee to reduce the likelihood of coastal flood damage at this critical public facility. Additional details related to this assumption can be found in Section 5.0.

2.5 INPUT 5: DEPTH-DAMAGE RELATIONSHIPS

The relationship between the depth of flooding and the damage to the structure and its contents varies by structure type. Also, saltwater is more damaging than freshwater for a given depth of flooding because of the corrosive effects of salt. The depth-damage functions used for this report are primarily taken from the results of an expert panel meeting in Louisiana in 1997. The USACE has only published freshwater depth-damage curves, which is why other sources were used. While the floodwaters may persist for many hours and potentially even days, the analysis uses estimates of short depth-damage relationships because the long-duration curves were developed with the hot and humid southern climate in mind. Using the long-duration curves would likely overestimate the flood damage in the study area.

Figure 7, Figure 8, Figure 9, and Figure 10 below show the relationships for the primary structure types. "SFR1" and "SFR2" stand for Single Family Residential 1-Story and 2-Story, respectively. The freshwater curves are taken from USACE Economic Guidance Memorandum (EGM) 04-01, and are shown for comparative purposes. It is important to note that the data for each relationship were developed independently and from different sources, resulting in inconsistencies across structure types. The curves for the "Displacement" cost category were taken from FEMA's Mitigation BCA Toolkit (FEMA, 2005).

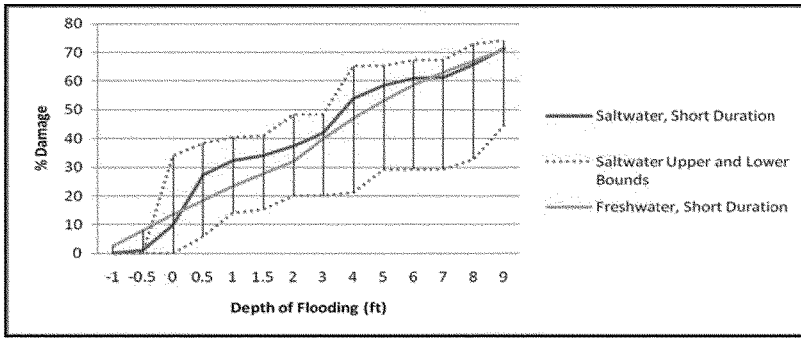


Figure 7: Structure Depth-Damage Relationship, 1-Story SFR

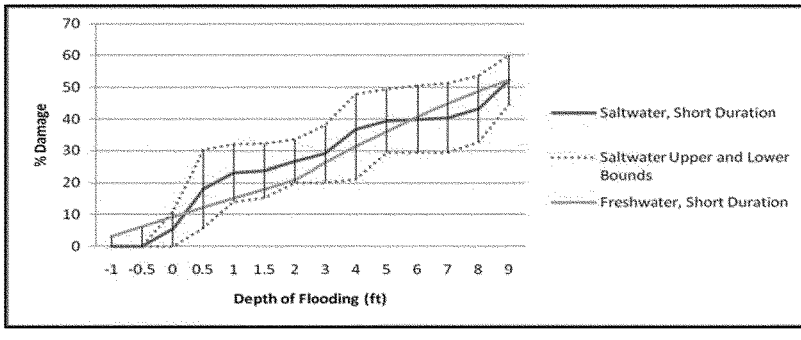


Figure 8: Structure Depth-Damage Relationship, 2-Story SFR

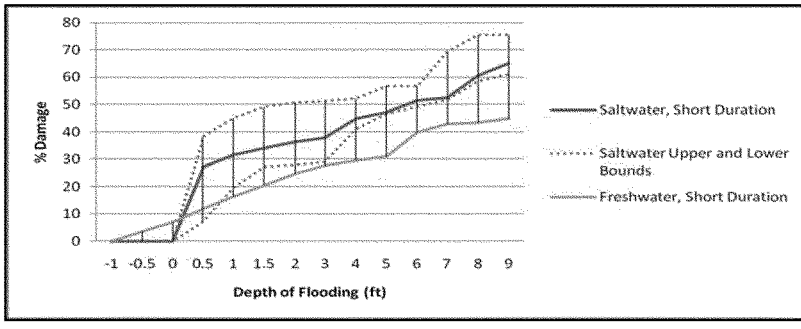


Figure 9: Structure Depth-Damage Relationship, Commercial

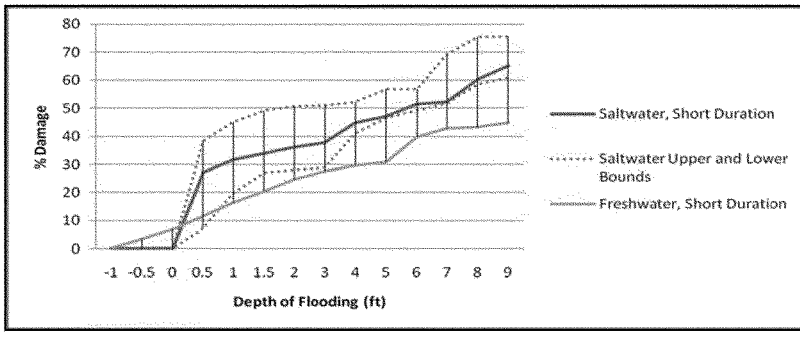


Figure 10: Structure Depth-Damage Relationship, Industrial

2.6 INTERIM RESULT 1: COMBINED PROBABILITY OF FLOODING

Multiplying the probability of the water surface elevation occurring in a given year by the probability that this elevation will cause a failure of the outboard non-engineered dike (which is the primary line of defense currently) results in a probability of a certain elevation of floodwater reaching structures, infrastructure, and people in the study area. Table 3 below displays how the flooding hazard in the study area increases over time for a given SLC scenario; the data shown is for the USACE Intermediate SLC scenario. In the table, "exterior" elevation refers to elevation at the outboard dike, and "interior" elevation refers to water surface elevation in the developed area (i.e., community of Alviso). In 2017, which is the base year for this study, there is just greater than a 1% chance of a flood event that results in 9.5 feet of water in Alviso. By the end of the period of analysis however, the annual probability of getting that same flood elevation in Alviso is 16%. This increase is due to the increase in relative sea level at the study location.

Table 3: Flood Hazard over Time (Intermediate SLC Scenario)

	ACE of Exterior Elevation (Outboard Dike)	99%	50%	20%	10%	4%	2%	1%	0.4%	0.2%
2017	Exterior Elevation (ft)	8.42	9.25	9.71	9.99	10.32	10.55	10.76	11.02	11.21
	Prob. of Levee Failure	0.16	0.28	0.355	0.385	0.55	0.65	0.75	0.9	0.92
	Interior Elevation (ft)	7.81	7.81	7.81	7.81	9.34	9.49	9.63	11.02	11.21
	Combined Annual Prob. of Flooding	16%	14%	7.1%	3.9%	2.2%	1.3%	0.75%	0.36%	0.18%
2027	Exterior Elevation (ft)	8.60	9.43	9.89	10.17	10.50	10.73	10.94	11.20	11.39
	Prob. of Levee Failure	0.19	0.31	0.37	0.45	0.65	0			
	Interior Elevation (ft)	7.99	7.99	7.99	8.5	9.4	9			
	Combined Annual Prob. of Flooding	19%	16%	7.4%	4.5%	2.6%	1.9%	0.85%	0.37%	0.25%
2037	Exterior Elevation (ft)	8.73	9.56	10.02	10.30	10.63	10.86	11.07	11.33	11.52
	Prob. of Levee Failure	0.205	0.325	0.4	0.5	0.7	0.8	0.9	0.93	0.95
	Interior Elevation (ft)	8.12	8.12	8.5	9.5	9.8	10.6	11.07	11.33	11.52
	Combined Annual Prob. of Flooding	21%	16%	8%	5%	2.8%	1.6%	0.9%	0.37%	0.19%
2047	Exterior Elevation (ft)	8.89	9.72	10.18	10.46	10.79	11.02	11.23	11.49	11.68
	Prob. of Levee Failure	0.22	0.355	0.45	0.6	0.75	0.9	0.92	0.94	0.96
	Interior Elevation (ft)	8.28	8.28	9.45	9.65	10.4	11.02	11.23	11.49	11.68
	Combined Annual Prob. of Flooding	22%	18%	9%	6%	3%	1.8%	0.92%	0.38%	0.19%
2057	Exterior Elevation (ft)	9.06	9.89	10.35	10.63	10.96	11.19	11.40	11.66	11.85
	Prob. of Levee Failure	0.25	0.37	0.55	0.7	0.85	0.91	0.93	0.96	0.98
	Interior Elevation (ft)	8.45	8.45	9.78	10.49	10.96	11.19	11.4	11.66	11.85
	Combined Annual Prob. of Flooding	25%	19%	11%	7%	3.4%	1.8%	0.93%	0.38%	0.20%
2067	Exterior Elevation (ft)	9.26	10.09	10.55	10.83	11.16	11.39	11.60	11.86	12.05
	Prob. of Levee Failure	0.28	0.4	0.65	0.8	0.91	0.93	0.95	0.98	1
	Interior Elevation (ft)	8.65	8.65	10.55	10.83	11.16	11.39	11.6	11.86	12.05
	Combined Annual Prob. of Flooding	28%	20%	13%	8%	3.6%	1.9%	0.95%	0.39%	0.20%

A 1% ACE Flood Event at 2017 is a 16% Event by 2067

2.7 INTERIM RESULT 2: EXISTING DIKE-POND SYSTEM PERFORMANCE

The HEC-FDA program produces "performance statistics" that are an indicator of the likelihood of damaging flood events under both the future without- and with-project conditions. When levees (or dikes) are present that have some likelihood of geotechnical failure (as is the case under the without-project condition), the project performance is computed based on the joint probability of annual exceedance and probability of geotechnical failure. Table 4 below shows the performance results for the existing dike-pond system in the year 2017, which is the project's base year. The annual exceedance probability is the likelihood that a damaging flood event will occur in any given year, the long-term risk is the risk of a damaging event over some defined period of time for a particular water surface profile, and the conditional non-exceedance probability is the likelihood that the damages would not occur as the result of a particular exceedance probability event. According to the HEC-FDA model, beginning in 2017 there is 32% chance of a damaging flood event in any given year. Figure 11 shows how likely it is to have one or more damaging flood events over different periods of time.

Table 4: Performance Statistics for Existing Dike-Pond System at 2017

		Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Stream Name	Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
SSFS - Alviso	levee	0.3203	0.3211	0.9792	1.0000	1.0000	0.5272	0.3810	0.3528	0.2954	0.1950	0.1331

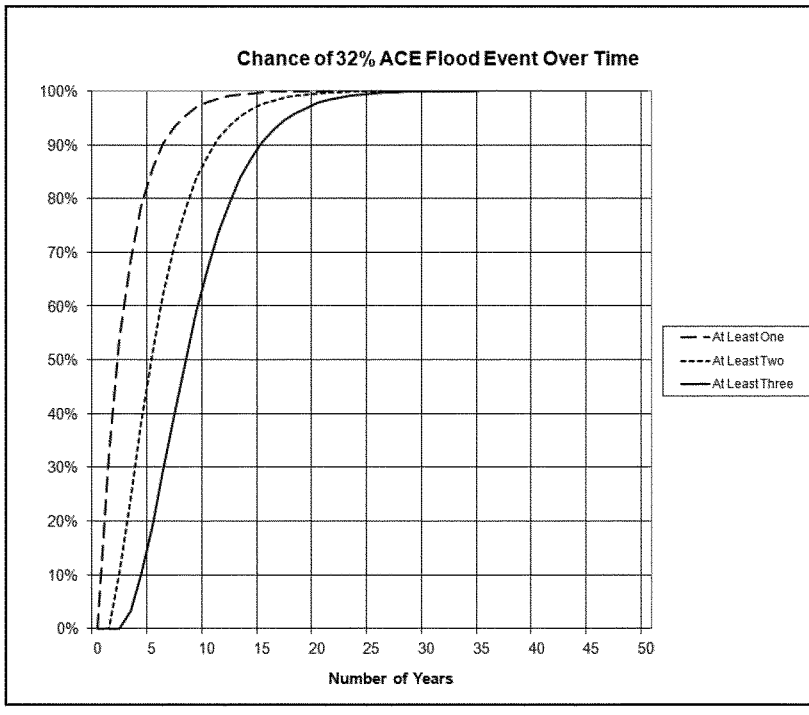


Figure 11: Binomial Distribution of Multiple Flood Events over Time Beginning 2017

The without-project performance of the dike-pond system changes over time with SLC, and the performance varies by scenario. Table 5 below shows the performance statistics at the end of the period of analysis (2067) under the USACE Intermediate SLC scenario. Under any of the future scenarios considered, the risk increases in the future. Table 5 shows that, according to the flood damage analysis, by 2067 the annual likelihood of a damaging flood event is essentially a coin flip, and over a ten-year period the chance of a damaging flood event is a virtual certainty (i.e., long-term risk over a ten-year period is 0.9995).

Table 5: Performance Statistics for Existing Dike-Pond System at 2067 (Intermediate SLC Scenario)

Stream Name	Target Stage	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
		Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
SSFS - Alviso	levee	0.5339	0.5325	0.9995	1.0000	1.0000	0.2960	0.1283	0.0734	0.0541	0.0363	0.0246

2.8 ECONOMIC DAMAGES & BENEFITS SUMMARY

As described in more detail in the Economics Technical Summary Section 5.0 of this report, the future without-project damages in the study area are estimated to be significant. Because of the low elevation, essentially any flood event in the developed area would be expected to cause millions of dollars in damage to homes, businesses, and infrastructure. Because some flood events could result in several or more feet of water in the community, human health and safety are also at risk from a coastal flood event. As Tables 3 and 4 above show, the likelihood of future flooding in the absence of a project is high.

The USACE typically reports economic flood damage in "expected annual" or "equivalent annual" terms. This is done because of the probabilistic nature of flooding. The average annual damage estimates should not be interpreted as actual damages expected in a given year, but the annual damage if the total flood damage over a very long time horizon were averaged to an annual value. The without-project expected annual flood damage between 2017 and 2067 is between $10M and $28M, depending on the year. The flood risk increases over time due to sea level change, and any structure relocations would decrease the consequences of future flood events in the area. The total equivalent annual damage over the fifty-year period of analysis under the USACE Low, Intermediate, and High SLC scenarios is $18.2M, $22.6M, and $40.2M, respectively. These values include the consideration of the cost of possible structure relocations over time. Under any of the scenarios, a large flood event could cause more than $100M in damage.

The with-project analysis of the different levee heights shows that levees higher than 12' reduce nearly all of the expected future flood damage through the fifty-year period of analysis, and thus greatly reduce the risk to the community from flooding over that time. The levee height with the greatest net benefits (difference between benefits and costs) differs depending on the SLC scenario. A 12.5' levee has the greatest net benefits under the USACE Low and Intermediate scenarios, while a 13.5' levee has the greatest net benefits under the USACE High scenario. The larger 13.5' levee height has the lowest overall residual flood risk, effectively eliminating expected annual damage for any of the three SLC scenarios. With a 12.5' levee in place, under the USACE High SLC scenario the HEC-FDA model results indicate that there would be approximately $1.5M in expected annual damage, which is equivalent to about 4% of the total future without-project annual damage expected under the High SLC scenario. Both the 12.5' and 13.5' levee are strongly economically justified under each of the three SLC scenarios. The benefit-cost ratios range from between about 6 and 12, depending on the levee height and SLC scenario.

According to the HEC-FDA modeling results, with either of the levee heights in place the probability of a damaging coastal flood event in 2017 is extremely low. As sea level rises over time, the likelihood of a damaging event will increase. Just considering the probabilities associated with storm-generated water surface elevations and the project levee elevations, under the USACE Low and Intermediate SLC scenarios each of the levees has a greater than 99% chance of containing a 1% annual chance of exceedance coastal storm event in the year 2067. However, under the USACE High SLC scenario, the 12.5' levee only has about a 1% chance of containing the 1% annual chance exceedance storm event in 2067, while the 13.5' levee has an 88% chance of containing that same storm event. In the year 2067 there is an 8% annual chance of a damaging flood event with 12.5' levee in place, and less than a 1% annual chance with the 13.5' levee. Thus, the 13.5' levee provides a much greater level of performance through the entire fifty-year period of analysis compared to the lower 12.5' levee. More details on the damages and benefits can be found in the Economics Technical Summary.

3.0 COASTAL ENGINEERING TECHNICAL SUMMARY

3.1 SEA LEVEL CHANGE AND TIDES

3.1.1 SEA LEVEL CHANGE PROJECTIONS

Projections developed for this SSFBS tidal flood risk analysis summary report are based on procedures prescribed by ER 1100-2-8162. The geographically closest, suitable NOAA tide gage to the project area is the San Francisco, CA, NOAA tide gage, Station ID: 9414290 (Figure 12). The San Francisco tide gage has a long record length (110 years) and has been referenced to NAVD88. Sea Level Rise projections for the project area in South San Francisco Bay will use the current Relative Sea Level Rise (RSLR) rate for the San Francisco tide gage, 2.06 mm/year, based on 1983-2001 National Tidal Datum Epoch (NTDE). The NOAA tide gage at Coyote Creek, CA, Station ID: 9414575, is located within 5 miles of the project are and has been intermittently operated to collect observed data. The gage does have an established tidal datums based on the last NTDE, and has predicted tide data available.

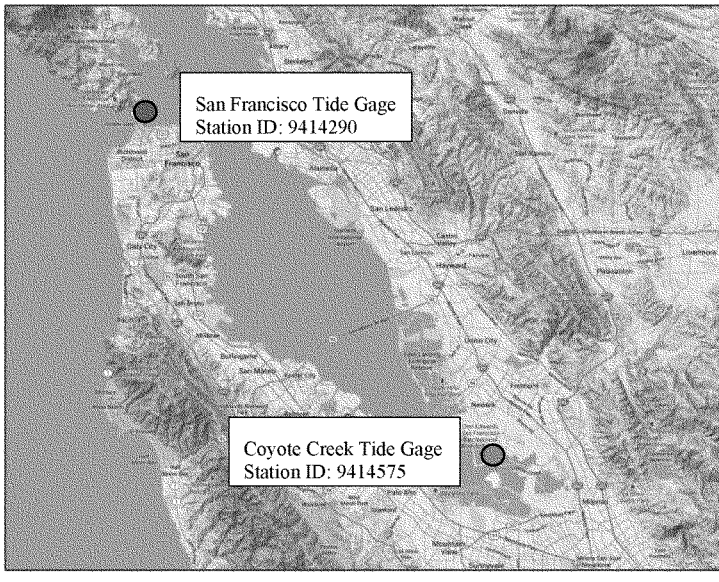


Figure 12: Vicinity Map showing location of Tide Gages used in SSFBS feasibility study.

The planning, design, and construction of a large water resources infrastructure project can take decades. Though initially justified over a 50-year economic period of analysis, USACE projects can remain in service much longer. The climate for which the project was designed can change over the full lifetime of a project to the extent that stability, maintenance, and operation may be impacted, possibly with serious consequences, but also potentially with beneficial consequences. Given these factors, the project planning horizon (not to be confused with the economic period of analysis) should be 100 years, consistent with ER 1110-2-8159 (USACE, 1997).

Water level changes have been developed for the end of the SSFBS 50-year and 100-year economic and planning analysis periods using the current (RSLR) for the San Francisco NOAA tide gage, 2.06 mm/yr (Table 6). Projections made to the year 2100.

Table 6: 50 Year RSLR Low, Intermediate, and High Estimates for the SSFBS Economic and Planning Analysis Periods.

South San Francisco Bay	2017-2067 Change (ft.)		
Scenario	Low	Intermediate	High
Coyote Creek Tide Gage /Alviso	0.51	1.01	2.59
	2017 – 2100 Change (ft.)		
Coyote Creek Tide Gage /Alviso	0.73	1.77	5.05

3.1.2 TIDAL DATUM

A temporary NOAA tide gage was deployed at Coyote Creek, Station ID 9414575. Water surface measurements archived between March and August of 2011 were used to update the tidal datum. The MLLW datum plane for the Coyote Creek tide gage was referenced to NAVD88, with some uncertainty due to difficulty in obtaining low water readings from the water level gages surveyed (Table 7).

Table 7: Coyote Creek Tidal Datums (Based on NTDE 1983-2001)

Coyote Creek, CA, Station ID: 9414575		
Tidal Datum	(feet above NAVD88)	(feet above MLLW)
Mean Higher-High Water	7.64	8.99
Mean High Water	6.99	8.33
Mean Tide Level	3.48	4.82
NAVD88	0.00	1.35
Mean Low Water	-0.07	1.28
Mean Lower-Low Water	-1.35	0.00

The uncertainty in water surface flood elevations due to the Coyote Creek tidal datum conversion to NAVD88 has been recognized and accounted for in the water surface elevations developed for existing conditions. The project vertical datum must be the latest vertical reference frame of the National Spatial Reference System, currently NAVD88, to be held as constant for tide station comparisons, and a project datum diagram (Figure 13) must be prepared per EM 1110-2-6056 (USACE, 2010).

Tidal datums are used throughout all USACE coastal areas and are based on long-term water level averages of a phase of the tide. Mean Sea Level (MSL) datum (or more precisely Local Mean Sea Level--LMSL) is commonly used as a base reference for hydrodynamic modeling, wind and wave surge modeling, high water mark observations, stillwater surge elevations, and design of coastal storm protection structure elevations. The hydraulic/tidal and geodetic vertical datum relationships must be assessed, developed and/or verified during the Feasibility and Preconstruction Engineering and Design (PED) phases, during construction, and periodically monitored after construction to account for subsidence, settlement, NOAA reference datum redefinitions and readjustments, SLC, and other factors. The Coyote Creek tide gage datum adjustment to NAVD88 will be reassessed in the PED phase, and adjustments will be made to design and other key information accordingly.

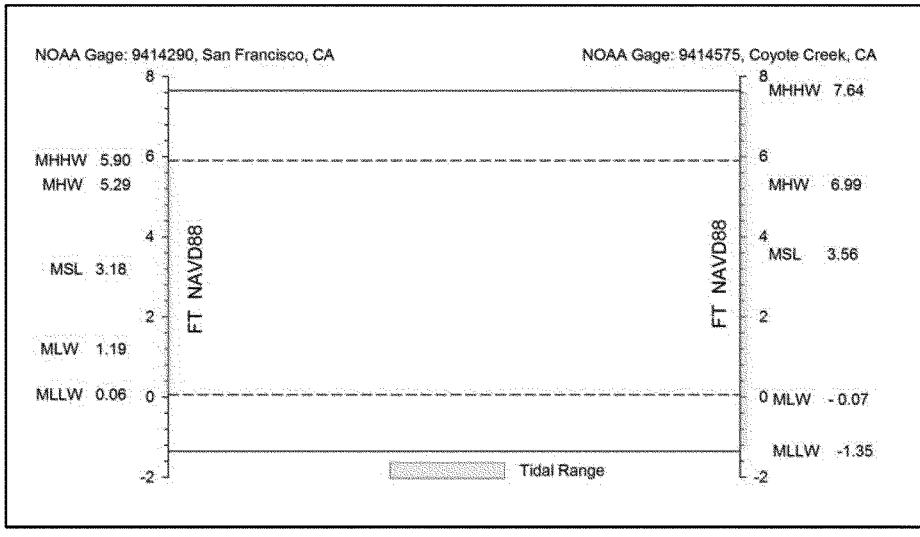


Figure 13: Project Datum Diagram, SSFBS, San Francisco and Coyote Creek Tide Gages.

3.1.3 TIDAL HYDRODYNAMICS AND VARIABILITY IN SAN FRANCISCO BAY

Tides and tide ranges are highly variable through the length of San Francisco Bay. The South Bay area has elevated tides relative to the Pacific Ocean and the rest of San Francisco Bay. The maximum tide levels generally increase with distance southward. As the tides propagate from the Pacific Ocean into San Francisco Bay, in the form of shallow water waves, the tide amplitudes and phases are modified by bathymetry, reflections from the shores, the earth's rotation and bottom friction. The enclosed nature of the South Bay creates a mix of progressive wave and standing wave behavior, wherein the wave is reflected back upon itself (Walters, Cheng, & Conomos, 1985). The addition of the reflected wave to the original wave increases the tidal amplitude. Amplification causes the tidal range in the South Bay to increase southward as shown in Figure 14. The tide range increases from 5.84 feet at the San Francisco tide gage to 9.01 feet at the project area tide gage, Coyote Creek.

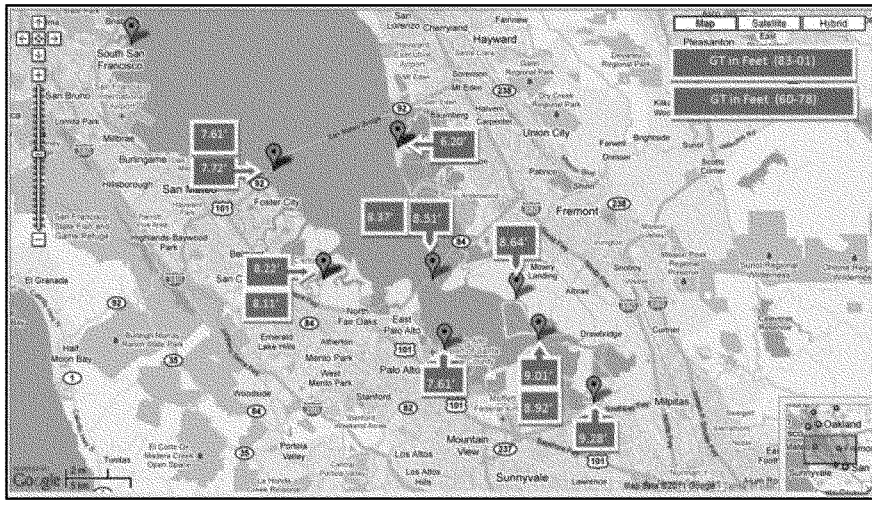


Figure 14: Tidal Ranges in South San Francisco Bay, Last Two Complete NTDE.

3.2 EXTREME WATER LEVEL STATISTICS IN PROJECT AREA, EXISTING AND WITHOUT-PROJECT CONDITIONS

3.2.1 METHODOLOGY

Extreme water statistics representative of coastal flood risk from high water levels in the South Bay area near the community of Alviso were developed by computing the tidal amplification factor between the predicted (astronomical) tide at the San Francisco tide gage and the Coyote Creek tide gage. Tidal residuals (observed – predicted tide) represent storm surge, and are assumed to transfer directly to the South Bay. This method is referred to as the Direct Transfer Method (DTM).

3.2.2 DIRECT TRANSFER METHOD

Factors used to amplify the predicted tide at San Francisco are assumed to be linear and were computed by comparing predicted tide at the San Francisco tide station to predicted tide at Coyote Creek (Figure 15). The comparison indicated tidal amplification at Coyote Creek varied with predicted tide water surface elevation at the San Francisco tide station. Four amplification factors were developed to account for the range of predicted tides, with a focus on the daily higher-high tide. Comparison of the derived water levels at Coyote Creek and predicted daily higher-high tides showed good agreement at Coyote Creek.

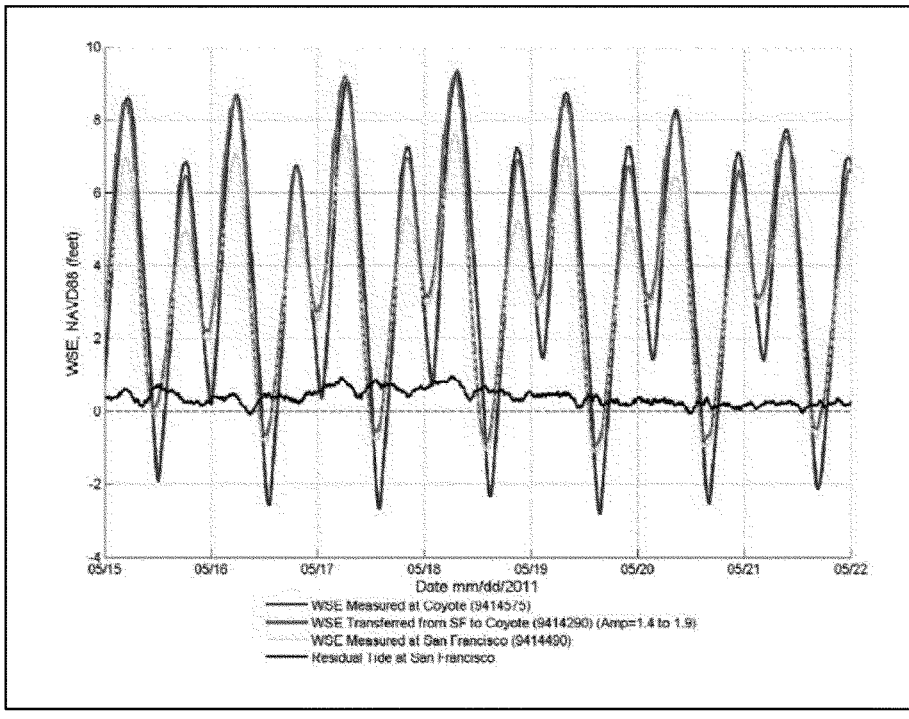


Figure 15: Comparison of Amplified Tides at San Francisco and Measured Tides at Coyote Creek.

Table 8 shows the amplification factors used in the DTM, based on the San Francisco tide gage MLLW tidal datum. The DTM is an appropriate surrogate method for developing accurate water levels and developing extreme water level statistics in areas where local mean sea level and tidal datum have been defined. Multidimensional hydrodynamic modeling may add precision, and is appropriate when decoupling of the tidal residual addition to the tide into components; wind, wave run-up, and surge is desired to aid design of coastal structures.

Table 8: Tidal Amplification Factor - San Francisco to Coyote Creek

Direct Transfer Method - Amplification Factor (San Francisco to Coyote Creek)	
Predicted Tide Range at San Francisco (feet MLLW)	**Amplification Factor at Coyote Creek**
Less Than 4.94	1.9
4.94 to 5.52	1.6
5.52 to 6.15	1.5
Greater Than 6.15	1.4

Amplification factors developed with the DTM were applied to extreme water statistics developed for the San Francisco tide gage and used to derive the extreme water statistics for the Coyote Creek tide gage, representing the study area's existing risk from coastal flooding.

3.2.3 EXTREME WATER LEVEL STATISTICS, SAN FRANCISCO TIDE GAGE

Extreme Water Level Statistics were developed for the San Francisco tide gage. Tide gage monthly highs or monthly extreme high water (MEHW) from 1 January 1901 through 31 December 2011 were converted to NAVD88. The bias due to RSLR was removed by detrending the data to the mid-year of the last complete NTDE (1983-2001), 1992. Figure 16 compares the detrended data (blue) with the biased data (red).

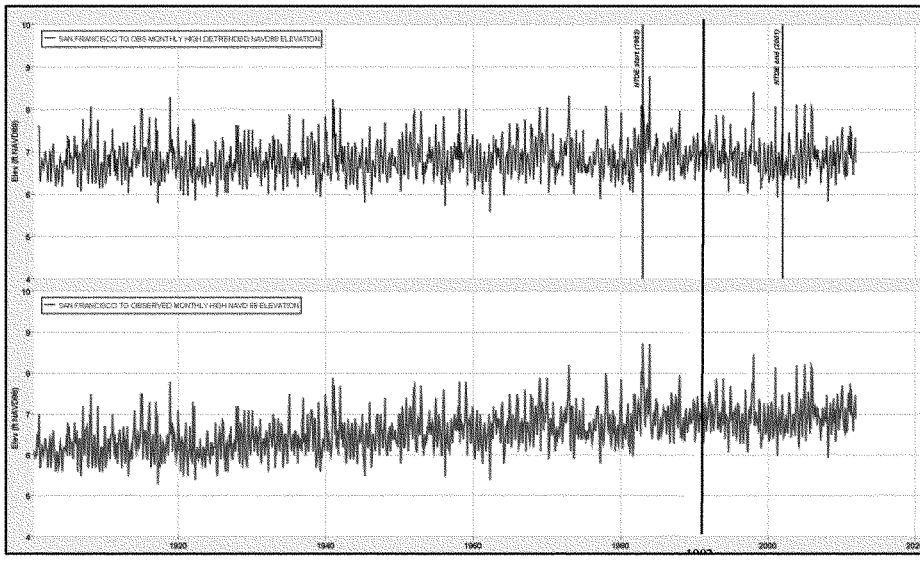


Figure 16: Observed Monthly MEHW levels, San Francisco Tide Gage (1901-2011).

Detrending the MEHW tide gage data creates a homogenous data set with regard to relative sea level rise. The year 1992 is used in the USACE SLC scenario equations, and is a base from which extreme water level statistics developed from the MEHW detrended data are projected to the project base year and future years by applying the 3 SLC rates related to the San Francisco tide gage.

The MEHW detrended time series was sampled to create an annual extreme high water level (AEHW) time series, for use in developing ACE statistics representing extreme water levels (Figure 17). The peak water level of record occurred January 23, 1983, while the second-highest water level occurred eleven months later on December 3, 1983. The annual series was adjusted slightly by moving the December 1983 high water level into the 1984 monthly series and recognizing it as the 1984 annual peak; had a

water year division been used to develop the annual series, this adjustment would not have been necessary.

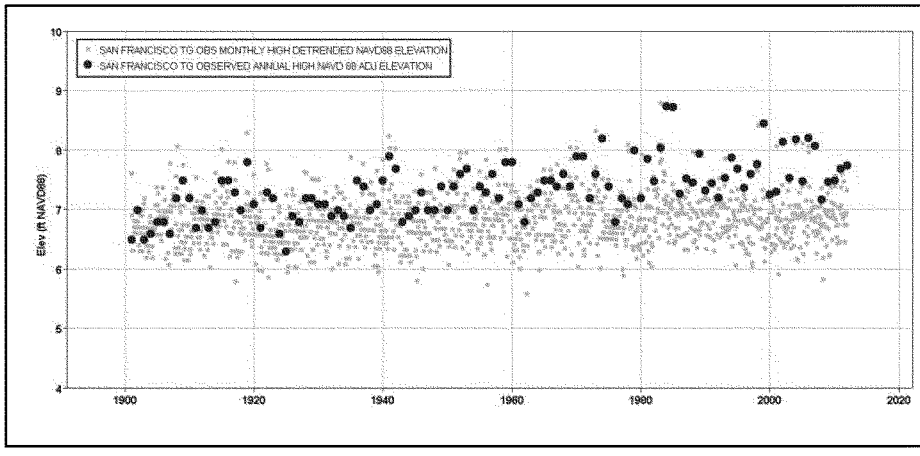


Figure 17: San Francisco Tide Gage AEHW Data (Blue) Developed from MEHW Data (Gray).

The 110 year AEHW annual series for the San Francisco tide gage was fit to a generalized extreme value distribution (GEV). The GEV distribution is a three parameter distribution (Table 9). The GEV probability distribution functions are defined by a location parameter (mean), a scale parameter (variance), and a shape parameter. If the shape parameter is zero, the distribution is known as a Gumbel distribution. If the shape parameter is positive, the distribution is called a Frechet distribution; if the shape parameter is negative, the distribution is called the Weibull distribution. The Frechet distribution has a thicker positive tail indicating a higher probability of extreme positive outliers. In contrast, the Weibull distribution actually goes to zero above some limiting positive value (Zervas C. E., 2005). Table 9 presents the GEV parameters from the 110 year annual series data.

Table 9: GEV Distribution Parameters for San Francisco Tide Gage Adjusted AEHW Record (1901-2011)

Parameter	Estimate	Standard Error
ξ (shape)	-0.091	0.06
σ (scale)	0.32	0.023
μ (location)	7.42	0.34

NOAA has used the GEV distribution to compute extreme water level statistics for 117 NOAA/National Ocean Service water level stations. The statistics show regional trends, and when the shape parameters are negative (Weibull distribution); there are relatively small differences in the levels of the four or five most extreme events. However, when the shape parameters are positive (Frechet distribution), there can be large differences in the levels of the top four or five extreme events. For the larger NOAA data set, the shape factors were negative for almost all of the high extreme levels at the Pacific Coast, Alaskan, and Pacific Island stations. In contrast, most of the GEV shape parameters for high extreme levels are positive

(Frechet distribution) ranging from 0 to 0.5 at the Atlantic Coast, Gulf of Mexico, and Atlantic Island stations. This is usually due to the interaction of a few powerful hurricanes with a wide, shallow, continental shelf at these stations, resulting in a handful of extreme values significantly higher than the levels of the most powerful winter storms (Zervas C. E., 2005). Figure 18 shows the relative uncertainty of the 1% annual chance probability water level versus shape parameter; for the San Francisco tide gage, this value corresponds roughly to 0.28 m or 0.9 feet. The record at San Francisco is very long, which reduces the confidence interval, however there is significant inter-annual variation observed primarily due to the effects of El Niño–Southern Oscillation (ENSO).

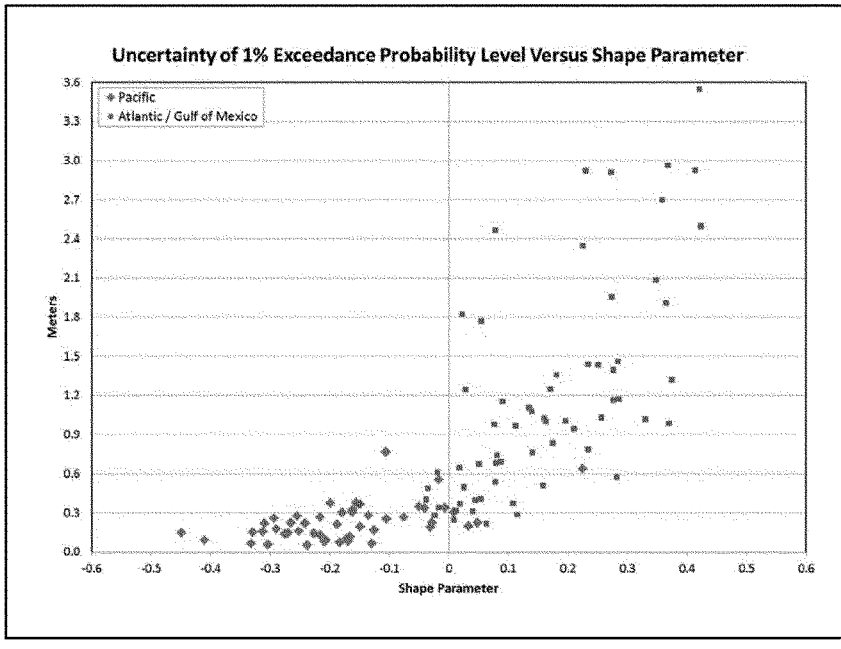


Figure 18: GEV Shape Factors for 117 NOAA Stations showing uncertainty and regional trends [adapted from (Zervas & Sweet, 2014)]

The GEV expected probability function was used to compute annual percent chance exceedance water level statistics for the San Francisco tide gage, which would be transferred to the Coyote Creek gage using the DTM (Figure 19). Statistics developed with the detrended data represent the midpoint year of 1992, the last complete NTDE. The statistics are then adjusted to the current year, project base year, or future years using the USACE SLC scenario equations and RSLR rate from the San Francisco tide gage as defined in EC 1165-2-212 and ER 1100-2-8162. Table 10 shows the annual percent chance exceedance water level statistics computed for the San Francisco tide gage. The low or observed RSLR (2.06 mm/year) was added to the 1992 statistics to project the base year (2017) conditions.

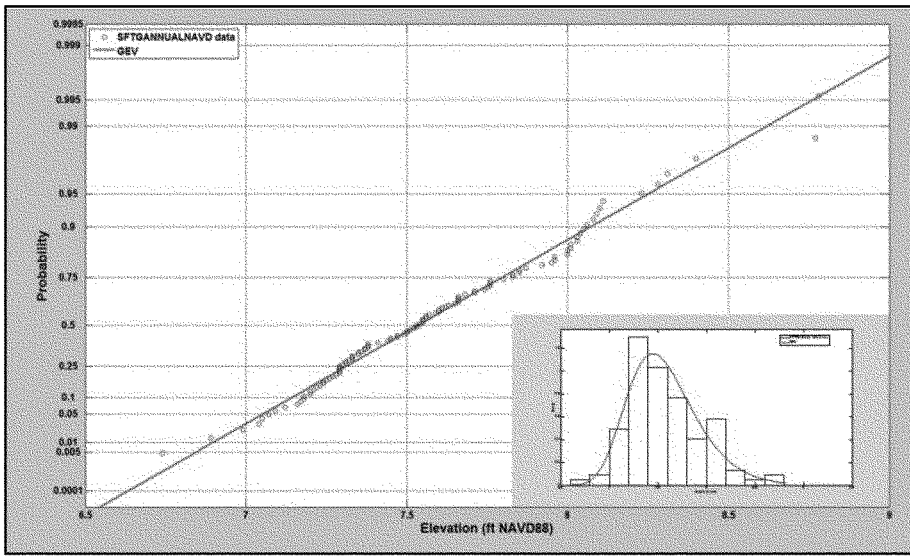


Figure 19: Annual Series of Peak Water Levels Fit to GEV, 1901-2011.

Table 10: Annual Chance of Exceedance (ACE) Water Levels, San Francisco Tide Gage 1992, 2017

	1992	1992	RSLR Low Rate 1992-2017	2017
FREQ (%)	feet MLLW	feet NAVD88	feet	feet NAVD88
99.99	6.89	6.95	0.17	7.12
50	7.48	7.54	0.17	7.71
20	7.81	7.87	0.17	8.04
10	8.01	8.07	0.17	8.24
4	8.25	8.31	0.17	8.48
2	8.41	8.47	0.17	8.64
1	8.56	8.62	0.17	8.79
0.4	8.75	8.81	0.17	8.98
0.2	8.88	8.94	0.17	9.11

3.2.4 COYOTE CREEK EXTREME WATER LEVEL STATISTICS FROM DTM

The DTM separates predicted tide and residual tide, amplifying predicted tide by an amplification factor, of 1.4 to 1.9 (Table 8), and adding the residual tide back to the amplified tide and adjusting for the local Coyote Creek datum.

Hydrodynamic model simulations were conducted to evaluate the change in residual tide recorded at the San Francisco tide station as it propagates into South San Francisco Bay. The simulation indicates that residual tide varied minimally (MacWilliams, Kilham, & Bever, 2012). This implies that it is a reasonable assumption that residual tide at San Francisco is additive to the amplified predicted tide when transferred

to Coyote Creek. These results confirm the DTM assumption that only the predicted tide is amplified, with the residual tide remaining constant. The DTM equations are;

$$MT_{CC} = PT_{CC} + RT_{SF} \qquad \text{Equation 1.1}$$

$$PT_{CC} = (PT_{SF} - MTL_{SF}) \times A + MTL_{CC} \qquad \text{Equation 1.2}$$

$$RT_{SF} = MT_{SF} - PT_{SF} \qquad \text{Equation 1.3}$$

where:

MT_{CC} = Estimated Measured WSE at Coyote Creek (NAVD88)

$RTSF$ = Residual Tide at San Francisco

$PTCC$ = Predicted Tide at Coyote Creek

$PTSF$ = Predicted Tide at San Francisco

$MTLSF$ = Mean Tide Level at San Francisco (3.24', MLLW)

A = Amplification Factor, Table 3

$MTLCC$ = Mean Tide Level at Coyote Creek (3.48', NAVD88)

$MTSF$ = Measured WSE at San Francisco (MLLW)

The tidal residual component contained in the extreme water level statistic represents what is commonly referred to as storm surge. Storm surge refers to the increased elevation of water levels due to meteorological conditions such as increase in water elevation due to low barometric pressure and wave setup to a limited extent. The ACE water levels are comparable to FEMA still-water surface elevations and base flood elevations.

The most likely or 50% ACE for Coyote Creek was computed by using the 50% residual tide statistic developed from analysis of 47 historical storm events, with residuals greater than 0.5 ft. Figure 20 shows the cumulative distribution function (CDF) of the tidal residuals from the San Francisco tide gage. The 50% residual value of 0.85 feet, 5 and 95 percent values (1.55 and 0.55 feet) respectively were selected from the CDF.

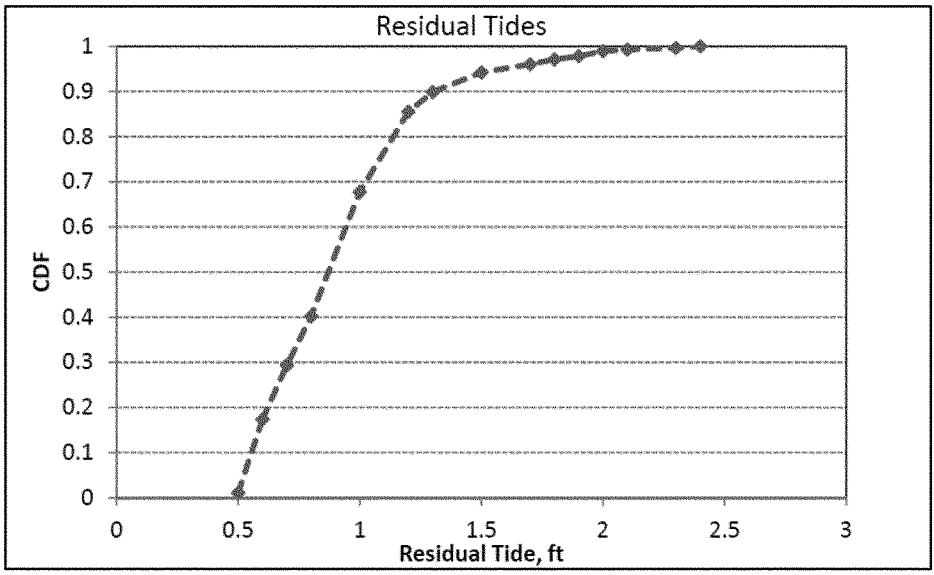


Figure 20: Cumulative Distribution Function for Tidal Residuals in feet developed from 47 Historical Storm Events at the San Francisco Tide Gage

The DTM was applied to the 1992 San Francisco ACE results in Table 11to produce the derived Coyote Creek 50% ACE (Table 11). Apparent RSLR was recognized from 1992 to 2017 in the amount of 0.17 feet based on the rate at the San Francisco tide gage (2.06 mm/year) and added to the 1992 detrended statistics to arrive at the 2017 existing and without-project conditions in South San Francisco Bay at the Coyote Creek tide gage.

Table 11: ACE Water Levels for San Francisco and Coyote Creek Tide Gages, 1992 and 2017

	San Francisco Tide Gage Station ID: 9414290		Coyote Creek Tide Gage Station ID: 9414575	
FREQ (%)	1992	2017	1992	2017
	feet MLLW	feet NAVD88	feet NAVD88	feet NAVD88
99.99	6.89	7.12	8.25	8.42
50	7.48	7.71	9.08	9.25
20	7.81	8.04	9.54	9.71
10	8.01	8.24	9.82	9.99
4	8.25	8.48	10.15	10.32
2	8.41	8.64	10.38	10.55
1	8.56	8.79	10.59	10.76
0.4	8.75	8.98	10.85	11.02
0.2	8.88	9.11	11.04	11.21

Note: San Francisco based on gage record of 110 years, Coyote Creek derived from San Francisco using DTM and 50% tidal residual value.

As the relative components of the extreme water levels are primarily tidal with small residuals, 1% exceedance levels can be reached only by a combination of a storm, a spring tide and an El Nino event (Zervas & Sweet, 2014). These thresholds will be easier to reach and more frequent under future sea level change scenarios. The 0.4 and 0.2 ACE values at both stations are expected values from the GEV distribution. With RSLR increasing the base water levels, the ENSO impacts are more likely to push extreme water levels into the higher ACE values under the same conditions.

3.2.5 COMPARISON OF 1 PERCENT ACE WATER LEVEL WITH PRIOR STUDIES.

The 1% ACE or 100-year values for San Francisco are compared with results from other studies in Table 12.

Table 12: Comparison of 1% ACE Water Levels for San Francisco and Coyote Creek Tide Gages to Prior Studies

	USACE (2014)[1]	(USACE, 1984)[2]	(Knuuti, 1995)[3]	(PWA, 2007)[4]
San Francisco Gage	8.79	8.69	8.89	8.72
Coyote Creek Gage	10.76	10.99	-	11.02

[1] Value represents record (1901-2011), detrended to 1992, projection to 2017
[2] Value represents record (1855-1983), adjustment of 0.53 ft. to the mean
[3] Value represents record (1897-1995), projection to 2000, detrended to 2000
[4] Value represents record (1897-2004), detrended to 2005

Variation in the 1% ACE water levels may be attributed to many factors, such as methodology, record length and statistical methods. Accounting for these differences, the results are very consistent. The USACE 2014 water level, representing the results of the current analysis, is based on an additional 7 to 31 years of data at the San Francisco tide gage. Interannual variations primarily due to ENSO may influence statistics if an extreme is appended to the end of the record. Apparent SLC rates have been lower in the recent 5 to 10 years due to a neutral ENSO phase, and will account for some of the difference in the PWA 2007 and USACE 2014 result. Current SLC rates and coefficients used in the other studies have been updated and are reflected in the USACE 2014 result, and account for some of the difference in results. The last reference (PWA, 2007) contains a more in-depth discussion of the methods behind the other the other results cited.

3.2.6 NATURAL VARIABILITY, UNCERTAINTY IN COYOTE CREEK EXTREME WATER LEVEL STATISTICS

ACE statistics presented in Table 12 represent the most likely or 50% occurrence. The bulk of natural variability is captured in the CDF of tidal residuals (Figure 20). The 5 and 95 percent ACE water surface elevation estimates were computed using the DTM function and assume tidal residuals of 1.55 and 0.55 respectively. In the DTM formula, the residual is not amplified so the result is that the higher residual (1.55 feet) is used to compute the lower 5 percent and the lower residual (0.55 feet) is used to compute the upper 95 percent confidence interval (Table 13). The higher number is achieved due to a larger component of the tide is predicted or astronomical and thus subject to the amplification factor. The natural variability assumptions and computation are recognized to be a simplifying, coarse assumption, but accurate. Combinations of water level components occurring concurrently such as high astronomical

tide, storm surge residual, and extreme wind generated waves are possible, but would occur in the 95 to 99.99 percentile. The confidence interval range of the water surface elevation used in the HEC-FDA model to estimate flood damage is slightly greater than that shown in Table 13. The FDA model uses order statistics to derive the confidence limit when using what is termed the "graphical method." As an example, the difference for the 50% ACE water surface elevation is about .1 feet, and the difference for the .2% ACE elevation is about .5 feet. Because of the small difference for the more likely events, and because the absolute value of the difference is generally symmetrical above and below the mean, this small difference in uncertainty parameters should have very little impact on the overall estimate of flood damage.

Table 13: Coyote Creek Tide Gage 2017

	Coyote Creek Tide Gage Station ID: 9414575		
	2017 (5%)	**2017 (50%)**	**2017(95%)**
FREQ (%)	**feet NAVD88**	**feet NAVD88**	**feet NAVD88**
99.99	8.14	8.42	8.54
50	8.97	9.25	9.37
20	9.43	9.71	9.83
10	9.71	9.99	10.11
4	10.04	10.32	10.44
2	10.27	10.55	10.67
1	10.48	10.76	10.88
0.4	10.74	11.02	11.14
0.2	10.93	11.21	11.33

The El Niño-Southern Oscillation (ENSO) is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean about every two to seven years. It is characterized by variations in the sea-surface temperature of the tropical eastern Pacific Ocean (NRC, 2012). ENSO is the dominant cause of sea-level variability in the northeast Pacific Ocean on interannual timescales (Zervas C. , 2009). Sea level rises off the west coast of the United States during El Niño events and falls during La Niña events. The highest sea levels recorded along the west coast and at the San Francisco tide gage were associated with El Niño events. On January 27, 1983, during one of the largest El Niños in half a century, seven tide gages along the west coast recorded their highest water levels. This event produced a water level 2.82 feet above Mean Higher High Water (MHHW) at the San Francisco gage. Figure 21 and Figure 22 show the impact of ENSO on relative sea levels (NRC, 2012).

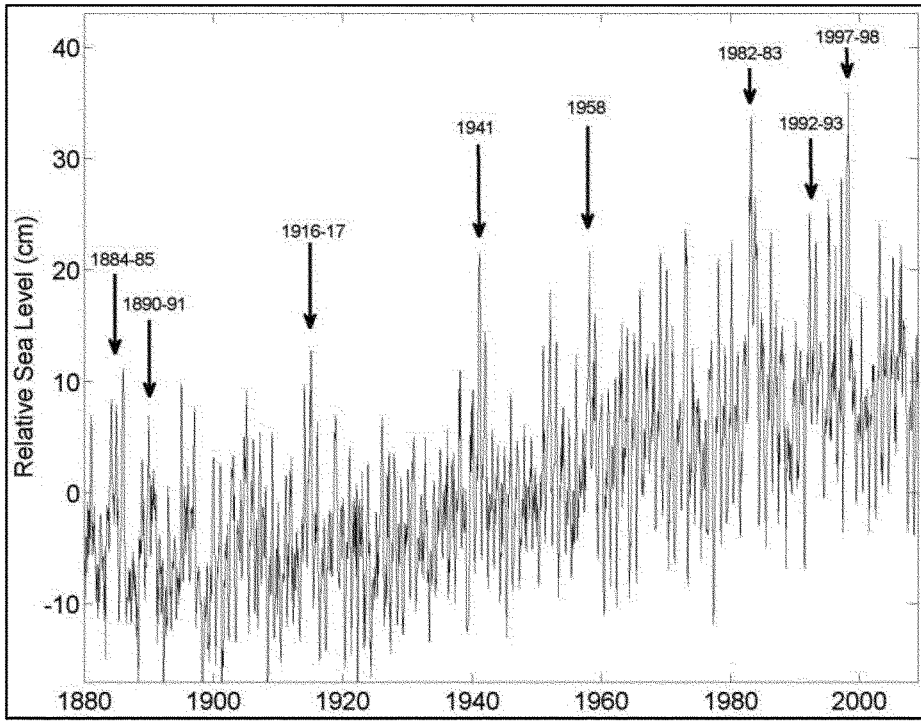


Figure 21: San Francisco Tide Gage Record Showing Relative Sea Level Rise Increases during Major El Niño Events [From (NRC, 2012)]

Most recent work on the impact of ENSO on west coast sea levels estimate the variability due to ENSO to be in the range of 10 to 30 cm (0.32 to 0.98 feet) , with 20 cm 0.66 feet the consensus. This estimate is visible by examination of

Figure 22, which shows variability of the ENSO pattern imposed on the MEHW by a seven-month moving average shown in red.

Decadal and longer variability in sea level off the United States West Coast often corresponds to forcing by regional and basin scale winds associated with climate patterns such as the Pacific Decadal Oscillation (PDO) (NRC, 2012).

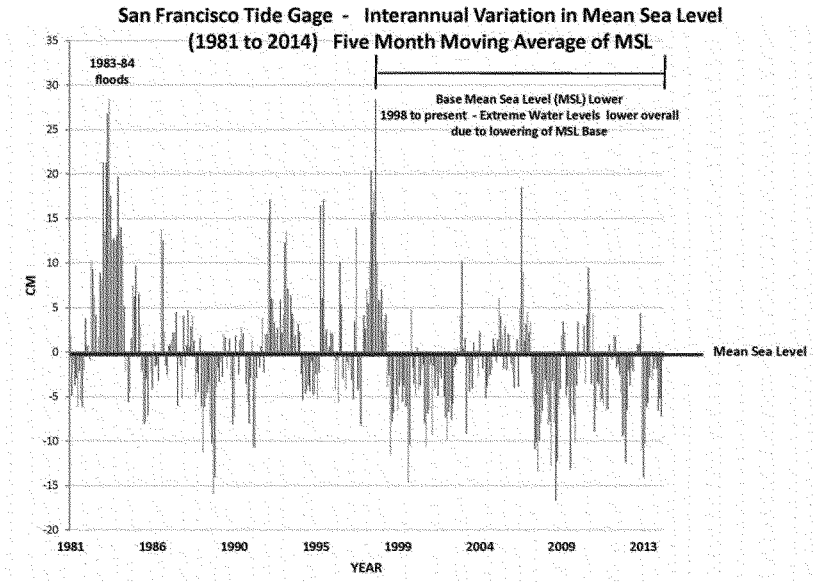


Figure 22: Detrended San Francisco Tide Gage MEHW, Moving Average Showing Range Interannual Variability Due to ENSO.

The daily, monthly and annual tidal cycles account for some of the natural variability in water levels and may contribute to an extreme water level when combined with other contributing factors. The Earth-Moon-Sun orbital geometry results in heightened high tides twice monthly (spring tides, near the times of the full and new moon) and every 4.4 years and 18.6 years (NRC, 2012). The largest tidal amplitudes of the year impacting San Francisco Bay occur in the winter and in summer are often more than 20 cm (0.66 feet) higher than tides in the spring and fall months. The peaks in the 4.4-year and 18.6-year cycles produce monthly high tides that are about 15 cm and 8 cm (0.49 feet and 0.26 feet), respectively, higher than they are in the intervening years (Flick, 2000). Table 14 summaries the various factors impacting extreme water levels.

Table 14: Summary of Extreme Water Level Natural Variability

Variability due to Single Event and Seasonal Climate Trends			Variability due to Tidal Cycles (added to peak)		
	Storm Surge	**ENSO**	**Seasonal**	**1 in 4.4 years**	**1 in 18.6 years**
feet	0.55 – 1.55	0.32 – 0.98	0.66	0.49	0.26
cm	17 – 47	10 – 30	20	15	8
Mean (feet)	0.85	0.66	0.66	0.49	0.26
S (feet)	0.54	0.33			

The water level component variability discussed in this section and summarized in Table 14 is reflected in the overall statistics developed for the San Francisco tide gage and DTM function for Coyote Creek.

Uncertainty in the ACE for the Coyote Creek tide gage is estimated by a simple uncertainty model created through estimates of two of the major factors identified in Table 14. The total uncertainty in extreme water levels for the Coyote Creek tide gage is developed using Equation 1-4, adapted from EM 1110-2-1619:

$$S_{Z,total} = \sqrt{S^2_{Z,natural} + S^2_{Z,model} + S^2_{Z,datum}} \qquad \text{Equation 1.4}$$

where

$S_{Z,\ total}$ = total standard deviation of error representing uncertainty in extreme water levels

$S_{Z,\ natural}$ = the standard deviation associated with uncertainty in extreme water levels due to natural variability

$S_{Z,\ model}$ = the standard deviation associated with uncertainty in extreme water levels due to application and assumptions in the Direct Transfer Function (DTM)

$S_{Z,\ datum}$ = the standard deviation associated with uncertainty in extreme water levels due to tidal datum to geodetic datum gage conversion

The factors comprising the total uncertainty (Table 15) are assumed to occur independently of each other, and determine the confidence interval applied to the ACE elevations for Coyote Creek tide gage. The ACE elevations and associated confidence interval represent the coastal elevation-probability function which describes exposure in the economics model, HEC-FDA. The approximate confidence interval estimated by equation 1-4, 0.76 feet, is input as an "equivalent gage record" value in HEC-FDA. The equivalent gage record was estimated by a sensitivity analysis using HEC-SSP software in which gage record lengths in years were input into a graphical frequency analysis model created with the San Francisco tide gage AEHW values and run to produce confidence intervals roughly equivalent to the value developed by equation 1.4 (Deering, 2014), in effect "backing into an equivalent gage value" which approximates the uncertainty estimate developed by equation 1.4. The HEC-SSP sensitivity analysis yielded an equivalent gage value of approximately 35 to 40 years.

Table 15: Uncertainty given by Equation 1.4 to create Confidence Intervals for Coyote Creek Tide Gage ACE Values

	Source/Type of Uncertainty				
	Natural		**Model**	**Datum**	**Total**
	Storm Surge	**ENSO**	**DTM function**	**Datum**	
S (feet)	0.54	0.33	0.33	0.25	
S^2 (feet)^2	0.29	0.11	0.11	0.06	0.57
S (feet)					0.76

3.2.7 ALVISO ECONOMIC IMPACT AREA, EXISTING WITHOUT-PROJECT CONDITION FLOOD RISK

The Alviso EIA identified in the existing without-project condition roughly comprises the community of Alviso, CA. The area has been subjected to high rates of subsidence from groundwater withdrawal for agriculture for the first half of last century, causing lands adjacent to San Francisco Bay to sink 2 to 8 feet by 1969, with 4 to 6 feet occurring in Alviso (USGS). Figure 23 shows the dramatic change in elevation at the South Bay Yacht Club in Alviso last century, with Alviso now several feet below sea level.

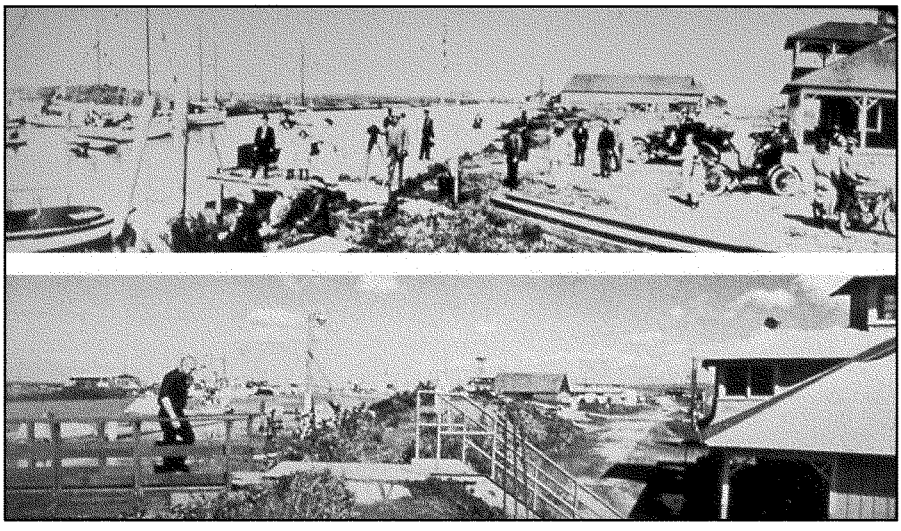


Figure 23 -South Bay Yacht Club, Alviso, CA. Top – 1914, Bottom – 1978 (Source: USBS, Santa Clara Valley Water District)

The degree of subsidence locally and across the South Bay effectively rendered the area vulnerable to flooding at high tides. The system of dikes and ponds, which was constructed and operated strictly for the purpose of harvesting salt, does provide incidental tidal flood risk reduction, demonstrated by the fact that there is no history of tidal flooding in Alviso. The existing without-project condition, under which the overall planning effort is being conducted, recognizes and accounts for this performance. An extensive geotechnical investigation of the dike system was conducted to assess current and future risk of flooding though failure or overtopping of the dike systems surrounding the salt ponds. Flood risk to Alviso from riverine flooding and localized rainfall flooding have been mitigated by levees and stormwater drainage systems aided by pumping to offset the loss of elevation from subsidence, which makes gravity drainage to the South Bay ineffective.

Under the existing without-project condition, water levels due to coastal or tidal flood risk for Alviso are defined by several assumptions;

1. Coyote Creek tide gage, ACE base year 2017 water levels represent the flood aspect of the existing dike-pond system

2. Two pathways for flooding in Alviso from outer dike breaching have been identified, as two discreet dike-pond systems exist, separated by Artesian Slough. The eastern path flows through Pond A18 and the western path flows through Ponds A9 through A16. The most likely path under the existing without-project condition is the western path, as dike elevations are lower, and geotechnical risk is higher. Figure 24 shows the assumed flood pathways to Alviso.
3. Hydrologic risk, represented by the Coyote Creek tide gage ACE water levels, is equivalent through both potential flood pathways.
4. The magnitude and breadth of predicted outboard dike breaches increase as the ACE water levels increase.

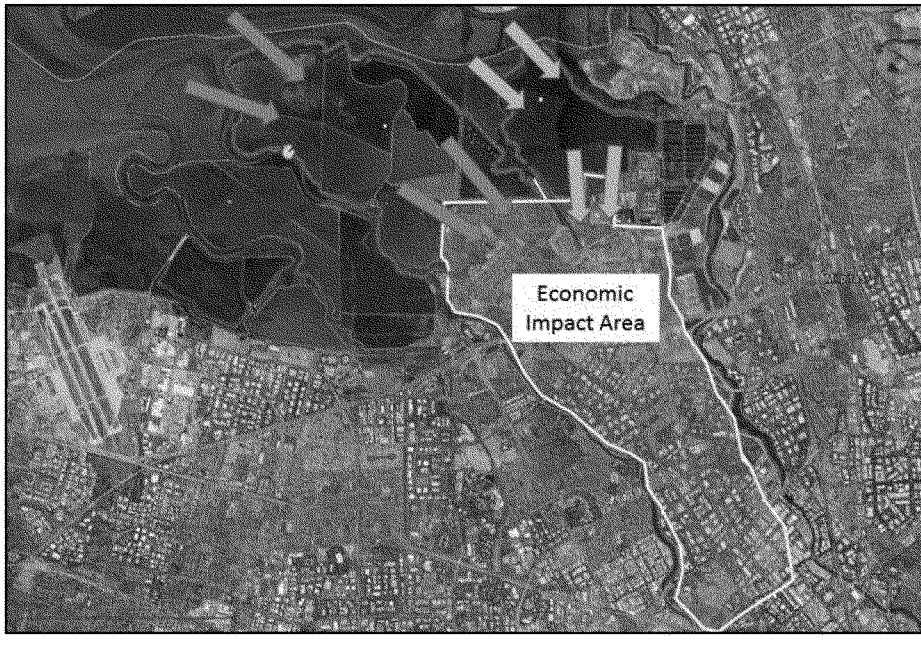


Figure 24 - South San Francisco Bay Area Showing the Outboard Dike System in Red and Potential Tidal Flood Pathways to the Alviso Economic Impact Area

5. The outboard and inboard dikes create a closed system, which is assumed to be at mean sea level. The available pond storage to mitigate initial flood levels is controlled by the average inboard dike elevation minus mean sea level.
6. Coyote Creek tide gage ACE levels are transferred to Alviso through breaching of outboard dikes. An exterior-interior ACE water level relationship was created between Coyote Creek and Alviso, which reflects performance of the dike-pond system resulting in some reduction of

potential flood levels in Alviso. The major controlling factors in the exterior-interior relationship are the duration and elevation of extreme water levels and available pond storage.

7. Performance for the western flood pathway through Ponds A9 through A16 is defined by a curve defining probability of unsatisfactory performance (Pu), also referred to as probability of failure, for a typical outboard dike elevation of 12 feet NAVD88 and represents the controlling geotechnical risk. This elevation represents the predominant elevation for most of the outboard dikes enclosing the pond and would represent a systemic failure resulting in flooding to Alviso immediately or within one or two tidal cycles.
8. Any outboard dike breach will result in an inboard dike breach and flooding to Alviso (see Section 6.3.2).
9. The minimal flood level occurring in Alviso with any outboard breach will be MHHW or highest high tide. This assumption is based on the fact that outboard and inboard breaches created in the flood event will continue to expand during recession of the flood tide, and fill to MHHW on subsequent tides. The water levels in the pond will quickly reach phase and equilibrium with the bay transferring a flood level to MHHW to areas of the Alviso, which are 6 to 8 feet below mean sea level as a result of subsidence from the cycle of groundwater withdrawals last century.
10. Water volume transferred to Alviso though inboard dike breaches will be conveyed to the lowest elevations and remain there. Flooding will progress to higher elevation areas once areas at lower elevations are flooded. Water volume transferred to the EIA though interior levee breaching is assumed to pond and remain until removed by existing drainage system aided by pumping or a targeted dewatering effort.

The topography of the EIA, which was influenced by rapid subsidence last century, may be described by an elevation storage curve. A critical performance element of the dike-pond system providing incidental tidal flood risk reduction for Alviso is the available storage in the ponds, which is defined by a critical elevation for inboard dike failure and the ambient water surface in the pond. While overtopping may start at elevations as low as 6.5 feet, the critical elevation for inboard dike failure is 7.5 feet. The ambient water surface on the pond is mean sea level and changes with time due to sea level rise; at 2017 it is 3.71 feet. The dike-pond system volume differential ameliorates the tidal flood potential in the bay, which is limited in duration as the bulk of the water surface elevation is due to astronomical tide. Performance of the closed system intact provides significant flood risk reduction. The open system performance with predicted failure due to the combination of hydrologic risk and geotechnical risk still provides some flood reduction as defined by the net elevation difference between the exterior and interior ACE water surfaces under the more frequent occurrence intervals.

Elevation-volume curves for the closed ponds bordering the EIA, and the EIA are given in Table 16. Elevation 7.5 feet has been established as a critical elevation for the inboard dikes and geotechnical failure criteria (Table 22) predicts that between 0.75 and 1.0 feet of overtopping for 1 to 3 hours will cause breaches to occur. At 7.5 feet NAVD88, approximately 20 percent of the inboard dike system would be likely to breach, a number representing 500 lineal feet (Figure 25).

Table 16: Elevation-Volume data for Alviso EIA, Western and Eastern Dike-Pond Systems

		Elevation-Volume Curves		
Elevation	**Alviso EIA**	**Western Ponds[1]**	**Volume needed to reach Critical Elevation**	**Eastern Ponds[2]**
(feet NAVD88)	**(acre-feet)**	**(acre-feet)**	**(acre-feet)**	**(acre-feet)**
-2.0	5	-		-
-1.0	29	-		-
0.0	168	980		102
1.0	465	1,864		160
2.0	919	3,268		252
3.0	1,741	5,858		643
3.73[3]	-	6,891	8,793[5]	-
4.3	2,547	8,104	7,580	1,351
5.2	3,492	10,364	5,320	2,156
6.6	4,953	13,395	2,289	3,237
7.5[4]	6,200	15,684	0	4,050
8.5	7,586	17,985		4,865
9.8	9,710	21,071		5,957
10.8	11,529	23,393		6,778
11.8	13,526			7,603
13.1	16,465			8,708
14.1	18,806			9,537

[1] Ponds A9 though A16
[2] Ponds A17, A18
[3] Mean Sea Level in South San Francisco Bay (2017), Coyote Creek tidal datum
[4] Critical elevation where inboard dikes will breach after overtopping for 1 to 3 hours
[5] Critical Volume needed to raise pond elevation to 7.5 feet NAVD88 and fail Inboard Dikes

The Alviso EIA ACE water level elevations are based on an exterior-interior relationship that was developed from a simple breach analysis, which transfers flood volume from the South Bay through a sequence of dike failures into the Alviso EIA (Table 17). Pertinent information for the breach analysis is listed below:

1. Critical Overtopping Elevation for inboard dikes = 7.5 feet NAVD88
2. Critical Overtopping Duration for inboard dike failure = 1 to 3 hours
3. V = Velocity through breach (6.0 to 6.5 feet/sec)
4. W = Cumulative Breach Width (200 to 755 feet) or (1.4 to 5.5 % of total outboard dike length)
5. D = Depth of Breach – Assume -1.0 feet NAVD88 mud line, equals (3HR WSE – (-1.0)) feet
6. Area = Assume rectangular breach W x D
7. 3HR Breach Volume = W x D x V x 3 hours
8. Ambient Pond Volume – Volume at MSL (3.73 feet) base year 2017 = 6891 acre-feet
9. Critical Overtopping Volume – Volume entering pond through outboard dike breach needed to raise pond elevation to 7.5 feet NAVD88, 8,793 acre-feet, assumes starting pond water level at MSL.
10. 3HR Breach Volume = Flood Volume to Alviso EIA
11. MHHW Elevation/Volume = 7.81 feet/6620 acre-feet, base year 2017

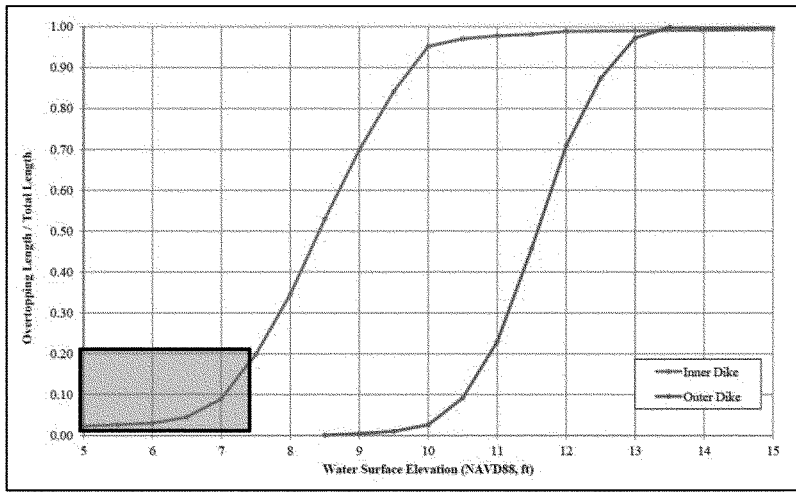


Figure 25: Inboard Dike Length (Blue) and Critical Overtopping Elevation of 7.5 feet NAVD88; Blue Box represents portion of total dike length likely to fail by overtopping (20 percent, approximately 500 lineal feet).

Table 17: Computation of Interior Water Surface Elevation for Alviso EIA from Breach Analysis

	2017 Exterior WSE[1]	2017 3 hour WSE	Assumed Breach Width	Breach Area[2]	Velocity through breach	3 hour Breach Volume[3]	Critical Inboard Dike Overtopping Volume[4]	Flood Volume to Alviso[5]	2017 Interior WSEL[6]
FREQ (%)	feet NAVD88	feet NAVD88		feet^2	feet/sec	acre-feet	acre-feet	acre-feet	feet NAVD88
99.99	8.42	7.92	200	1,784	6.00	2,654	8,793	6,620	7.81
50	9.25	8.75	300	2,924	6.00	4,349	8,793	6,620	7.81
20	9.71	9.21	350	3,573	6.00	5,315	8,793	6,620	7.81
10	9.99	9.49	400	4,195	6.00	6,241	8,793	6,620	7.81
4	10.32	9.82	525	5,412	6.25	8,806	8,793	8,806	9.34
2	10.55	10.05	530	5,524	6.25	9,073	8,793	9,073	9.49
1	10.76	10.26	540	5,629	6.25	9,420	8,793	9,420	9.63
0.4	11.02	10.52	705	8,124	6.45	12,922	8,793	12,922	11.02
0.2	11.21	10.71	755	8,838	6.50	14,243	8,793	14,243	11.21

[1] Coyote Creek tide gage
[2] Breach Width x Depth
[3] (Breach Width x Depth x Velocity) x 3 Hour
[4] Volume added to starting pond water surface elevation (MSL) volume (8793+6891) acre-feet
[5] Flood Volume to Alviso, less than 8,703 acre-feet, Flood Volume equal to MHHW – 7.81 feet
[6] Water Surface Elevation in Alviso EIA, from elevation-volume table (Table 16)

For the existing without-project base year scenario, a potential flood event impacting the Alviso EIA would occur as a result of an outboard dike breach though the western ponds. Any outboard dike breach will cause overtopping to occur at the inboard dikes protecting the Alviso EIA, either on the initial storm tide or from a subsequent MHHW tide. The dikes on the eastern pond system are higher, and carry less geotechnical risk overall, so the controlling failure mode describing hypothetical flood events is based on the western pond system.

A three-hour duration ACE water surface elevation for the 2017 Coyote Creek tide gage was developed to compute water volumes to be transferred into the western ponds during an outboard dike breach. The controlling factor in the transfer of tidal flood water volume into the Alviso EIA is the ambient water level in the pond, assumed to be at mean sea level. The ambient water level is the starting water level in the pond for the potential flood event and determines the volume of flood water needed to bring the pond water level to 7.5 feet NAVD88, the water level at which a significant amount overtopping occurs over 20 percent (500 feet) of inboard dikes, causing them to fail and transferring a substantial volume of water into the Alviso EIA during either the initial storm tidal cycle or subsequent tidal cycles. The potential flood event and simplified breach analysis describe the performance of the dike-pond system as it transitions from a closed system to a partially open system to finally a fully open system. The exterior-interior relationship between the Coyote Creek tide gage and the Alviso EIA reflects the performance and transitions between closed and open systems. Figure 26 shows the range of breach assumptions used to describe performance under the annual recurrence intervals.

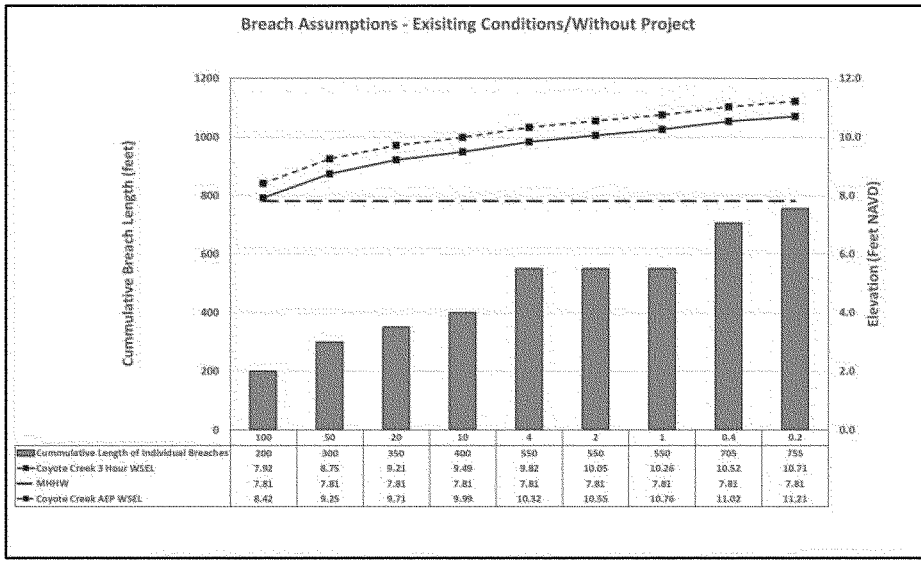


Figure 26: Breach Assumptions for 3-hour ACE Water Surface Elevations for the Coyote Creek Tide Gage.

The ability of the dike pond system to transfer flood volume into the Alviso EIA is constrained by the ability of the pond to reach the critical overtopping elevation of 7.5 feet NAVD88 within a very short time. There are three flooding conditions possible:

1. *For the more frequent events, it is not possible to transfer enough volume into the pond to achieve the critical overtopping elevation of 7.5 feet under the initial tidal cycle containing the storm tide.* As the initial storm tide recedes, and water drains out of the pond through the outboard dike breaches, which will continue to expand on the falling tide and on the subsequent rising tides, the pond will refill to the MHHW elevation of 7.81 feet NAVD88, failing a section of inboard dikes and transferring flood volume into the Alviso EIA, the water surface in the Alviso EIA will reach equilibrium with the MHHW tide. This partially closed system will become completely open over subsequent tidal cycles, with Alviso at risk from flooding from daily high tides.
2. *Storm tides that are able to transfer enough volume to raise the pond elevation past the overtopping failure threshold while transferring a significant volume into the Alviso EIA during the initial storm tidal cycle.* This results in an internal water surface elevation at Alviso lower than the external water surface elevation at Coyote Creek. This level of performance reflects the fact that the breaches created are not sufficient to bring the pond into phase or equilibrium with the South Bay. This partially closed system will become completely open over subsequent tidal cycles, with Alviso at risk from flooding from daily high tides.
3. *Storm tides that are able to transfer enough volume to raise the pond elevation past the overtopping failure threshold during the initial storm tidal cycle by transferring a volume, which results in an internal water surface elevation in the Alviso EIA equal to the external water surface elevation at Coyote Creek.* This condition will occur when breaches and failures on both inboard and outboard dikes are substantial enough to create enough volume transfer for the pond to be in phase with the South Bay, creating an open system. This condition will occur more quickly if the ambient pond levels are raised creating a condition requiring less volume to fill the pond to the critical inboard dike overtopping elevation at 7.5 feet.

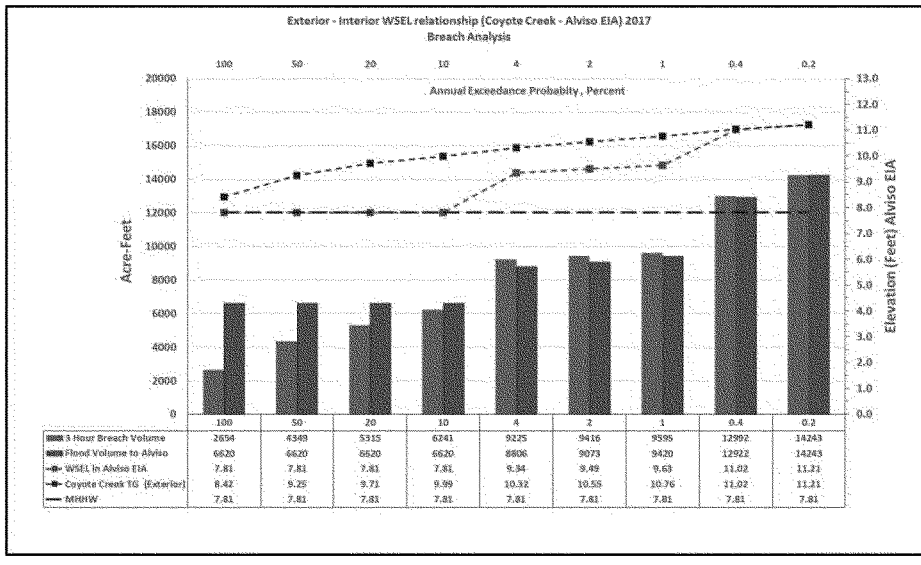


Figure 27: Exterior-Interior Water Surface Relationship between Coyote Creek Tide Gage and Alviso assuming Outboard Dike Breaching.

3.2.8 ALVISO ECONOMIC IMPACT AREA, FUTURE WITHOUT-PROJECT CONDITION FLOOD RISK

Future conditions in the project are impacted by SLC, which in turn further reduces the performance and reliability of the existing west and east dike pond systems currently preventing tidal flooding in the Alviso EIA.

Under the three SLC scenarios, the assumption is that the tidal ranges in San Francisco Bay remain unchanged, but shift to higher levels and inland. The ACE statistics are projected forward under the three SLC rates. The ability of the existing dike-pond systems to prevent tidal flooding declines significantly and rapidly under the USACE High SLC scenario. Figure 27 illustrates the transfer in volume under an assumed failure of the dike-pond system that defines the exterior-interior relationship between Coyote Creek and Alviso in the base year of 2017.

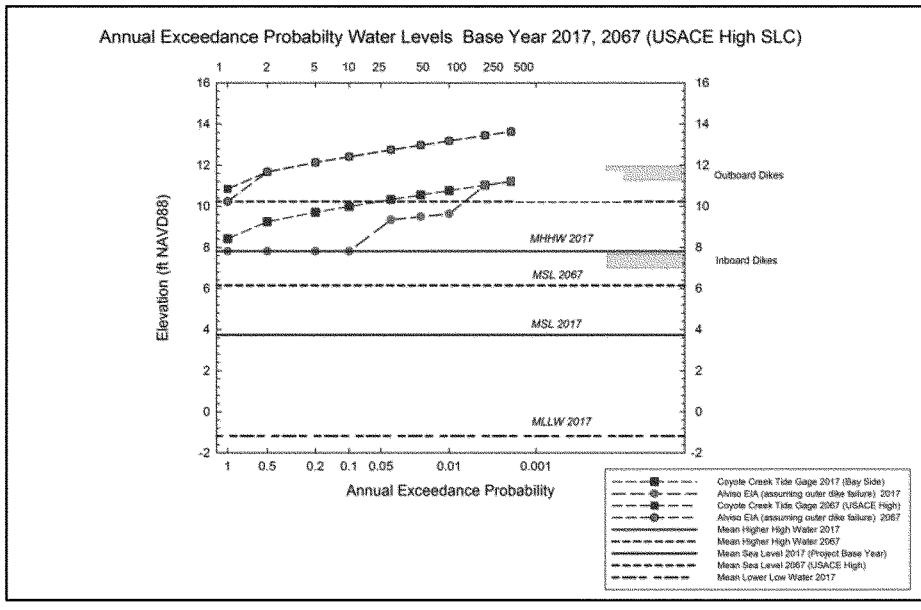


Figure 28: ACE for Coyote Creek Tide Gage and Alviso EIA for 2017 and 2067 under USACE High SLC Scenario.

The impact of SLC on the performance of the dike-pond system and the change in exterior-interior water surface elevation relationship can be seen in Figure 28. The change in mean sea level, potentially several feet higher under the USACE High SLC scenario effectively eliminates any flood risk reduction benefit by the dike-pond system through storage. Water would only need to rise by 1 to 1.5 feet for the inboard dikes to be overtopped and fail. The transition to a completely open system now occurs at the 50 percent ACE, and the exterior-interior relationship is no longer in effect. ACE water surface elevations are developed in 10-year increments for the base year 2017 through 2067 using the web tool at https://corpsclimate.us/ccaceslcurves.cfm. The low rate is used for all 2017 scenarios since the base year of 2017 is so close to the current year. Exterior-interior relationships between the Coyote Creek tide gage and Alviso EIA based on breach analysis developed for the existing without-project condition are estimated for the future SLC scenarios, accounting for changes impacting performance.

Table 18, Table 19, and Table 20 contain ACE water surface elevations for the three SLC scenarios, USACE Low, Intermediate, and High.

Table 18: USACE Low SLC Scenario - ACE Water Surface Elevations, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.49	7.88[1]	8.55	7.94[1]	8.62	8.01[1]	8.69	8.08[1]	8.76	8.15[1]
50	9.25	7.81[1]	9.32	7.88[1]	9.38	7.94[1]	9.45	8.01[1]	9.52	8.08[1]	9.59	8.15[1]
20	9.71	7.81[1]	9.78	7.88[1]	9.84	8.50	9.91	8.45	9.98	8.65	10.05	9.20
10	9.99	7.81[1]	10.06	8.30	10.12	8.70	10.19	8.90	10.26	9.15	10.33	9.45
4	10.32	9.34	10.39	9.36	10.45	9.65	10.52	9.80	10.59	9.99	10.66	10.20
2	10.55	9.49	10.62	9.57	10.68	9.75	10.75	9.92	10.82	10.70	10.89	10.80
1	10.76	9.63	10.83	9.75	10.89	9.85	10.96	10.80	11.03	11.03	11.10	11.10
0.4	11.02	11.02	11.09	11.09	11.15	11.15	11.22	11.22	11.29	11.66	11.36	11.36
0.2	11.21	11.21	11.28	11.28	11.34	11.37	11.41	11.41	11.48	11.85	11.85	11.85

[1] MHHW

Table 19: USACE Intermediate SLC scenario - ACE Water Surface Elevations, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.60	7.99[1]	8.73	8.12[1]	8.89	8.28[1]	9.06	8.45[1]	9.26	8.65[1]
50	9.25	7.81[1]	9.43	7.99[1]	9.56	8.12[1]	9.72	8.28[1]	9.89	8.45[1]	10.09	8.65[1]
20	9.71	7.81[1]	9.89	7.99[1]	10.02	8.50	10.18	9.45	10.35	9.78	10.55	10.55
10	9.99	7.81[1]	10.17	8.50	10.30	9.50	10.46	9.65	10.63	10.49	10.83	10.83
4	10.32	9.34	10.50	9.40	10.63	9.80	10.79	10.40	10.96	10.96	11.16	11.16
2	10.55	9.49	10.73	9.68	10.86	10.60	11.02	11.02	11.19	11.19	11.39	11.39
1	10.76	9.63	10.94	10.55	11.07	11.07	11.23	11.23	11.40	11.40	11.60	11.60
0.4	11.02	11.02	11.20	11.20	11.33	11.33	11.49	11.49	11.66	11.66	11.86	11.86
0.2	11.21	11.21	11.39	11.39	11.52	11.52	11.68	11.68	11.85	11.85	12.05	12.05

[1] MHHW

Table 20: USACE High SLC Scenario - ACE Water Surface Elevations, Ext - Coyote Creek Gage, Int - Alviso

	2017		2027		2037		2047		2057		2067	
ACE (%)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)	Ext (ft.)	Int (ft.)
99.99	8.42	7.81[1]	8.94	8.33[1]	9.30	8.69[1]	9.74	9.13[1]	10.26	9.65[1]	10.84	10.23[1]
50	9.25	7.81[1]	9.77	8.33[1]	10.13	8.69[1]	10.57	9.85	11.09	11.09	11.67	11.67
20	9.71	7.81[1]	10.23	8.75	10.59	9.70	11.03	11.03	11.55	11.55	12.13	12.13
10	9.99	7.81[1]	10.51	9.50	10.87	10.10	11.31	11.31	11.83	11.83	12.41	12.41
4	10.32	9.34	10.84	9.80	11.20	11.20	11.64	11.64	12.16	12.16	12.74	12.74
2	10.55	9.49	11.07	11.07	11.43	11.43	11.87	11.87	12.39	12.39	12.97	12.97
1	10.76	9.63	11.28	11.28	11.64	11.64	12.08	12.08	12.60	12.60	13.18	13.18
0.4	11.02	11.02	11.54	11.54	11.90	11.90	12.34	12.34	12.86	12.86	13.44	13.44
0.2	11.21	11.21	11.73	11.73	12.09	12.90	12.53	12.53	13.05	13.05	13.63	13.63

[1] MHHW

4.0 GEOTECHNICAL ENGINEERING TECHNICAL SUMMARY

4.1 INTRODUCTION

This section summarizes the assumptions for geotechnical performance for the existing pond dikes within the South San Francisco Bay Shoreline (SSFBS) study area. The proposed SSFBS project includes ecosystem restoration in retired salt production ponds and the construction of flood risk management features along an existing inboard dike on the west and east side of Artesian Slough. No existing dikes or berms are engineered structures. The geotechnical recommendations are focused on the outboard and inboard dike system west of Artesian Slough (Figure 29). By comparison, the existing condition of the west side of the project is consistently at lower elevations (i.e., > 2 ft) on both inboard and outboard dikes. Therefore, the likely source of initial flooding under more frequent flood events is through the dike-pond system that is west of Artesian Slough.

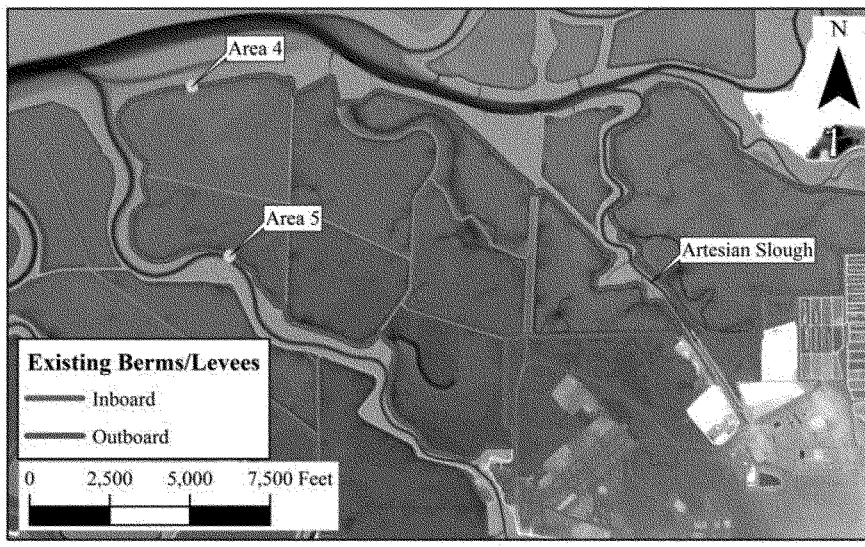


Figure 29: Project Map of Existing Dikes and Berms.

There are no new geotechnical analyses relative to what was completed for the USACE Feasibility Scoping Meeting milestone (USACE, 2009a)and Alternative Formulation Briefing milestone (USACE, 2013b) to support the current effort to identify the Federal interest and determine whether a potential project is economically justified. Instead, research of existing sources of geotechnical information and analyses were used to revise the geotechnical assumptions that have been applied for the reevaluation of Federal interest and economic justification for a future project. Through this effort, the failure mechanisms that form the geotechnical fragility curve of the outboard dike were reevaluated. The revised geotechnical fragility curve was judged to be more appropriate in light of observed performed at the project site for water levels that are lower than those characteristic of a higher SLC curve.

The geotechnical performance assumes that the outboard dike is the only line of protection. This approach assumes that a breach failure at the outboard dike will result in a subsequent breach from overtopping at the inboard dike above a specific threshold loading.

4.2 GEOTECHNICAL PERFORMANCE

4.2.1 OUTBOARD DIKE PERFORMANCE (FRAGILITY CURVE)

Geotechnical fragility curves for the entire SSFBS project were developed for the FSM milestone (USACE, 2009a) to characterize the without-project condition of the existing pond dikes. This effort leveraged data from existing (650 SPT and 43 CPT soundings), as well as new (34 SPT and 102 CPT soundings), geotechnical exploration locations along the existing inboard and outboard dikes. This data was used to create a total of 14 index points; six on the outboard dikes and eight on the inboard dikes. Two of the index points developed, Area 4 and Area 5, are along the outboard dike that is west of Artesian Slough (Figure 29). Probability of unsatisfactory performance (P_u), also referred to as probability of failure, was reported as a function of water surface elevation from the crest (i.e., crest elevation minus water surface elevation).

The fragility curve developed for the Feasibility Scoping Meeting milestone was based upon seepage and rapid drawdown and judged incompatible with the short duration (hours) loading of flood events. Erosion and overtopping erosion were identified as the mechanisms critical to determining the likelihood of failure/breach of the outboard dike. In addition, newer and higher resolution survey information in the study area had been collected. An additional fragility curve was developed to more accurately represent loading (i.e. erosion and overtopping) and updated dike dimensions (i.e. elevation and crest width) known to exist in the study area.

An additional fragility curve was developed for combined erosion and overtopping mechanisms. No new geotechnical analysis was performed to quantitatively support the current effort. However, existing analysis for erosion and overtopping as well as empirical observations of dike performance were leveraged to support the revised fragility curve. The primary factors supporting the revised fragility curve were (i.) typical conditions along the outboard dike, (ii.) hydraulic and breach modeling already performed for the without project condition in the study area, and (iii.) observed performance relative to maintenance performed.

A 2010 USGS LiDAR survey of the study area was used to identify the typical configuration of the outboard dike. The cross-section geometry was sampled at 21 representative locations (Figure 30). Cross sections were purposely concentrated in areas where overtopping is likely to occur first (i.e., saddles) and/or erosion is more likely (i.e., proximity to sloughs). Plotted cross sections are shown in Figure 31. Crest widths were estimated by measured the section width 1 ft below the peak crest elevation. This method was used to avoid underestimating crest widths due to irregular topography. Factors that contribute to functionally narrower crests, such as rodent holes, were not considered in the estimate of the crest width. Average crest elevation and width of the selected cross sections was 10.8 ft NAVD88 and 18 ft, respectively.

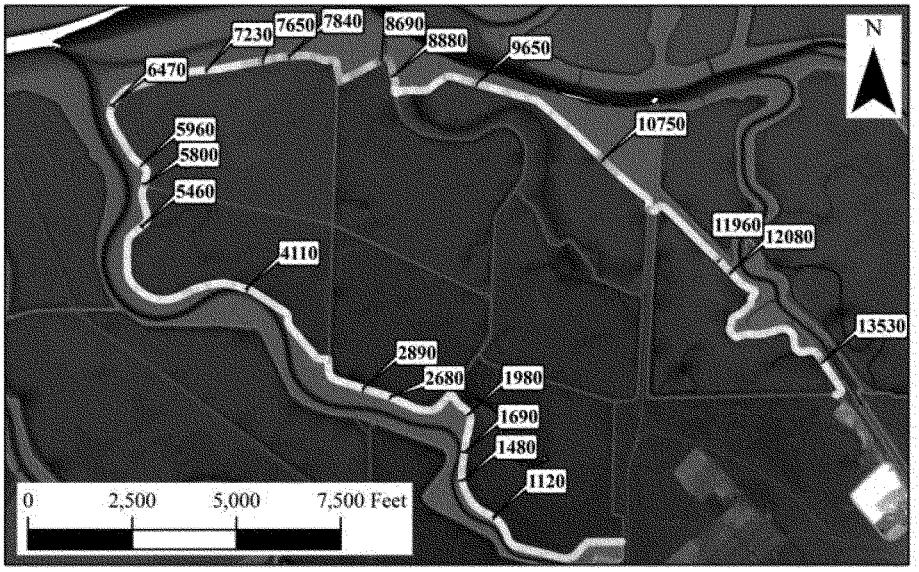


Figure 30: Locations of Select Cross sections Along the Outboard Dike.

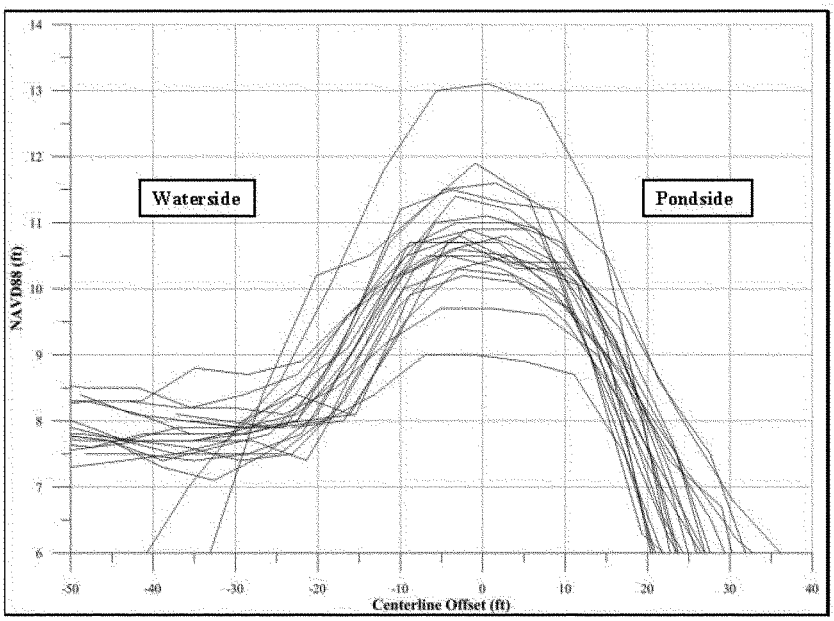


Figure 31: Cross sections along the Outboard Dike

Overtopping and erosion are critical to the performance of the outboard dike. Existing information duration of tidal flood events and the results of breach modeling efforts in the study area were used to estimate the thresholds at which the likelihood of breach along the outboard dike will occur. The following section discusses the basis for estimated loading duration and respective performance impacts to the outboard dike with respect to the peak water surface elevation (WSE) experience during a flood event.

The duration of flood loading was estimated using the tidal signal (i.e., shape) from the San Francisco Golden Gate tide gauge. The peak of the signal was set equal to a given WSE and the duration above lower elevations was recorded. Table 21 shows the approximate durations of loading above elevations incrementally lower than the peak WSE.

Table 21: Summary of Durations Exceeding Elevations Lower than the Peak WSE

Peak Water Level (NAVD88, ft)	WSE above (NAVD88, ft)	Duration Above WSE (hr)
12	11	4.5
	10	7
	9	9
	8	> 10
11	10	4.5
	9	7
	8	9
10	9	4.5
	8	7

(USACE, 2008) details the investigation and modeling effort to establish likely times to breach from wave attack, overtopping erosion, or both. Table 22 summarizes the overtopping scenarios likely to induce a breach at the outboard dike between Alviso and the ponds west of Artesian Slough. The table was adapted from (USACE, 2008) and shows the expected time to breach for overtopping scour only.

Table 22: Estimated Time to Breach versus Dike Crest Width

		Expected critical time to breach (hr) for respective crest width (ft)					
q (ft^3/s) per foot of dike	Height (ft) of overtopping	W = 25*	W = 20*	W = 15	W = 11	W = 7	W = 5
0.5	0.30	--	--	42.86	31.43	19.43	14.04
1	0.47	--	--	9.19	6.7	4.33	2.98
2	0.75	--	--	4.46	3.32	2.08	1.49
3	0.98	5.50	4.40	3.29	2.42	1.53	1.09
4	1.19	4.60	3.70	2.75	2.02	1.27	0.91

1. Overtopping flow rate from the Feasibility Scoping Meeting Geotechnical Appendix (USACE, 2009b)
2. Overtopping height determined from broad crested weir equation (Henderson, 1966).
3. (*) Indicates time to breach estimated from linear fit of data for dikes with W from 5 to 15 ft.

The cross-section geometry, anticipated loading duration, loading required for overtopping breach, and past performance were considered to identify possible breach locations. Figure 32 shows potential overtopping breaches that can be expected to occur from a given peak WSE. Point labels represent crest elevation and width at respective outboard dike station (Figure 30). Lines draw indicate the approximate threshold (i.e. overtopping duration vs. crest width) to which overtopping breaches are likely to occur. Of the 21 cross sections evaluated, three locations are at risk of an overtopping breach for a peak WSE of 11 ft. The number of potential overtopping breaches increases to 12 for a peak WSE of 12 ft.

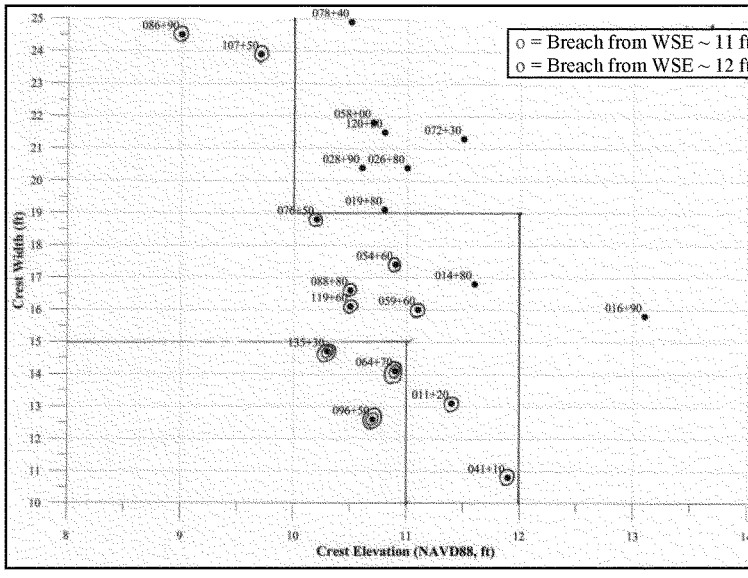


Figure 32: Potential Overtopping Breach Locations for Given Peak WSE.

The impact of wave attack and erosion on the waterside of the outboard contribute to the performance of the outboard dike. USACE (2008) modeled wave attack, however, wave height (i.e. 3 ft height or greater) was judged to be overestimated by at least 2 ft in the study area. Past performance along the outboard dike during frequent (i.e. non-overtopping) events was inferred from maintenance records for the period 1995 to 2005 (Geomatrix, 2006). These records provide a generally coarse interpretation of distress along the outboard dike. Figure 33 shows the number of repair episodes along the outboard dike in the period of record. Figure 34 shows the summed extent of repairs in the period of record when such records were available. The extent of repairs was typically described in terms of linear feet and/or cubic yards. A review of the storm frequency and annual maximum water levels showed a positive correlation between "stormier years" and increased maintenance (i.e. 1997 and 2003).

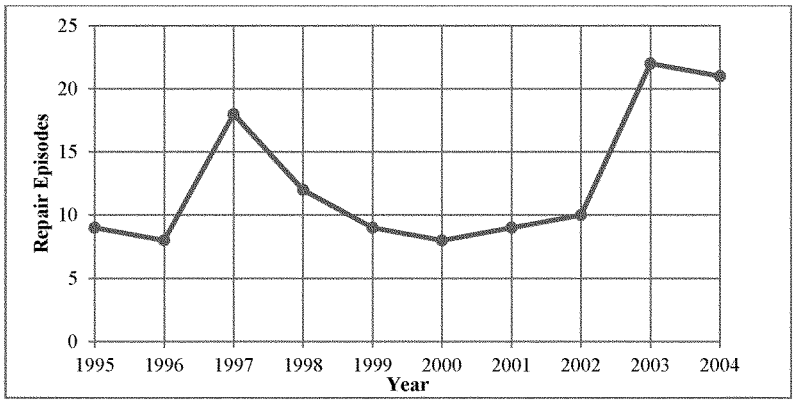


Figure 33: Number of Maintenance Episodes by Year along the Outboard Dike.

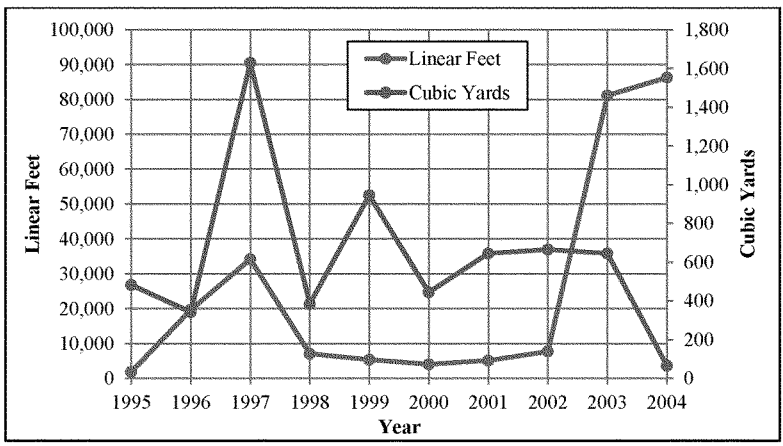


Figure 34: Summed Total Extent of Repairs by Year along the Outboard Dike.

The fragility curve for outboard dike combined geotechnical investigation, numerical modeling, and maintenance record datasets to capture the primary mechanisms critical to performance along the outboard dike; overtopping and erosion. The key assumptions used to construct the fragility curve are as follows:

- Time to overtopping breach is quantitatively supported in the geotechnical analyses performed in USACE (2009a).
- Maintenance records demonstrate distress and/or damage occurring in "stormier years" with presumably higher than typical water surface elevations. Maintenance was generally ad-hoc when the ponds and associated dikes were owned by Cargill, Incorporated; however, the U.S.

Fish and Wildlife Service (FWS) performs maintenance annually in the period following the wet season.

- Wave height in the project area is limited to 0.5 to 1 ft above the static WSE and does not increase with increasing static WSE. The outboard dike is assumed partially exposed to wave attack above elevation 8 ft and fully exposed above elevation 9 ft (USACE 2008).
- The extent of resources (e.g., funding and staff) for FWS to maintain the outboard dike into the future is uncertain. To date, repairs have been prioritized to the areas of highest need and is not comprehensive to all needs (USACE, 2014a)(USACE, 2014).

Figure 35 shows the fragility curves developed for the SSFBS study. Table 23 shows the estimated probability of unsatisfactory performance for the two mechanisms and the combined probabilities for respective elevations. Commentary is provided below as justification to support the engineering judgment applied and to describe the typical conditions anticipated during specific loading.

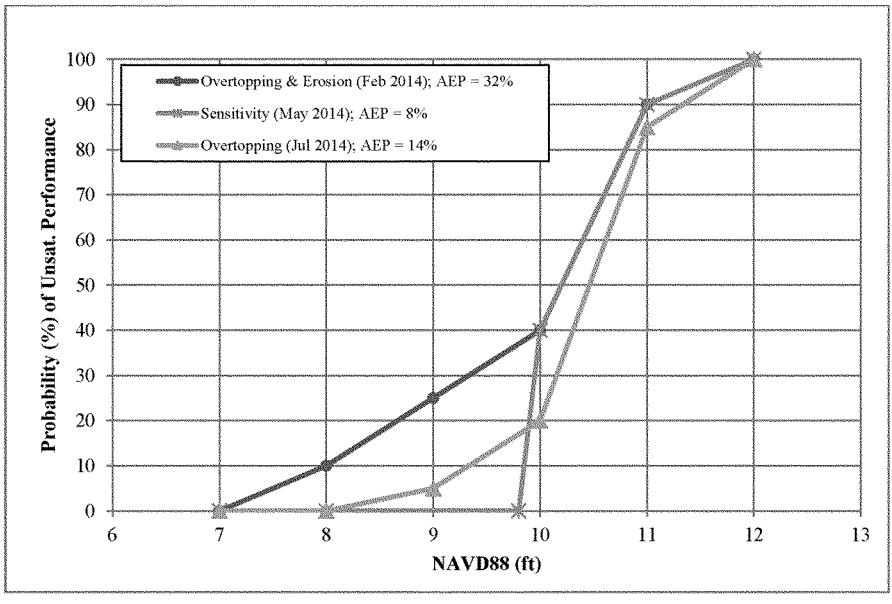


Figure 35: Outboard Dike Fragility Curves Developed.

Two additional fragility curves were developed and implemented in HEC-FDA to the risks assumed during the reanalysis of SLC scenarios (Figure 35). The first added curve was constructed to disallow failure below elevation 10 ft and the second is the probability of failure induced by overtopping only. Both additional curves represent conditions that ignore mechanisms/elevations that are documented to have negative impacts to outboard dike performance. However, there is concern that implementation of a geotechnically appropriate fragility curve in HEC-FDA and the application of a specific failure mode scenario may have led to the overestimation of flood risks in the immediate future. The sensitivity analysis addressing the impacts on the economic results when adjusting the fragility curve is discussed in Section 5.0

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Table 23: Updated Probability of Unsatisfactory Performance (Breach) Based on Erosion & Overtopping Only

Static WSE (NAVD88, ft)	Probability of Failure (P_u)			Comments
	Erosion	Overtopping	Combined	
12	0.3	1.0	1.0	1. 32,000 ft of outboard dike (70% of length) overtops. About 21,000 ft overtops over elevation 11 ft for 4hrs, possibly inducing up to 3 overtopping breaches. 2. Overtopping of crest elevations at 10 ft for 6.5 hours, possibly inducing 9 additional overtopping breaches (Figure 32).
11	0.3	0.85	0.90	1. 9,250 ft of outboard dike (25% of length) overtops above elevation 10 ft for 4 hrs. Potential overtopping breaches at three locations. 2. Overtopping height is transient and the duration required to induce breaching may not occur. 3. Breach from combined erosion and overtopping increases the likelihood of breach at the three locations (Figure 32).
10	0.25	0.20	0.40	1. Overtopping at a limited number of locations. These locations have wide sections and sustain overtopping erosion for proportionally longer durations than narrow (< 15 feet) sections. 2. The dike crest in several reaches is composed of loose highly erodible silt with organics (USACE, 2014a). Time to overtopping breach may be substantially shorter in these reaches. 3. Rodent activity in the uppermost 1 to 3 feet of the dike section may contribute to internal erosion (USACE, 2014a) or effectively "narrower" crest width available during overtopping. 4. Increased size and frequency of maintenance can be expected based on maintenance records (Geomatrix 2006). 5. The difference between the 2010 site survey and current conditions in 2014 is uncertain (e.g. potential for lower and thinner than measured crest elevations). 6. Repairs/Action to restore crest elevation from subsidence is recognized only after overtopping occurs (i.e., no periodic surveys/measurements of dikes). 7. Dike vulnerability to combined erosion and overtopping in low spots is very minor or incipient overtopping.
9	0.2	0.05	0.25	1. WSE in the range observed to have increased frequency and scope of repairs. 2. Lower WSE more frequent in a single wet season with maintenance performed annually and not ad-hoc. 3. Prioritization of repairs/maintenance relative to available resources can allow "semi-vulnerable" locations to become increasing vulnerable to loading. 4. Loss of section height and width due to normal coastal processes.
8	0.1	0	0.10	
7	0	0	0.0	1. Water levels experienced frequently (daily to weekly) with no noteworthy distress.

Notes:
1. Calculated per ETL 1110-2-547; (1 - Erosion) * (1 - Overtopping) = 1 - Combined.

4.2.2 INBOARD DIKE PERFORMANCE

The inboard dike was assumed to fail due to overtopping. The inboard dike crest width is variable in the reach west of Artesian Slough. Crest widths are typically between 10 and 15 ft wide but can be as little as 8 ft along the alignment. Crest elevations vary from 6 to 11 feet suggesting substantial overtopping length (i.e. 1,000 ft) if the dike was exposed to normal high tides (i.e. MHHW = 7 ft NAVD88) or greater than one mile of overtopping length for WSEs that cause an overtopping breach of the outboard dike. It can be inferred from Table 23 that an overtopping height of 1 ft for the duration of 3 to 4 hrs is likely to induce a breach through the inboard dike. An accumulation of overtopping high tide cycles in the days following a non-overtopping outboard dike breach, or an overtopping induced breach of the outboard dike would result in subsequent failure of the inboard dike.

Static failures prior to overtopping were not considered credible during the current effort. Water levels have been sustained for significant periods near mean tide elevation (i.e., 3.5 ft) without failure. If the outboard dike experienced a breach, normal high tide water levels (i.e., MHHW ~ 7 ft) would overtop the lowest reaches (elevation 6 to 6.5 ft) of the inboard dike. Therefore, sustained water levels that are appreciably above elevation 3 ft and do not overtop the inboard dike are highly unlikely.

4.2.3 FAILURE MODE SEQUENCE

The geotechnical performance of the outboard dike is critical to the performance of the entire dike-pond system. The failure at the outboard dike will result in overtopping and subsequent failure at the inboard dike. Overtopping is likely to occur at as low as elevation 6.5 ft for the inboard dike. Overtopping, or a breach before overtopping, of the outboard dike will likely result in at least 2 feet of overtopping at the inboard dike. In addition, a breach of the inboard dike is assumed to occur shortly after breach of the outboard.

5.0 ECONOMICS TECHNICAL SUMMARY

5.1 WITHOUT-PROJECT FLOOD DAMAGE

Table 24 below shows the economic damages estimated in the HEC-FDA model for the USACE Intermediate SLC scenario. The decrease in damages between consecutive years is due to the assumption that relocations are occurring in response to damaging floods. For example, the decrease in damages from 2026 to 2027 is a result of the structure relocations that were assumed to take place in 2027.

Table 24: Without-Project Structure & Content EAD, Intermediate SLC Scenario (1,000s)

Year	Commercial	Displacement	Industrial	Public	Residential	Total
2017	$4,845	$471	$2,542	$553	$2,945	$11,356
2026	$7,181	$617	$3,109	$675	$3,691	$15,273
2027	$6,799	$373	$418	$255	$2,230	$10,075
2036	$10,383	$515	$565	$292	$2,712	$14,467
2037	$9,421	$419	$568	$46	$2,200	$12,654
2046	$12,716	$527	$662	$52	$2,564	$16,521
2047	$12,189	$388	$608	$52	$1,763	$15,000
2056	$21,343	$848	$887	$85	$3,262	$26,425
2057	$14,363	$680	$44	$17	$1,948	$17,052
2067	$23,421	$1,234	$69	$33	$3,466	$28,223

As noted previously, in addition to the structure and content damage calculated in the HEC-FDA models, the without-project damage analysis considers the cost of relocations out of the floodplain and the cost to protect the San Jose/Santa Clara Water Pollution Control Plant. The plant serves 1.4 million people and thousands of businesses, and is the largest treatment plant in the region. In the absence of a structural project to keep coastal storm water from reaching the basin, it is assumed that, because of its economic and environmental importance, actions would be taken to reduce the likelihood of damage to the plant. A ring levee surrounding the plant was estimated to cost $25M to construct. It was assumed that in the face of increased coastal flood risk the ring levee would be constructed by 2027.

Table 25 below shows an example of how the total EAD is calculated for each year of the period of analysis. The table only shows eleven years of the period of analysis, for illustrative purposes. For each year, the damages from all of the damage categories are summed and the present value is calculated using the applicable discount rate. The values for the intervening years between the beginning and end of each FDA model's 10-year periods of analysis were calculated by interpolation. The sum total of the annual present values is then annualized to calculate an equivalent annual damage.

Table 25: Example of Without-Project Total EAD Calculation - Intermediate SLC Scenario (1,000s)

Year of Project	Year	Present Value Factor	EAD From FDA Model	Relocation Cost	Ring Levee Construction	Total	Present Value
0	2017	1.000	$11,356	$0	$0	$11,356	$11,356
1	2018	0.966	$11,791	$0	$0	$11,791	$11,392
2	2019	0.934	$12,226	$0	$0	$12,226	$11,413
3	2020	0.902	$12,661	$0	$0	$12,661	$11,420
4	2021	0.871	$13,096	$0	$0	$13,096	$11,413
5	2022	0.842	$13,532	$0	$0	$13,532	$11,393
6	2023	0.814	$13,967	$0	$0	$13,967	$11,362
7	2024	0.786	$14,402	$0	$0	$14,402	$11,320
8	2025	0.759	$14,837	$0	$0	$14,837	$11,268
9	2026	0.734	$15,273	$0	$0	$15,273	$11,206
10	2027	0.709	$10,075	$168,484	$25,000	$203,559	$144,306

The total equivalent annual damage for the fifty-year period of analysis under the USACE Low, Intermediate, and High SLC scenarios is $18.2M, $22.6M, and $40.2M, respectively.

5.2 WITH-PROJECT RESULTS

5.2.1 DAMAGES REDUCED

The with-project economic analysis was conducted by inputting levees of various heights into the HEC-FDA models. As tables further below show, a non-structural plan was also analyzed.

For all plans involving levee construction, an assumption was made that no relocations would occur, and that for levee heights above the elevation of the water pollution control plant no ring levee would be constructed. Table 26 below shows the first eleven years (for comparison's sake with the without-project results) of the with-project analysis for a 12' levee height.

Table 26: Example of With-Project Total EAD Calculation – 12' Levee, USACE Intermediate SLC Scenario (1,000s)

Year of Project	Year	Present Value Factor	EAD From FDA Model	Relocation Cost	Ring Levee Construction	Total	Present Value
0	2017	1.000	$33	$0	$0	$33	$33
1	2018	0.966	$37	$0	$0	$37	$36
2	2019	0.934	$41	$0	$0	$41	$38
3	2020	0.902	$45	$0	$0	$45	$40
4	2021	0.871	$49	$0	$0	$49	$42
5	2022	0.842	$53	$0	$0	$53	$44
6	2023	0.814	$56	$0	$0	$56	$46
7	2024	0.786	$60	$0	$0	$60	$47
8	2025	0.759	$64	$0	$0	$64	$49
9	2026	0.734	$68	$0	$0	$68	$50
10	2027	0.709	$72	$0	$0	$72	$51

5.2.2 BENEFIT TO COST RATIO, NET BENEFITS, & RESIDUAL RISK

Table 27, Table 28, and Table 29 below show the results for each levee height under each of the three USACE SLC scenarios. As the results tables show, a levee project is economically justified under any of the three SLC scenarios. A 12.5' levee is the height with the greatest net benefits under the USACE Low and Intermediate scenarios, and a 13.5' levee is the greatest net benefit plan under the USACE High SLC scenario. The small difference in net benefits between many of the levee heights is in large part a reflection of the small difference in the construction cost. The non-structural plan, which involves the relocation of several hundred homes and businesses, while highly effective at reducing flood damage is the least efficient option, consistently having the lowest benefit to cost ratio for all of the options.

Table 27: With-Project Results – USACE Low SLC Scenario

Without-Project Equivalent Annual Flood Damage (1,000s)										
Structure & Content Damage	$11,478									
Relocation Cost	$6,691									
Total	$18,170									
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)										
	No Action	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$18,170	$2,418	$1,123	$84	$17	$0	$0	$0	$0	$0
Annual Damages Reduced	$0	$15,752	$17,047	$18,086	$18,153	$18,170	$18,170	$18,170	$18,170	$18,170
Project Costs (1,000s)										
Project First Cost	$0	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
Interest During Construction	$0	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results										
Annual Net Benefits	**$0**	**$12,758**	**$13,982**	**$14,951**	**$14,966**	**$14,931**	**$14,846**	**$14,761**	**$14,577**	**$65**
Benefit-to-Cost Ratio	**N/A**	**5.26**	**5.56**	**5.77**	**5.70**	**5.61**	**5.47**	**5.33**	**5.06**	**1.00**

Table 28: With-Project Results - USACE Intermediate SLC Scenario

Without-Project Equivalent Annual Flood Damage (1,000s)										
Structure & Content Damage	$15,391									
Relocation Cost	$7,153									
Total	$22,545									
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)										
	No Action	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$22,545	$3,894	$1,534	$131	$21	$1	$0	$0	$0	$0
Annual Damages Reduced	$0	$18,650	$21,011	$22,414	$22,524	$22,544	$22,545	$22,545	$22,545	$22,545
Project Costs (1,000s)										
Project Cost	$0	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
Interest During Construction	$0	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results										
Annual Net Benefits	$0	$15,656	$17,946	$19,278	$19,337	$19,305	$19,221	$19,136	$18,952	$4,440
Benefit-to-Cost Ratio	N/A	6.23	6.86	7.15	7.07	6.96	6.78	6.61	6.28	1.25

Table 29: With-Project Results - USACE High SLC Scenario

Without-Project Equivalent Annual Flood Damage (1,000s)												
Structure & Content Damage	$31,902											
Relocation Cost	$8,293											
Total	$40,195											
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)												
	No Action	10' Levee	10.5' Levee	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$40,195	$72,421	$49,111	$29,154	$14,490	$5,071	$1,575	$419	$92	$16	$0	$0
Annual Damages Reduced	$0	-$32,226	-$8,916	$11,040	$25,704	$35,123	$38,619	$39,776	$40,103	$40,178	$40,195	$40,195
Project Costs (1,000s)												
Project Cost	$0	$55,036	$56,611	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
IDC	$0	$2,857	$2,939	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,942	$0
Total Investment Costs	$0	$57,893	$59,550	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,478	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,466	$2,537	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,215	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,853	$2,924	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,602	$18,105
Results												
Annual Net Benefits	$0	-$35,079	-$11,840	$8,046	$22,639	$31,988	$35,432	$36,537	$36,779	$36,770	$36,592	$22,090
Benefit-to-Cost Ratio	N/A	-11.29	-3.05	3.69	8.39	11.20	12.12	12.28	12.07	11.79	11.16	2.22

5.2.3 WITH-PROJECT PERFORMANCE STATISTICS

When engineered levees are assumed not to fail before overtopping as they were for this analysis (no geotechnical failure function entered into HEC-FDA), the HEC-FDA program uses the top of levee elevation as the performance criteria. Table 30 below shows the performance statistics for the two levee heights that have been identified as having the greatest net benefits under the various SLC scenarios – 12.5' under the USACE Low and Intermediate scenarios, and 13.5' under the USACE High scenario. The annual exceedance probability (AEP) is the likelihood that the levee will be overtopped, the long-term risk is the risk of overtopping over some defined period of time for a particular water surface profile, and the conditional non-exceedance Probability (CNP, also referred to as "assurance") is the likelihood that the levee would contain a particular exceedance probability event. As an example, Table 30 reports

that with a 12.5 ft levee under the USACE Low SLC scenario, the likelihood of overtopping is extremely low. There is just a 2.6% chance over a period of thirty years that the levee would be overtopped once, and the levee has a 99.9% chance of containing the 1% ACE event at the end of the period of analysis. The primary difference in performance statistics can be seen under the USACE High SLC scenario. Table 30 shows that the 13.5 ft levee has substantially lower residual risk by the end of the period of analysis under this scenario than the 12.5 ft levee. For example, the 12.5 ft levee has an AEP of 8.5%, while the 13.5 ft levee has an AEP of only 0.5%. Similarly, the CNP for the 1% ACE event is less than 1% for the 12.5 ft levee, but over 88% for the 13.5ft levee. Since under any of the scenarios sea level is expected to continue rising beyond 2067, these results should be viewed as a single snapshot in time of the risk and not a permanent reality.

Table 30: Project Performance Statistics - 12.5 ft and 13.5 ft Levee, USACE Low, Intermediate, and High SLC Scenario, 2067

SLC Scenario	FRM Option	Mean Annual Exceedence Probability	Long-Term Risk (30 Years)	Conditional Non-Exceedence Probability by Event			
				10%	2%	1%	0.20%
Low	No Action	39.5%	99.9%	36.9%	24.7%	16.2%	3.9%
	12.5' Levee	0.08%	2.6%	99.9%	99.9%	99.9%	94.9%
	13.5' Levee	0.02%	0.7%	99.9%	99.9%	99.9%	99.9%
Intermediate	No Action	53.2%	99.9%	29.6%	7.3%	5.4%	2.5%
	12.5' Levee	0.08%	2.0%	99.9%	99.9%	99.9%	92.6%
	13.5' Levee	0.02%	0.6%	99.9%	99.9%	99.9%	99.9%
High	No Action	94.9%	99.9%	0.3%	<.01%	<.01%	<.01%
	12.5' Levee	8.51%	93.0%	66.7%	3.2%	0.7%	0.0%
	13.5' Levee	0.48%	13.4%	99.9%	98.3%	88.2%	33.5%

5.2.4 SENSITIVITY ANALYSIS – ECONOMIC JUSTIFICATION & LEVEE FAILURE PROBABILITY

As the previous sections show, there is strong economic justification for the construction of a levee to reduce the risk of flooding in the study area. The strong justification is in large part the result of the finding that there is currently a high annual likelihood of flooding in the study area. The most uncertain of the inputs to the estimation of the likelihood of flooding in the study area is the likelihood of failure of the outer dike, which is incorporated in the HEC-FDA model as the without-project levee failure function. Because of the uncertainty associated with the likelihood of outer dike failure, an obvious sensitivity analysis that can be performed is to determine how changes to the levee failure function affect project economic justification. The uncertainty in the levee failure function is greater at the lower elevations, and so for this sensitivity analysis an adjustment was made to the probability of failure near the bottom of the levee – between 7' and 10'. The probability of failure was set to zero between above 7' and below 10'. At and above 10' the probability of failure was unchanged from the expected value curve as described previously. Altering the failure curve at the lower elevation to this degree is simply an adjustment that was made for purposes of understanding the sensitivity of the economic justification to the changes in the failure curve; the adjusted curve is not an alternative to what the USACE engineers consider is the most likely relationship between water elevation and probability of failure. The two curves are shown in Figure 36 below for comparative purposes.

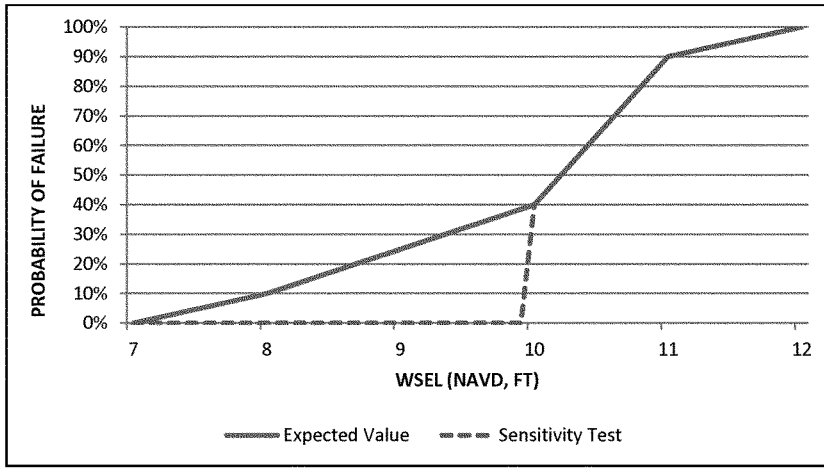

Figure 36: Levee Failure Function Comparison – Economic Justification Sensitivity Test

For the sensitivity analysis, the without-project HEC-FDA models for the USACE Low SLC scenario were altered to include the adjusted levee failure function. As a result of the significant decrease in the risk of flooding, the sensitivity analysis assumed no relocations would occur. The tables below show the results of this sensitivity analysis.

As Table 31 below shows, the change to the failure function reduces the annual likelihood of damage from 32% (see Table 4) at 2017 to 7%. However, an AEP of 7% is still significant and would almost certainly lead to failure over the fifty-year period of analysis.

Table 31: Without-Project Performance with Adjusted Failure Function

	Target Stage Annual Exceedance Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Target Stage	Median	Expected	10	30	50	10%	4%	2%	1%	.4%	.2%
levee	0.0689	0.0727	0.5298	0.8960	0.9770	0.6618	0.3999	0.3567	0.2929	0.1939	0.1311

Table 32: Sensitivity Test Results - Economic Justification

Without-Project Equivalent Annual Flood Damage (1,000s)											
Structure & Content Damage	$8,688										
Relocation Cost	$756										
Total	$9,443										
With-Project Equivalent Annual Damages & Damages Reduced (1,000s)											
	No Action	10.5' Levee	11' Levee	11.5' Levee	12' Levee	12.5' Levee	13' Levee	13.5' Levee	14' Levee	15' Levee	Non-Structural
With-Project Avg Annual Flood Damage	$9,443	$6,244	$2,418	$1,123	$84	$17	$6	$3	$1	$0	$0
Annual Damages Reduced	$0	$3,199	$7,026	$8,320	$9,359	$9,427	$9,438	$9,441	$9,442	$9,443	$9,443
Project Costs (1,000s)											
Project Cost	$0	$56,611	$58,186	$59,761	$61,336	$62,486	$63,636	$65,536	$67,436	$71,536	$425,000
IDC	$0	$2,939	$3,021	$3,102	$3,184	$3,244	$3,304	$3,402	$3,501	$3,714	$0
Total Investment Costs	$0	$59,550	$61,207	$62,863	$64,520	$65,730	$66,940	$68,938	$70,937	$75,250	$425,000
Capital Recovery Factor (CRF)	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426	0.0426
Average Annual Costs	$0	$2,537	$2,607	$2,678	$2,749	$2,800	$2,852	$2,937	$3,022	$3,206	$18,105
Annual O&M Costs	$0	$387	$387	$387	$387	$387	$387	$387	$387	$387	$0
Total Average Annual Costs	$0	$2,924	$2,994	$3,065	$3,136	$3,187	$3,239	$3,324	$3,409	$3,593	$18,105
Results											
Annual Net Benefits	**$0**	**$275**	**$4,031**	**$5,255**	**$6,224**	$6,240	**$6,199**	**$6,117**	**$6,033**	**$5,851**	**-$8,662**
Benefit-to-Cost Ratio	**N/A**	**1.09**	**2.35**	**2.71**	**2.98**	2.96	**2.91**	**2.84**	**2.77**	**2.63**	**0.52**

As Table 32 above shows, the without-project damages decreased by 50% compared to the damages under the USACE Low SLC scenario when using the expected probabilities for outer dike failure. However, as the results table shows, even under the USACE Low SLC scenario, the levee project is still economically justified with the adjusted failure function. Including some consideration of structure relocations would not materially change the results because of the offsetting effects of repeated flood damages or high relocation cost. These results reflect a lower bound as far as economic justification with a modification to the levee failure function, since they are based upon the low SLC scenario. Since without project damages and with project benefits are higher under the intermediate and high SLC scenarios, conducting this same sensitivity analysis on those scenarios would yield higher net benefits and benefit/cost ratios than those shown in the table above.

6.0 SUMMARY

The existing pond-dike system fronting the community of Alviso, while not composed of engineered structures, has incidentally provided a measure of coastal flood risk reduction to the area. Initial analyses performed for the SSFBS study indicated a Federal interest for coastal flood risk reduction largely based on the USACE High SLC scenario; however, additional work was deemed necessary to demonstrate Federal interest under all three SLC scenarios that must be analyzed in USACE studies. In order to comply with EC 1165-2-212 (USACE, 2011) and ER 1100-2-8162 (USACE, 2013a) Federal interest, as determined solely by NED outputs, was also demonstrated for the USACE Low and Intermediate SLC scenarios in subsequent analyses (summarized in this report). The current flood risk analysis is policy compliant and provides results useful for the SSFBS study that can be incorporated into the Integrated Interim Feasibility Study and Environmental Impact Statement/Report. Without-project analysis results indicate that there currently is a high probability of failure of the existing dike-pond system, and that the risk increases over time with a rise in relative sea level. In 2017 the annual chance of a damaging flood event is estimated to be 32%, and by 2067 the annual chance is estimated to be as high as 53% for the USACE Intermediate SLC scenario. The with-project results for the three USACE SLC scenarios show positive net benefits under each scenario, ranging from approximately $15 million to $37 million in annual net benefits. All structural projects considered have strong economic justification under each of the three SLC scenarios considered (the benefit to cost ratios range from approximately 4 to 12). The optimum levee heights based on annual net benefits for the three SLC scenarios are 12.5 feet under the USACE Low and Intermediate SLC scenarios, and 13.5 feet under the USACE High SLC scenario.

The current probability of exceeding the existing the dike-pond system's capacity to alleviate flood risk (as described above) may seem high given the fact that there have been no historical coastal flood events in the study area. Given the water elevations in the bay near the existing outboard dike, and given the low elevation of the community of Alviso and surrounding area, it is clear that the dike-pond system has been providing the community of Alviso with some level of coastal flood risk reduction. The San Francisco District believes that the updated Coastal Engineering and Geotechnical Engineering analyses presented in this report have made reasonable assumptions and changes from previous analyses conducted under the SSFBS study. These changes include the use of extreme water level statistics from the DTM for the Coyote Creek gage, uncertainty estimate for the extreme water level statistics, interior-exterior relationship for the outboard and inboard dikes, outboard dike failure mechanisms, levee fragility curve, and inboard dike performance. Perhaps the most significant of the changed assumptions is for the inner dike, where in the initial analysis reported at the USACE Alternative Formulation Briefing milestone for this study it was assumed that the inner dike would not breach, but only be overtopped. The current analysis assumes the inner dike will breach due to overtopping. These assumptions and changes are based on USACE policy, accepted standard practices, and best engineering judgment and represent the best estimates for these parameters. A sensitivity analysis on the dike fragility curve indicates that positive net benefits are still obtained even under more stout assumptions about dike performance.

In conclusion, the flood risk analysis presented in this report meets USACE policy, follows accepted practices, and represent reasonable best estimates. These results, combined with results from other analyses and criteria, can be used to determine Federal interest, evaluate plans, and select a recommended plan. The project delivery team has moved forward with the existing analysis and has acknowledged the risks that remain in communicating flood risk via the flood damage analysis for the existing without and FWOP condition. The reduced level of confidence in the reported AEP can be attributed to multiple factors that define the complexity of the dike-pond system and floodplain in the study area. While an AEP of 32% may appear to substantially overstate the flood risk for the study period, there is reason to believe that existing flood risk to the Alviso economic impact area is fundamentally different than what past performance would otherwise indicate.

7.0 REFERENCES

Deering. (2014). Personal communication.

FEMA. (2005). Full Data Module for Benefit-Cost Analysis of Riverine Hazard Mitigation Projects, Mitigation BCA Toolkit CD, Version 2.0, January 2005'.

Flick, R. E. (2000). Time-of-day of peak tides in a mixed-tide regime. *Shore & Beach*, 15-17.

Geomatrix. (2006). *South Bay Salt Pond Restoration Project Levee Assessment.* Oakland, CA: Geomatrix.

Henderson, F. M. (1966). *Open channel flow.* New York, NY: MacMillian Publishing Comoany.

Knuuti, K. (1995). *Extreme tide prediction for San Francisco Bay.* Berkeley, CA: University of California.

MacWilliams, M., Kilham, N. E., & Bever, A. J. (2012). *South San Francisco Bay Shoreline Study, South San Francisco Bay Long Wave Modeling Draft Report.* San Francisco, CA: Delta Modeling Associates.

NRC. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future.* Washington, DC: National Research Council, The National Acadamies Press.

PWA. (2007). *South Bay Salt Pond Restoration Project Flood Analyses Report.* San Francisco, CA: Phillip Williams and Associates.

USACE. (1984). *Tidal Stage versus Frequency Study.* San Francisco, CA: San Francisco District.

USACE. (1997). *Life Cycle Design and Performance, ER 1110-2-8159.* Washington, DC: Headquarters.

USACE. (2008). *Erosion-induced Breaching: Reliability Assessment of San Francisco South Bay Salt Pond Levee.* Geotechnical and Structures Laboratory.

USACE. (2009a). *Appendix C: Geotechnical Investigation and Analysis South San Francisco Bay Shoreline Study F3 Milestone Without Project.* San Francisco, CA: San Francisco District.

USACE. (2009b). *Reliability Assessment of San Francisco South Bay Salt Pond Inboard Levees.* Vicksburg, MS: Geotechnical and Structures Laboratory.

USACE. (2010). *Standards and Procedures for Referencing Project Evaluation Grades to Nationwide Vertical Datums, EM 1110-2-6056.* Washington, DC: Headquarters.

USACE. (2011). *SEA-LEVEL CHANGE CONSIDERATIONS FOR CIVIL WORKS PROGRAMS, EC 1165-2-212.* Washington, DC: Headquarters.

USACE. (2013a). *INCORPORATING SEA LEVEL CHANGE IN CIVIL WORKS PROGRAMS, ER 1100-2-8162.* Washington, DC: Headquarters.

USACE. (2013b). *Geotechnical Appendix to South San Francisco Bay Shoreline Study Alternative Formulation Briefing.* San Francisco, CA: San Francisco District.

USACE. (2014). Memorandum for Record: South San Francisco Bay Shoreline Study Supplemental Analyses on Sea Level Change and flood risk associated with US Fish & Wildlife Service's (FWS) Refuge Lands, dated 12 Mar 2014. San Francisco, CA: San Francisco District.

USACE. (2014a). *Geotechnical field assessment of the San Francisco South Bay dike system.* Richard Olsen.

Walters, R. A., Cheng, R. T., & Conomos, T. J. (1985). Time scales of circulation and mixing processes of San Francisco Bay waters. *Hydrobiologia*, 13-36.

Zervas, C. (2009). *Sea Level Variations of the United States 1854–2006, NOAA Technical Report NOS CO-OPS 053.* Silver Spring, MD: NOAA.

Zervas, C. E. (2005). Response of Extreme Storm Tide Levels. *Oceans, Proceedings of the MTS/IEEE* (pp. 2501-2506). Wasnington DC: MTS/IEEE.

Zervas, C., & Sweet, W. (2014). Calculation of Exceedance Probability Statistics Using NOAA's Historical Water Levels . New York City : USACE Workshop on Extreme Water Levels .

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Appendix E

Civil Design and Cost Engineering

September 2015
(revised December 2015)

Appendix E1

Civil Design

Civil Design Appendix

South San Francisco Bay Shoreline Study

U.S. Army Corps of Engineers, San Francisco District

September 2015

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Existing Utilities Information Technical Memorandum

1.0 General

1.1 Purpose

This civil design report is a technical appendix to the South San Francisco Bay Shoreline Study (Shoreline Study) and was developed by HDR and the USACE San Francisco District. The purpose of this Civil Design Appendix is to provide additional information regarding the technical aspects of engineering elements. These technical details presented pertain to the construction of the new or improved levees that protect the community of Alviso, CA as authorized by the Committee on Transportation and Infrastructure of the U.S. House of Representatives on July 24, 2002 (Docket 2697). The purpose of this study is to determine the feasibility and the Federal interest of a combined tidal Flood Risk Management (FRM) and Ecosystem Restoration (ER) project.

1.2 Authority

The Shoreline Study is being prepared in response to the resolution adopted by the Committee on Transportation and Infrastructure of the U.S. House of Representatives on July 24, 2002, for the South San Francisco Bay Shoreline Study (Shoreline Study), California (Docket 2697), which reads as follows:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the Final Letter Report for the San Francisco Bay Shoreline Study, California, dated July 1992, and all related interims and other pertinent reports to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of tidal and fluvial flood damage reduction, environmental restoration and protection and related purposes along the South San Francisco Bay shoreline for the counties of San Mateo, Santa Clara and Alameda, California."*

1.3 Background

The Shoreline Study was originally authorized by Congress in 1976 to assess the need for flood risk management in the San Francisco South Bay (South Bay). A subsequent flood control study, issued in 1992 by the U.S Army Corps of Engineers (Corps), found that a Federal flood management project along the South Bay shoreline was not economically justifiable mainly because it was determined that Cargill Salt would continue to maintain their existing salt pond levees due to their economic interest in keeping ocean and river water from diluting the brines of its salt-making operations. These salt pond levees were not engineering levees; however, they provided incidental flood risk management for the surrounding communities.

In 2003, the Federal and state governments began planning a restoration project when they acquired 15,100 acres of salt ponds from Cargill Salt in the South Bay. The planned restoration project would affect the utility of the salt pond levees as flood protection structures. As a result, the U.S. House of Representatives requested that the Corps review its previous study on

flood management along the South Bay shoreline as well as to include environmental restoration and protection, and tidal and fluvial flood risk management.

The Corps completed an initial reconnaissance analysis in September 2004, which determined that due to the current and future anticipated conditions in the South Bay, it was likely that a Federal flood risk management and ecosystem restoration project would be justified. On October 24, 2005, the Corps, the U.S. Fish and Wildlife Service (FWS), the Santa Clara Valley Water District (SCVWD) and the California State Coastal Conservancy (Conservancy) kicked off the first study phase of the Shoreline Study. This first phase covers the southern portion of the South Bay, including the Alviso Ponds and other lands and waters stretching from southwest Fremont to Palo Alto.

1.4 Study Area and Existing Conditions

The Shoreline Study (**Figure 1 - Study Area**) encompasses shoreline and floodplain areas, three groups of former salt production ponds, and other parcels that represent additional opportunities for flood risk management and/or ecosystem restoration benefits along the South Bay in Northern California. The Shoreline Study area extends from the Ravenswood Ponds in San Mateo and State Route (SR) 92 in the city of Hayward south along both sides of the bay to its southern end, and includes adjacent areas that may be flooded by the bay and/or that may offer opportunities for restoration of tidal and related habitats.

The study area for this phase of the project is located near the town of Alviso in San Jose, CA and adjacent to the San Jose – Santa Clara Water Pollution Control Plant (WPCP). There are three significant streams in the area, Alviso Slough, which is to the West of Alviso; Coyote Bypass, which is north of the water treatment plant; and Artesian Slough, which flows out of the water treatment plant. Alviso is surrounded by the New Chicago Marsh, and Ponds A12, A13 and A16. Pond A18 is to the northwest of the water treatment plant.

The foundation soils in the study area consist primarily of Bay Mud. Bay Mud is normally consolidated and typically very weak clayey/silty soil. The Bay Mud is approximately 5 to 40 feet thick in the project area and contains occasional inclusions of organics in the upper 10 feet of the soil profile.

Near Artesian Slough is the Don Edwards Education Center which must be taken into consideration during the analysis. Also on the project site is the Union Pacific Rail Road running in a North-South direction on the west side of Alviso, and the Zanker Landfill to the southern portion of Artesian Slough.

2.0 Alternative Selection and Project Development

2.1 Flood Risk Management Options

Several Flood Risk Management (FRM) options were formulated to provide an array of flood management options at differing levels of protection (LOP) across several potential alignments.

The purpose of this array was to provide a wide range of options that would allow for estimating quantities, costs, and benefits at each alignment at each LOP. This array was used to evaluate and compare options to determine the National Economic Development (NED) Plan and the Locally Preferred Plan (LPP). Each of these FRM options involves the construction of new, engineered levees.

2.1.1 Levee Design Considerations

Where levees will be constructed in place of existing salt pond dikes, the existing dikes and an inspection trench will be excavated before new fill is placed. Based on geotechnical requirements (Appendix O), the built to elevation will be the design top of fill plus an allowance for foundation settlement. In areas where the height of fill exceeds the allowable placement, wick drains will be installed prior to levee fill placement. Geotechnical data also indicates the existing dikes are underlain with bay mud ranging from 0 to 25 feet deep.

The new and reconstructed levees have been designed with a 3:1 grade on both the waterside and landside slope. Based on geotechnical requirements (Appendix O), the new and reconstructed levee crowns will be 16 feet wide. The crown will slope 2% from the centerline. There will be a 12-foot wide access road along the top of the levee to accommodate non-Federal sponsor requirements for inspection. A 12-foot wide access road provides an 8-foot width trafficable surface for operations and maintenance traffic, and includes 2-foot wide shoulders. The top of levee design elevation is set to the crown hinge point. In areas where the new levee coincides with roadways, the levee crown width will be increased to conform existing grades and turns. Additionally, levee surfacing will match the existing surface as necessary.

2.1.2 Alignments

For the purpose of developing alignments for the project, the project was split into an Alviso side, and a San Jose / Santa Clara Water Pollution Control Plant (WPCP) side, separated by Artesian Slough in the middle. A series of levee alignments were devised for either side, each of which provided different benefits and drawbacks. A total of 3 alignments were developed for the Alviso side and 2 alignments were developed for the WPCP side.

2.1.2.1 Alviso Alignments

Three alignments were developed for the Alviso side of the project. They are as listed below:

- Alviso North: This alignment involves the removal and reconstruction of levees from existing high ground to the west of Alviso along the existing dikes bordering ponds A12, 13, and 16. This alignment ties into the closure structure at Artesian Slough just north of the Don Edwards Center. The total length of this alignment is approximately 9,600 feet.
- Alviso Railroad: This involves the removal and construction of levees from existing high ground to the west of Alviso along the existing dikes bordering pond A12 and then

east along the existing Union Pacific Rail Road (UPRR) line to Grand Blvd. The alignment follows Grand Blvd to the Artesian Slough dikes and continues to just north of the Don Edwards Center to tie into the closure structure at Artesian Slough. The total length of this alignment is approximately 12,600 feet.

- Alviso South: This alignment involves the removal and construction new levees from existing high ground West of Alviso south through the town of Alviso. The alignment follows the outer boundary of Alviso, then follows Grand Blvd to the East and ties into a proposed closure structure just north of the Don Edwards Center. Portions of Grand Blvd will be raised and widened to accommodate levee construction. The total length of this alignment is approximately 14,200 feet.

2.1.2.2 WPCP Alignments

Two alignments were developed for the WPCP side of the project. They are as listed below:

- WPCP North: This alignment involves the construction of new levees from the closure on the west side of Artesian Slough through Pond A18 similar to that found in the San Jose – Santa Clara WPCP Master Plan. The levees will tie into the existing levees along Coyote Creek to the north side of the project. The total length of this alignment is approximately 10,200 feet.
- WPCP South: This alignment involves the removal and construction of new levees from the closure on the west side of Artesian Slough along the southern border of Pond A18 along the existing dikes adjacent to the WPCP. The levees will tie into the existing levees along Coyote Creek to the north side of the project. The total length of this alignment is approximately 10,100 feet.

2.1.3 Artesian Slough Closures

Two options were developed for providing tidal flood risk management around Artesian Slough. These are described below:

- Levees: The first option for tidal flood risk management consists of constructing levees from just north of the Don Edwards Center to tie into existing high ground at the nearby landfill. The levees would then be constructed from the south portion of Artesian Slough north to tie into the WPCP alignment.
- Tide gate: The other option for tidal flood risk management consists of constructing a tide gate across Artesian Slough connecting the levees on the Alviso and WPCP alignments.

2.1.4 Levels of Protection

Four different LOPs were analyzed for potential flood risk management. The 25-, 50-, 100-, and 200-year LOPs were considered, which correlate to the 4%, 2%, 1%, and 0.5% Annual Chance of Exceedance (ACE) respectively. Design top of levee elevations were based on hydraulic model results performed to estimate water surface elevations.

2.1.5 FRM Final Array

An initial array of options made from combinations of the alignments, LOPs, and Artesian Slough closures was made that provides a comparison between the different combinations of the three. Quantities, estimates and benefits were developed for the seven initial options. These seven initial options were used to extrapolate estimates for four new options that were used for the analysis of determining the LPP and the NED Plan. The four new options were developed based on analyses of the initial seven options, along with non-Federal sponsor input, and together with the initial seven options formed the final array of 11 FRM options. A detailed description and figures showing the final array of FRM options is shown in Chapter 3.

Table 1. Summary of Final Array of FRM Options

Option	Level of Protection (-year)	Alviso Alignment	WPCP Alignment	Alviso Slough Closure	Approximate Total Length At Analysis (ft.)	Estimated Cost ($)
1A	200	North	North	Tide Gate	19,855	70,364,798
1B	100	North	North	Tide Gate	19,855	70,357,212
1C	50	North	North	Levees	24,606	81,566,366
1D	25	North	North	Tide Gate	19,855	65,403,971
2 (LPP)	100	North	South	Tide Gate	19,929	73,459,432
3	200	RR	North	Tide Gate	22,786	74,269,014
4	50	South	South	Tide Gate	24,675	82,894,824
5	100	RR	South	Tide Gate	22,400	78,284,646
6	100	South	South	Tide Gate	24,675	86,150,430
7 (NED)	25	North	South	Tide Gate	19,929	68,287,791
8	200	North	South	Tide Gate	19,929	73,467,353

2.1.6 FRM Option 1A – Alviso North and WPCP North, 200-year event

Option 1A (**Figure 2 – FRM Option 1A**) involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate through pond A18, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. These levees will follow the alignment defined in the WPCP Master Plan. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 16.27 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 200-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep bay mud in one phase rather than 2 or 3 over the course of several years, approximately 2,600,364 linear feet of wick drains will be necessary.

2.1.7 FRM Option 1B – Alviso North and WPCP North, 100-year event

Option 1B (**Figure 3 – FRM Option 1B**) involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate through pond A18, tying into the Coyote Creek Bypass northeast of the WCPC sludge ponds. These levees will follow the alignment defined in the WPCP Master Plan. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 15.85 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 100-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,618,822 linear feet of wick drains will be necessary.

2.1.8 FRM Option 1C – Alviso North and WPCP North with no Tide Gate, 50-year event

Option 1C (**Figure 4 – FRM Option 1C**) involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will continue upstream on both banks of Artesian Slough to daylight at design grade.

New levees will be constructed from levee on Artesian Slough through pond A18, tying into the Coyote Creek Bypass northeast of the WCPC sludge ponds. These levees will follow the alignment defined in the WPCP Master Plan. The levees and closure structure at the UPRR will be construction to an elevation of 15.41 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16' for the entire length as well as 3:1 side slopes and would provide a 50-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,791,029 linear feet of wick drains will be necessary.

2.1.9 FRM Option 1D – Alviso North and WPCP North, 25-year event

Option 1D (**Figure 5 – FRM Option 1D**) involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate through pond A18, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. These levees will follow the alignment defined in the WPCP Master Plan. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 14.96 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 25-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,531,963 linear feet of wick drains will be necessary.

2.1.10 FRM Option 2 – Alviso North and WPCP South, 100 year event

Option 2 (**Figure 6 – FRM Option 2**) involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 15.85 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 100-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,661,126 linear feet of wick drains will be necessary.

2.1.11 FRM Option 3 – Alviso RR and WPCP North, 200-year event

Option 3 **(Figure 7 – FRM Option 3)** involves the construction of new levees from existing high ground West of Alviso along the existing dikes bordering pond A12, and east along the existing UPRR line to Grand Blvd. The levees will follow Grand Blvd to the Artesian Slough levees and go north around the outside of the Don Edwards Center and there tie into a new tide gate.

New levees will be constructed from the tide gate through pond A18, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. These levees will follow the alignment defined in the WPCP Master Plan. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 16.27 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 200-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,185,656 linear feet of wick drains will be necessary.

2.1.12 FRM Option 4 – Alviso South and WPCP South, 50-year event

Option 4 **(Figure 8 – FRM Option 4)** involves the construction of levees from existing high ground West of Alviso south to the town of Alviso. The new levee alignment will follow the outer boundary of Alviso, go along Grand Blvd to the East and tie into a new tide gate north of the don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 15.41 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 50-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, approximately 2,026,280 linear feet of wick drains will be necessary.

2.1.13 FRM Option 5 – Alviso RR and WPCP South, 100-year event

Option 5 **(Figure 9 – FRM Option 5)** cost estimates were extrapolated based on the analyses of the initial seven options. No quantities were developed. This option involves the construction of new levees from existing high ground West of Alviso along the existing dikes bordering pond A12, and east along the existing UPRR line to Grand Blvd. The levees will follow Grand Blvd to the Artesian Slough levees and go north around the outside of the Don Edwards Center and there tie into a new tide gate.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 15.85 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 100-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, wick drains will be necessary.

2.1.14 FRM Option 6 – Alviso South and WPCP South, 100-year event

Option 6 **(Figure 10 – FRM Option 6)** cost estimates were extrapolated based on the analyses of the initial seven options. No quantities were developed. This option involves the construction of levees from existing high ground West of Alviso south to the town of Alviso. The new levee alignment will follow the outer boundary of Alviso, go along Grand Blvd to the East and tie into a new tide gate north of the don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and

closure structure at the UPRR will be construction to an elevation of 15.85 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 100-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, wick drains will be necessary.

2.1.15 FRM Option 7 – Alviso North and WPCP South, 25-year event

Option 7 (**Figure 11 – FRM Option 7**) cost estimates were extrapolated based on the analyses of the initial seven options. No quantities were developed. This option involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 14.96 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16' for the entire length as well as 3:1 side slopes and would provide a 25-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, wick drains will be necessary.

2.1.16 FRM Option 8 – Alviso North and WPCP South, 200-year event

Option 8 (**Figure 12 – FRM Option 8**) cost estimates were extrapolated based on the analyses of the initial seven options. No quantities were developed. This option involves the removal and reconstruction of levees from existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough.

New levees will be constructed from the tide gate along the existing pond A18 alignment, tying into the Coyote Creek Bypass northeast of the WPCP sludge ponds. The levees, tide gate, and closure structure at the UPRR will be construction to an elevation of 16.27 feet, plus allowances for settlement.

Due to the concerns regarding the structural integrity of the existing dikes, this option involves the replacement of the entire dike alignment. Additional geotechnical studies will be required to identify reach segments to determine how much existing dike material is suitable for re-use.

The new levee would have a crown width of 16 feet for the entire length as well as 3:1 side slopes and would provide a 200-year level of protection. Project geotechnical data indicates the existing dikes are underlain with Bay Mud, a highly compressible soil; therefore, a nominal foundation excavation plan is assumed. Also, to accommodate construction on deep Bay Mud in one phase rather than 2 or 3 over the course of several years, wick drains will be necessary.

2.2 Ecosystem Restoration Measures

A series of restoration measures were developed that include a combination of transitional habitat construction, tidal marsh restoration, and recreation mitigation. Transitional habitat construction and pond restoration features are summarized in the following section.

2.2.1 Transitional Habitat

Three levels of transitional habitat were considered: large-ecotone with 100:1 slopes, which would provide the most expansive habitat; medium-ecotone incorporating 30:1 slopes; and a 50-foot-wide bench to provide for minimal amount of refugia immediately following construction. These are further described in **Table 2 – Transitional-Upland Slope Design**.

Table 2. Transitional-Upland Slope Design

ER Option	Design
50 Foot Bench	3:1 (H:V) front slope of the levee with a 50-foot wide bench at elevation 9.0 feet NAVD88 forms the transitional zone.
Medium Ecotone	30:1 (H:V) slope for the transitional zone. The zone begins at the approximate upgraded flood-control levee crest and maintains a 30:1 slope from the levee crest to EL 5.0 feet NAVD88. It is assumed that the upper slope of the transitional zone would be planted and hydro-seeded with a native seed mix.
Large Ecotone	100:1 (H:V) slope for the transitional zone. The zone begins at the approximate upgraded flood-control levee crest and maintains a 100:1 slope from the levee crest to EL 5.0 feet NAVD88. It is assumed that the upper slope of the transitional zone would be planted and hydro-seeded with a native seed mix.

The 30:1 and 100:1 (H:V) slopes in the Medium and Large Ecotone options represent idealized slopes. During final design and construction, the slopes would include some variation both in plan view to create a more natural shoreline and along the slope to create benches and shallow depressions to form pannes at a variety of elevations. The intent is to create a nuanced feature within the overall idealized slope to create an upland transitional zone with complexity.

2.2.1.1 Phasing

The initial stage fill for the transitional habitat along Pond A12 would be constructed between 2019 and 2020 during the FRM levee construction period.

The transitional habitat along Pond A18 would initiated during the FRM levee construction period and completed between the years 2023 and 2025 as fill becomes available.

2.2.2 Tidal Marsh Restoration

2.2.2.1 Overview

All alternatives include modifications to existing salt ponds to allow tidal flow between adjacent sloughs and the existing ponds, and support both ecosystem restoration and FRM functions. These modifications are discussed below. **Figures 13A through 13C – Pond Restoration Measures** illustrate the locations of the pond restoration features by anticipated construction year.

2.2.2.2 Outboard Dike Breaches

Outboard pond dike breaches are excavations through the perimeter dikes that open the pond to tidal inundation from the adjacent tidal sloughs. Breaches through the outboard dike and excavation of pilot channels through the outboard marsh leading to these breach sites would be placed at major historic tidal channel locations. Breach size would be determined based on the hydrologic relationship between the tidal channel and marsh drainage area and on data from tidal channels in mature marshes throughout the bay (ESA PWA 2012). Breaches are sized to long-term equilibrium dimensions to balance between excavation costs, scour potential, and tidal drainage, consistent with Design Guidelines for Tidal Wetland Restoration in San Francisco Bay (PWA, 2004). Dimensions are adjusted to provide a cross-section with side slopes of 4:1 to 5:1 and a bottom width of approximately 10 feet. On the inboard side of the dike, the breach excavation would extend to the dike toe.

The breaches are expected to be undersized compared to restored tidal flows due to the larger tidal prism of the existing subsided ponds. Large tidal flows are expected to scour and enlarge the breaches until equilibrium between the tidal prism and channel dimensions is reached. Over time, the tidal prism would decrease as the pond fills in due to sedimentation and vegetation establishment. During final design, the breach cross-sectional area will be revised to size individual breaches based upon estimated drainage area at each individual breach.

Breach design details and construction years are described in **Table 3 – Outboard Dike Breach Cross-Sections** below.

Table 3. Outboard Dike Breach Cross-Sections

Watersheds	Number of Breaches	Drainage Area [ac]	Breach Invert Elevation [ft NAVD]	Breach Top Width (@ EL 7.5 feet) [ft]	Breach End Const. Year
Pond A9	2	454	-8.6	190	2026
Pond A10	2	228	-6.0	140	2026
Pond A12 (1)	1	246	-6.3	145	2021
Pond A12 (2)	1	265	-6.5	150	2021
Ponds A13-15	1	914	-11.6	260	2031
North A18	1	116	-3.9	100	2026
Central A18	1	221	-5.9	135	2026
Southwest A18	2	258	-6.4	145	2026
East A18	1	255	-6.4	145	2026

*Cross Sectional Area below EL 7.5 feet NAVD88

2.2.2.3 Internal Pond Berm Breaches, Raising and Possible Lowering

Internal pond berms would be breached to reconnect historic channels and restore the hydrologic connections to the innermost ponds in the project footprint. Breach excavations would be sized in a similar manner to those applied to the outboard levees and would extend beyond the berm into the remnant historic channel. Internal pond breach details are shown in **Table 4 – Internal Berm Breach Cross-Sections.** During final design, the breach cross-sectional area will be revised to size individual breaches based upon estimated drainage area at each individual breach.

Table 4. Internal Berm Breach Cross-Sections

Internal Berm Breach	Total Drainage Area [ac]	Breaches [#]	Average Drainage Area [ac]	Average Invert Elevation [ft NAVD]	Average Top Width* [ft]	Internal Breach End Const. Year
Pond A9/A14	92	2	46	-1.6	65	2031
Pond A12/11	n/a	1	n/a	-1.6	125	2021
Pond A10/A11	203	1	203	-5.6	140	2026
Ponds A13-15	647	11	59	-2.1	75	2031

*Top Width at EL 7.5 feet NAVD88
**Cross-sectional Area below elevation 7.5 feet NAVD88

Berms in adjacent ponds not yet breached will be temporarily raised to temporarily provide increased flood protection during pond construction. Assumed design sections for raised internal berms include a 10 to 15 feet wide crest at elevation 9.8 feet, with 2:1 to 3:1 side slopes. In the future, existing internal berms may also be lowered in some areas during the same excavation work to create wave-break berms to limit wave action, enhance sedimentation, and create vegetated marsh habitat on the berm crests in the short term while the ponds develop

from mudflat to vegetated marsh. No new berms are proposed. Details of internal berm raising and construction years are provided below in **Table 5 – Internal Berm Interim Raising.**

Table 5. Internal Berm Interim Raising

Internal Berm Raise	Length of Berm Raise [ft]	Crest Elevation [ft NAVD]	Internal Berm Raise End Construction Year
Pond A12 North & Northwest	4,590	9.8	2021
Pond A9 East	3,440	9.8	2026
Pond A11 North and East	4,900	9.8	2026

2.2.2.4 Borrow Ditch Blocks

Material excavated from the existing levees and berms will be used to construct ditch blocks, which would inhibit flow through existing borrow ditches, promote scour and flow through the remnant historic and starter channels, and provide pickle weed habitat. Ditch blocks would be located so that the borrow ditch on both sides of the block connect to a breach, also reducing the potential for fish stranding.

Ditch blocks are assumed to be trapezoidal in section with a top with of about 50 feet, crest at elevation 7.5 feet NAVD, and 5:1 or flatter side slopes. The ditch blocks would extend across the borrow ditch adjacent to the existing levee (generally at least 100 feet from the inboard levee crest). We assume that at least 26 ditch blocks would be constructed – one adjacent to each outboard levee and internal berm breach.

2.2.2.5 Pilot Channels

Pilot channels would be excavated through the outboard marsh to connect each outboard levee breach to the adjacent tidal slough. The new channels would be located at historic channel locations. Similar to the outboard breaches, pilot channels would be sized to the long-term channel depth and 60-80% of the long-term channel width, with the side slopes of approximately 3:1. The resulting channels are somewhat undersized to reduce the amount of excavation and are expected to naturally scour and enlarge. Marsh vegetation will be excavated to the root zone to reduce the resistance to pilot channel bank erosion.

The assumed cross-section dimensions and lengths for each pilot channel are presented in **Table 6 – Pilot Channel Cross-Section Dimensions and Lengths** below.

Table 6. Pilot Channel Cross-Section Dimensions and Lengths

Watersheds	Drainage Area [ac]	Pilot Channel Invert Elevation [ft NAVD]	Pilot Channel Top Width* [ft]	Pilot Channel Length** [ft]	Pilot Channel End Const. Year
Pond A9	454	-8.6	135	1,480	2026
Pond A9 (West)	N/a	-8.6	135	1480	2026
Pond A10	228	-6.0	100	265	2026
Pond A10 (West)	n/a	-6.0	100	300	2026

Watersheds	Drainage Area [ac]	Pilot Channel Invert Elevation [ft NAVD]	Pilot Channel Top Width* [ft]	Pilot Channel Length** [ft]	Pilot Channel End Const. Year
Pond A11	246	-6.3	100	155	2026
Pond A12	265	-6.5	105	575	2021
Ponds A13-15	914	-11.6	180	1,110	2031
North A18	116	-3.9	70	130	2026
Central A18	221	-5.9	95	175	2026
Southwest A18	258	-6.4	100	330	2026
East A18	255	-6.4	100	490	2026

* Top Width at EL 7.5 feet NAVD88
**Length assumes that 50 feet from outboard levee crest is excavated as part of the outboard levee breach

3.0 Locally Preferred Plan

3.1 Flood Risk Management Levees

The LPP involves the construction of FRM levees at a 100-year LOP (1% ACE) along with a medium fill ecotone built to a 30:1 slope in Pond A18 only. Pond restoration measures as detailed above are included in the LPP for Pond A18 only. The LPP is summarized in **Table 7 – Locally Preferred Plan Summary** and the following sections.

Table 7. Locally Preferred Plan Summary

Section	Station Range	Side Slopes (H:V)	Average Height (including settlement) (ft.)	Crown Width (ft.)	Wick Drains?	30:1 Ecotone?
Sec 1	0+00 to 43+80	3:1	16.7	16	No	Yes
Sec 2	43+80 to 65+00	3:1	16.7	16	No	No
Sec 3	65+00 to 94+75	3:1	19.7	16	Yes	No
Sec 4	94+75 to 150+00	3:1	19.7	16	Yes	Yes
Sec 5	150+00 to 197+75	3:1	15.4	16	No	Yes

3.1.1 Alignment

The Locally Preferred Plan includes an Alviso North, WPCP South alignment with a closure structure across Artesian Slough. On the Alviso side, levees would be constructed from STA 0+00 at existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough (reference drawings) at approximate STA 94+75. On the WPCP side, new levees will be constructed from the tide gate, along the existing dikes of Pond A18, and will tie into the existing levees at Coyote Creek north of the WPCP sludge ponds at STA 197+75 **(Sheets C-01 to C-54, LPP Plans, Profiles and Sections)**.

3.1.2 Design, Considerations, and Construction

The levee will be built to the elevations shown in **Table 7** to achieve a post-settlement design elevation of 15.2[1] feet. Fill quantities and resultant construction costs reflect an "overbuilt" cross-section. Settlement was estimated using Figure 3-1 of the Geotechnical Appendix. The thickness of Bay Mud transitions gradually along the levee alignment (< 1-foot / 100-linear feet) suggesting that regrading of the post-settlement levee cross-section will not be necessary. The levee side slopes will be 3H:1V and the crown will be 16 feet wide. A 12-foot wide levee crest access road will be constructed of 6-inch thick gravel. Turnarounds on each side of the railroad gate (STA 43+75) and one turnout at STA 155+00 will be constructed.

Construction activities include clearing and grubbing and stripping of work areas including the permanent and temporary construction easement. Hydroseeding is included for erosion protection along finished grades. Foundation preparation for the new levee will include degrading the existing levee to elevation 0 ft and excavating an inspection trench along the centerline of the levee. The inspection trench will be 4 feet deep with 1:1 side slopes and have a bottom width of 8 feet. All excavation is assumed to have a 50% fill suitable for re-use on the new levees. Excess cut would be stored onsite for the construction of the ecotone.

The deep Bay Mud will also require the use of wick drains during construction to hasten time to consolidate and increase strength of foundation soils. Wick drains will have 6-foot mid point spacing. Wick drains will extend approximately 5 feet beyond the levee crest and 5 feet deeper than the lower extent of the Bay Mud. Corrugated conduit will span horizontally across the levee footprint and be attached to each wick drain to drain the water. Wick drains will be required from approximately STA 65+00 to 94+75. The design basis for requiring wick drains is related to the thickness of Bay Mud (i.e. > 10 feet) and the height of new fill (i.e. > 10 feet) being constructed (Geotechnical Appendix).

Erosion protection for the new levee will be provided by vegetation on the water and landside slopes. Flood water surface elevations are relatively static in the project area due to existing topographic features and prevailing wind direction. Therefore, vegetation alone was judged sufficient for providing erosion protection. In addition to the vegetation, ecotone fill (STA 0+00 to 43+80 and STA 94+75 to 197+75) provides a substantial buffer between erosive forces and the levee prism for the full design height. Existing berms and islands serve to dissipate wave energy in the managed pond adjacent to the levee from STA 43+80 to 94+75.

3.2 Closure Structures

3.2.1 Railroad Closure – Flood Gate

The railroad structure at STA 43+75 would be a mitre leaf swing gate measuring approximately 50 feet x 12 feet and constructed to an elevation of 16 feet. The structure would be supported

[1] Following development of the final array of alternatives, determination of the design water surface (and top of levee) was refined and revised. The 100-year LOP levee elevations for the LPP are therefore different than the 100-year elevations of the final array.

on a concrete pile deep foundation system to transfer loads through the soft Bay Mud strata to stiff foundation soils. A concrete cutoff will be installed beneath the gate to prevent through seepage in the railroad bed beneath the gate. The cutoff will extend 5 feet below the bottom of each gate leaf. The selected closure would be operated manually and coordinated with local authorities and the railroad in anticipation of a flood. Manual operation minimizes the risk of mis-operation on an active railroad at the risk of not being closed during a tidal flood event. Not closing the gate would result in limited flooding but would not induce additional failure modes along other FRM features.

3.2.2 Artesian Slough Closure – Tide Gate

The Artesian Slough closure at STA 94+75 would consist of a concrete headwall measuring approximately 100 feet x 20 feet and constructed to an elevation of 16 feet. The structure would include two 72-inch discharge pipes to release flow from Artesian Slough. The pipes will include gates capable of both allowing normal tidal exchange to, and preventing flood water from entering into, the slough. The structure would be supported on a concrete pile deep foundation system to transfer loads through the soft Bay Mud strata to stiff foundation soils. The selected closure would be operated passively and/or automatically to minimize disruptions to normal tidal fluctuations and ensure closure occurs ahead of, and during, flood events.

3.3 Ecosystem Restoration

3.3.1 Transitional Habitat Alignment

The ecotone alignment would generally follow the levee alignment and be constructed on and adjacent to the waterside slope of the new FRM levee. The extent of ecotone in the western reach of the alignment is within Pond A12 and 13 from STA 0+00 to 43+80, and in the eastern reach of the alignment within Pond A18 from STA 94+75 to 197+75 **(Sheets C-01 to C-54, LPP Plans, Profiles and Sections)**.

3.3.2 Design, Consideration, and Construction

The ecotone will be constructed to an elevation of 15.2feet at its interface with the waterside slope of the new levee under the LPP. The ecotone will have a 30:1 slope which transitions to a 3:1 slope at approximately elevation 5 feet. Hydroseeding and plantings are included for erosion protection. The ecotone would be constructed with excess cut or waste material non-suitable for levee fill and no cost fill generated by local construction/maintenance projects identified by the non-federal sponsor.

3.3.3 Pond/Tidal Marsh Restoration

Pond Restoration will occur under the LPP. Pond restoration will include a series of inboard and outboard dike breaching, construction of pilot channels, temporary heightening of inboard levees, and the construction of ditch blocks to block currently existing channels in restored ponds. The pond restoration measures will be constructed as detailed above in Section 2.2.

Construction will utilize fill available onsite, such as fill from existing berms, and any dredging that may occur.

4.0 National Economic Development Plan

4.1 Flood Risk Management Levees

The NED Plan involves the construction of FRM levees built to an elevation containing the 25-year flood event along with the no fill Ecosystem Restoration alternative 50-foot wide bench. Pond restoration measures as detailed above are also included in the NED Plan. The NED Plan is summarized in the table below and the following sections.

Table 8. National Economic Development Plan Summary

Section	Station Range	Side Slopes (H:V)	Average Height (including settlement) (ft.)	Crown Width (ft.)	Wick Drains?	50-foot Bench?
Sec 1	0+00 to 43+80	3:1	13.5	16	No	Yes
Sec 2	43+80 to 65+00	3:1	13.5	16	No	No
Sec 3	65+00 to 94+75	3:1	16.0	16	Yes	No
Sec 4	94+75 to 150+00	3:1	16.0	16	Yes	Yes
Sec 5	150+00 to 197+75	3:1	12.7	16	No	Yes

4.1.1 Alignment

The NED Plan includes an Alviso North, WPCP South alignment with a closure structure across Artesian Slough. On the Alviso side, levees would be constructed from STA 0+00 at existing high ground West of Alviso along the existing dikes bordering ponds A12, 13, and 16. The levees will tie into a new tide gate north of the Don Edwards Center at Artesian Slough (reference drawings) at approximate STA 94+75. On the WPCP side, new levees will be constructed from the tide gate, along the existing dikes of Pond A18, and will tie into the existing levees at Coyote Creek north of the WPCP sludge ponds at STA 197+75 (See **Sheets C-01 to C-54, NED Plans, Profiles and Sections**).

4.1.2 Design, Considerations, and Construction

The levee will be built to the elevations shown in **Table 8** to achieve a post-settlement design elevation of 12.5 feet. Fill quantities and resultant construction costs reflect an "overbuilt" cross-section. Settlement was estimated using Figure 3-1 of the Geotechnical Appendix. The thickness of Bay Mud transitions gradually along the levee alignment (< 1-foot / 100-linear feet) suggesting that regrading of the post-settlement levee cross-section will not be necessary. The levee side slopes will be 3H:1V and the crown will be 16 feet wide. A 12-foot wide levee crest access road will be constructed of 6-inch thick gravel.

Construction activities include clearing and grubbing and stripping of work areas including the permanent and temporary construction easement. Hydroseeding is included for erosion protection along finished grades. Foundation preparation for the new FRM levee will include degrading the existing levee to elevation 0 ft and excavating an inspection trench along the

centerline of the levee. The inspection trench will be 4 feet deep with 1:1 side slopes and have a bottom width of 8 feet. All excavation is assumed to have a 50% fill suitable for re-use on the new levees. Excess cut would be stored onsite for the construction of the ecotone.

The deep Bay Mud will also require the use of wick drains prior to and during construction to reduce settlement time and strengthen soil to increase the rate of construction. Wick drains will have 6-foot mid point spacing. Wick drains will extend approximately 5 feet beyond the levee crest and 5 feet deeper than the lower extent of the Bay Mud. Corrugated metal piping will span horizontally across the levee footprint and be attached to each wick drain to drain the water. Wick drains will be required from approximately STA 65+00 to 150+00. The design basis for requiring wick drains is related to the thickness of Bay Mud (i.e. > 10 feet) and the height of new fill (i.e. > 10 feet) being constructed (Geotechnical Appendix).

Erosion protection for the new levee will be provided by vegetation on the water and landside slopes. Flood water surface elevations are relatively static in the project area due to existing topographic features and prevailing wind direction. Therefore, vegetation alone was judged sufficient for providing erosion protection. In addition to the vegetation, the 50 foot bench (STA 0+00 to 43+80 and STA 94+75 to 197+75) provide a substantial buffer between erosive forces and the levee prism below elevation 9 feet and helps to dissipate remaining wave energy above elevation 9 feet. Existing berms and islands serve to dissipate wave energy in the managed pond adjacent to the levee from STA 43+80 to 94+75.

4.2 Closure Structures

4.2.1 Railroad Closure – Flood Gate

The railroad structure at STA 43+75 would be a mitre leaf swing gate measuring approximately 50 feet x 12 feet and constructed to an elevation of 16 feet. The structure would be supported on a concrete pile deep foundation system to transfer loads through the soft Bay Mud strata to stiff foundation soils. A concrete cutoff will be installed beneath the gate to prevent through seepage in the railroad bed beneath the gate. The cutoff will extend 5 feet below the bottom of each gate leaf. The selected closure would be operated manually and coordinated with local authorities and the railroad in anticipation of a flood. Manual operation minimizes the risk of mis-operation on an active railroad at the risk of not being closed during a tidal flood event. Not closing the gate would result in limited flooding but would not induce additional failure modes along other FRM features.

4.2.2 Artesian Slough Closure – Tide Gate

The Artesian Slough closure at STA 94+75 would consist of a concrete headwall measuring approximately 100 feet x 20 feet and constructed to an elevation of 16 feet. The structure would include two 72-inch discharge pipes to release flow from Artesian Slough. The pipes will include gates capable of both allowing normal tidal exchange to, and preventing flood water from entering into, the slough. The structure would be supported on a concrete pile deep foundation system to transfer loads through the soft Bay Mud strata to stiff foundation soils.

The selected closure would be operated passively and/or automatically to minimize disruptions to normal tidal fluctuations and ensure closure occurs ahead of, and during, flood events.

4.3 Ecosystem Restoration

4.3.1 Transitional Habitat Alignment

The 50 foot bench alignment would generally follow the levee alignment. It would be constructed along the western side of the alignment at Pond A12, 13, and 16 from STA 0+00 to 43+80 as well as along pond A18 from STA 94+75 to 197+75 (See **Sheets C-01 to C-54, NED Plans, Profiles and Sections**).

4.3.2 Design, Consideration, and Construction

The bench will be constructed to an elevation of 9 feet. The bench will span 50 feet before transitioning to a 3:1 slope to meet existing grade. Hydroseeding and plantings are included for erosion protection. The bench and restoration would be constructed with cut material from the degradation of the existing levee and levee foundation excavation that is non-suitable for levee fill.

4.3.3 Pond/Tidal Marsh Restoration

Pond Restoration will occur under the Locally Preferred Plan. Pond restoration will include a series of inboard and outboard levee breaching, construction of pilot channels, temporary heightening of inboard levees, and the construction of ditch blocks to block currently existing channels. The pond restoration measures will be constructed as detailed in Section 2.2. Construction will utilize fill available onsite, such as fill from existing berms, and any dredging that may occur.

5.0 Recreation Mitigation

5.1 Bridges

Both the NED and LPP will require mitigation for recreation facilities currently in place in the project area. To provide access for cyclists, joggers, etc., the levees will require bridges at the rail road and Artesian Slough closures. The bridge at the railroad crossing will span approximately 380 feet with a width of 12 feet. The bridge at the Artesian Slough crossing will span approximately 100 feet with a width of 12 feet. Representative details for the rail road bridge are shown in **Sheets D-05 and D-06 of the NED and LPP Plans, Profiles and Sections**. Representative details for the Alviso Slough crossing are shown on **Sheets D-02 to D-04 of the NED and LPP Plans, Profiles and Sections**. Typical bridge construction has been assumed for the purposes of this study, as in-depth consideration of use, capacity, and architectural requirements will need to be determined during the pre-construction engineering and design (PED) phase. Quantity development and assumptions are further discussed in Section 8.0.

5.2 Bay Trails

For both the NED and LPP, existing recreational trails will require reconstruction and improvement due to FRM and ER construction. Bay trails will be designed to CalTrans standards (Highway Design Manual Chapter 1000, Bicycle Transportation Design) as Class I Bikeways. The recreational trails will be a total length of approximately 22,000 feet long. They will be constructed to a paved width of 10' feet with 3 foot shoulders of all-weather material (total width of 16 feet). For this study, it is assumed compacted dirt is sufficient for this purpose. Clearing and grubbing will occur over the work area, including the 16 food wide trail and 10 foot easements on either side for construction. Stripping will occur over the entire 16 foot width of the trail.

6.0 Real Estate

For the Locally Preferred Plan, acquisition of approximately 900 acres currently owned by the City of San José are allocated to ecosystem restoration, with approximately 54 acres for levee easements, 7 acres of permanent road easements, and 52 acres of temporary work easements. These acquisitions are currently split with approximately 31 parcels, more or less. The non-Federal sponsor is responsible for procurement of all lands, easements, relocations, rights-of-way, and disposal areas (LERRDs) that are necessary for construction, operation, and maintenance of the project. Potential real estate needs are described in the following sections.

6.1 Easements and R/W Requirements

Maintenance easements will be required for the proposed project. Levee maintenance and inspection will likely be performed from toe of the proposed levee, but may be accomplished from the levee crown. Fifteen feet from the landside toe of proposed levee has been designated as maintenance (permanent) easement. In addition to maintenance easements, utility relocation may require easement acquisition, depending on the placement of the relocated utilities and overhead/underground utilities.

Temporary construction easements will also be required for this project, and have been assumed to be 15 additional feet beyond the limits of the maintenance easement. In areas where the landside toe of the proposed levee lands within existing structures or property, there may be an opportunity to minimize required temporary easements by performing construction activities on the levee crown. For the purposes of this study, in areas where there was minimal infringement of temporary easement on existing property/structures, the temporary easement was reduced in width. This variance will require further investigation during final design.

Permanent and temporary construction easements are detailed on **Sheets C-01 through C-20 of the NED and LPP Plans, Profiles and Sections**

6.2 Borrow Locations

Borrow material from sources other than what will be derived from the degradation of existing levees is required to complete the levee construction. The sponsor will be required to provide 960,000 cubic yards of borrow to construct the LPP FRM levee. The borrow is anticipated to require approximately 54 acres at the identified borrow sites; Upper Llagas Creek, Upper Guadalupe River and Permanente Creek. Upper Llagas Creek is the borrow site that is the furthest from the Shoreline project at 30 miles one-way. For cost estimating purposes, it was conservatively assumed that all levee borrow will be delivered via a 60 mile round trip. Upper Llagas Creek and Upper Guadalupe River are active USACE projects for which the sponsor is required to obtain the necessary real estate, and would be eligible to receive credit under LERRDs for the respective federal projects. Permanente Creek is a non-federal project requiring a borrow easement for approximately 22 acres, and would be eligible to receive credit under LERRDs for the South San Francisco Bay Shoreline Project.

The non-Federal sponsor will secure sufficient fill to substantially construct restoration features prior to the initiation of construction. It is assumed this restoration fill will be placed within the project boundaries, and will have no purchase cost. Costs to cover rehandling of stockpiled materials and construction of restoration fills have been included in the LPP cost estimate.

6.3 Disposal and Storage Area

There is no need for disposal areas. All material that cannot be used as levee fill will be used as common fill within the project footprint. Common fill is expected to be used for construction of the bench (NED) and/or ecotone (LPP). No excess material is anticipated that would require on-site storage or that would require off-site disposal.

6.4 Staging Area

Potential staging areas have been identified around the project site for the NED and LPP alternatives. Due to the use of the same alignment, staging areas are the same for both plans **(Sheet G-03, NED and LPP Plans, Profiles and Sections)**.

7.0 Relocations and Modifications

7.1 Overview

In total, there are over 80 known utilities within the study area that may be impacted by construction of flood risk management and environmental restoration features. Only four utility crossings are known to cross the alignment of the new flood control levee alignment. Utilities operated by the WPCP comprise of a large portion of the existing utilities potentially impacted. The WPCP owns approximately 61 of the more-than 80 utilities in the area. The majority of the WPCP's 61 known utilities in the project area are sited along both sides of Artesian Slough between the WPCP and the Don Edwards Center. Storm drains, sanitary sewers, and other utilities potentially conflict on the west and east side of Alviso and along

Grand Blvd. These utilities are described in the Existing Utilities Information Technical Memorandum dated 29 September 2011 (**Appendix A**).

7.2 LPP and NED

Due to the same alignment, utility relocation/modification needs for the NED and LPP are identical. The utility relocation and modifications that apply to the NED and LPP alignment are summarized below:

- A siphon near STA 76+00 was installed in 2012 and maintains flow through the existing inboard dike to New Chicago Marsh. The siphon will be modified to allow for means of positive closure during flood events.
- Approximately 685 feet of an underground electrical supply leading to the SCWD weir at approximately STA 95+00 will need to be relocated to an overhead configuration.
- A culvert near STA 96+00 that maintains flow from Artesian Slough to a small mitigation area near the southwest extent of Pond A18. The culvert will be replaced to maintain existing functionality and include a means of positive closure during flood events.
- 5 existing PG&E power towers run through Pond A18 and may require in-place erosion protection due to potential changes in hydraulics caused by levee, ecotone, bench, or pond restoration construction. Overhead clearance of the new levee (STA 130+00) is substantial enough to not impact levee construction.
- The existing rail road bridge to the north of the project will require approximately 8,400 tons of rock protection due to potential changes in hydraulics caused by levee, ecotone, bench, or pond restoration construction.

8.0 Development of Construction Quantities

8.1 Levee and Transitional Habitat Quantities

Quantities were developed at a feasibility level of design for each alternative. Quantities were based on output from Autodesk Civil3D as well as typical cross sections determined from average levee heights and design geometry. Imported fill for levee construction is assumed to be within 30 miles of the levee alignment based on the furthest of the three fill sources (i.e. Upper Llagas Creek) identified in **Section 6**. Hand calculation sheets including geometry and sample calculations are found in **Figures 14 - 27**. Fill volumes include settlement. Build to elevations (i.e. fill heights) for the LPP and NED levees are shown in the plan set for each levee. Quantities for the NED levees and bench are found in **Quantities Tables 1** respectively, LPP levees and ecotone in **Quantities Tables 2.**

8.2 Pond Restoration Quantities

Autodesk Civil3D developed cross-sections and aerial topography (LiDAR) of the majority of the salt ponds within the Shoreline Study area were used to develop quantities. Areas in which there was no LiDAR available, assumed values for levee geometry were used. Hand calculation sheets including geometry and sample calculations are included in **Figures 28-31**. Pond restoration quantities are found in **Quantities 3-7**.

8.3 Recreation Mitigation Quantities

8.3.1 Bay Trail Quantities

Quantities were developed based on a typical cross section. It was assumed that the Bay Trail would have a 10-foot paved width with 3-foot compacted dirt shoulders per CalTrans standards. Hand calculations are found in **Figure 32**. Bay Trail Quantities are found in **Quantities 8**.

8.3.2 Bridge Quantities

Bridge quantities were developed based on a March 2006 Feasibility Report titled *Alviso Slough Pedestrian Bridge Feasibility Study, Bay Trail Reach 9B,* developed by CH2MHILL for the City of San Jose Department of Parks, Recreation and Neighborhood Services[2]. Quantities for the pedestrian bridges in this report were scaled based on length to become a representative sample of the pedestrian bridges included in the Shoreline Project, acceptable for cost estimating purposes. Bridge restoration quantities are found in **Quantities 9**.

9.0 Cost Estimates

Construction costs was developed using MII (MCACES) software and is summarized in **Table 9**. Costs for each applicable element include 27% for contingency for the NED/NER and 26% contingency for the LPP. The contingency was originally developed at the 2013 Cost and Schedule Risk Assessment and refined in the spring of 2015.

Table 9. Project First Cost Summary

Element	NED/NER	LPP
Real Estate	$13,392,000	$13,493,000
FRM Features	$55,402,000	$67,299,000
Bank Stabilization	$1,535,000	$1,523,000
Utility Relocations	$587,000	$587,000
Transitional Habitat	$0	$35,944,000
Pond Restoration	$5,765,000	$5,765,000

[2] The Alviso Slough Pedestrian Bridge was identified by the non-Federal sponsors as a suitable go-by for estimating for the Shoreline Study.

Recreation	$4,848,000	$4,848,000
Preconstruction Engineering and Design	$15,071,000	$24,842,000
Construction Management	$7,440,000	$12,327,000
Monitoring	$984,000	$984,000
Adaptive Management	$6,276,000	$6,276,000
Total	**$111,300,000**	**$173,900,000**

10.0 Value Engineering

A Value Engineering (VE) study, sponsored by the Corps and facilitated by Value Management Strategies, Inc., was conducted for the Shoreline Study in Sacramento, California April 2-5, 2012. The VE study evaluated the initial array of FRM options (FRM Options 1A through 4), with the objective of confirming the process by which the PDT arrived at the array of alternatives, and to make recommendations for improving the design and evaluation of alternatives. The Revised draft Value Engineering Report, dated May 3, 2012, and provided the following statement of concurrence:

"Based on the information provided, it appears that the Project Delivery Team (PDT) considered an adequate range of alternatives and the process used to arrive at the array of alternatives (Options 1A, 1B, 1C, 2, 3, 4, and non-structural)[3] is reasonable."

The VE study developed six alternatives for consideration by the PDT. The purpose of the six alternatives was to reduce project cost, reduce implementation schedule, and/or improve project performance. A summary of the recommended alternatives along with the PDT response is provided below.

1.1 Select Option 2 – 100-year as the final alignment; eliminate wick drains; reuse existing levees; do not remove them, just raise them with earth

Final plan selection will be based on the NED analysis and non-Federal sponsor preference. The elimination of wick drains will require additional analyses during the PED phase. While eliminating wick drains is technically feasible (based on known conditions), the time required to construct without eliminating pore pressure as a significant negative impact on the short-term level of protection.

If during the PED phase additional investigations and analyses indicate that the existing levees are suitable foundation for additional fill, they can be left in place.

[3] At the time the VE team reviewed the array of options, only the seven FRM options had been formulated. Subsequent to completion of the VE study, through coordination with the non-Federal sponsors, four additional FRM options were added to the final array, as discussed in Section 2.1.

1.2 Select Option 2 – 100-year as the final alignment; eliminate wick drains; reuse existing levees; do not remove them, just raise them using precast concrete units

Final plan selection will be based on the NED analysis and non-Federal sponsor preference. The elimination of wick drains will require additional analyses during the PED phase. While eliminating wick drains is technically feasible (based on known conditions), the time required to construct without eliminating pore pressure as a significant negative impact on the short-term level of protection.

Although the overall weight may be reduced by concrete, the bay mud is highly compressible and even small increases in stress over the existing stress condition may cause significant settlement and the need for wick drains may not be eliminated. The seepage risks may be increased by allowing a higher head on the existing levee without increasing the seepage path length. The reliability of the levee may not be improved significantly when compared to the existing levee fragility analysis. Higher reliability is a primary goal of the project so that damages are reduced. Differential settlement that may result as of construction sequencing and foundation differential bay mud thickness could result in differing crest elevations and preferred flood overtopping locations and would be difficult to re-grade to a uniform crest elevation.

1.3 Construct geofoam block core levees; eliminate wick drains

EPS block is a common practice in general soft ground construction (highway embankments, etc), not levee construction. Should the fill over the blocks become damaged or eroded the buoyancy resistance would be reduced, compounding an erosion problem into potential other problems. This recommendation can, however, be examined further during PED phase.

2.0 Limit crown width to 10 feet

While this is a valid potential way to reduce cost, it is quite common for levee crest widths to exceed 10 feet. Below are a few examples of levees with crest widths greater than 10 feet.

Feather River near Arboga, CA	Crest Width: 20 ft
Truckee Irrigation Canal Levee, near Fearnly, NV	Crest Width: 15 ft
Jones Track Levee near Stockton, CA	Crest Width: 28 ft
Natomas Levees near Sacramento, CA	Crest Width: 20 to 44 ft
Winslow Levees, near Winslow AZ	Crest Width: 22 ft
Guadalupe River Levees, near Alviso, CA	Crest Width: 20 ft
Coyote Creek Levees, near San Jose/Alviso, CA	Crest Width: 18 ft
San Mateo Bay Front Levees, San Mateo, CA	Crest Width: 12 to 18 ft
Roaring Sough Levee, CA	Crest Width: 30 ft

A performance change in reducing the crest width may include decreased flexibility if levee settles too much or sea level rise exceeds expectations (1-foot raise at 3:1 slopes would reduce the crest to 10 ft), and that emergency access and flood fighting would be reduced.

Additionally, loss of levee fill width would lead to shorter time for erosion to breach levee should erosion initiate.

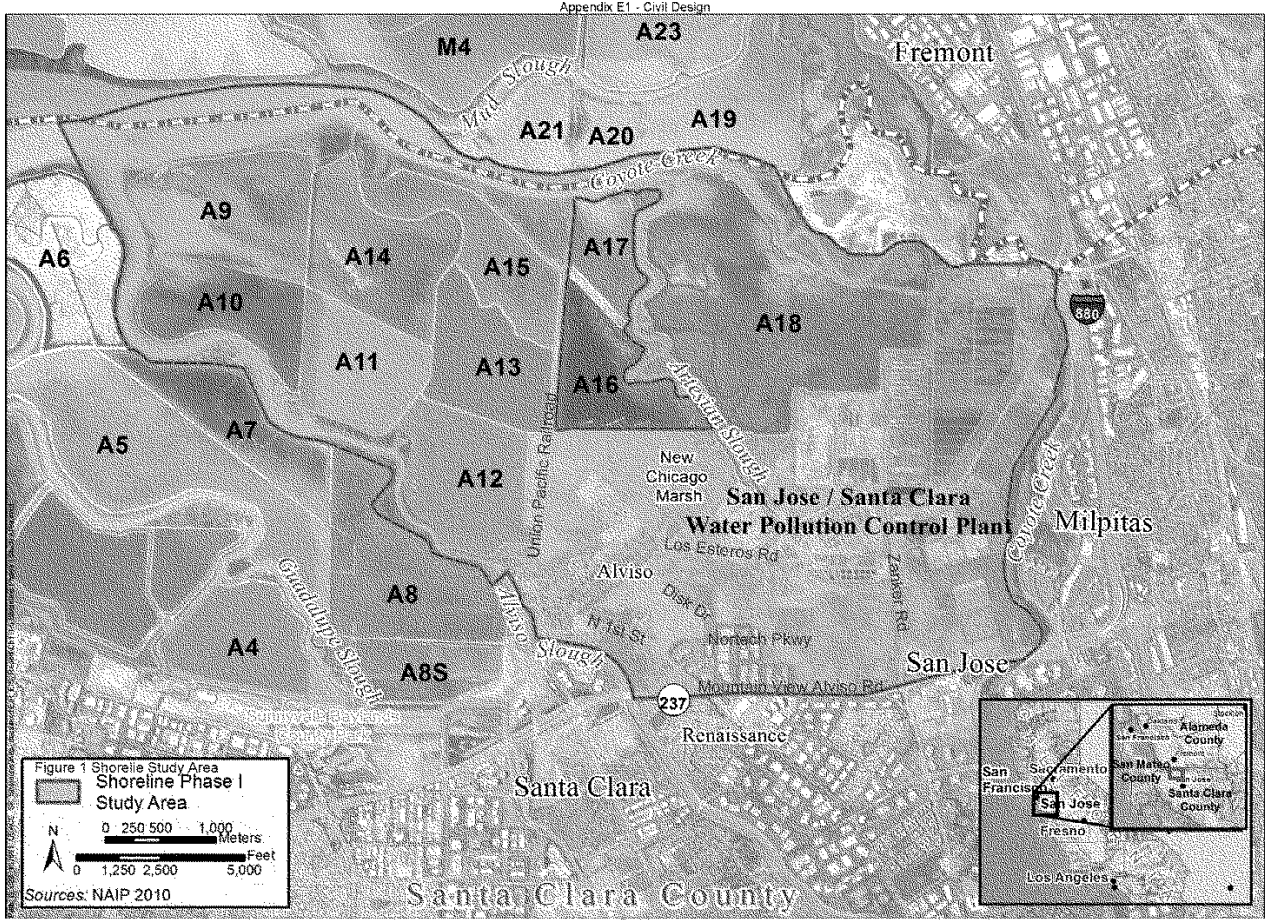
3.0 Do not gravel top the levees; no vehicular access

The levee could become impassible during wet weather, making emergency access and flood fighting more difficult and could reduce levee performance. Levee surfaces now on the outer levees are not graveled and even during small rain events, light trucks are unable to pass the levee crest safely. The non-Federal sponsor has suggested a preference for gravel surfacing.

4.0 Consider a 12-hour-per-day construction operation to improve the schedule

Where the construction schedule is not controlled by the rate of foundation consolidation, this is a reasonable and effective method to reduce the overall construction schedule. This recommendation should be considered during PED phase.

Figures


M4
A23
Fremont
Mud Slough
A21
A20
A19
Coyote Creek
A9
A6
A14
A15
A17
A10
A18
880
A11
A13
A16
Artesian Slough
A5
A7
A12
New Chicago Marsh
San Jose / Santa Clara Water Pollution Control Plant
Milpitas
Union Pacific Railroad
Los Esteros Rd
Alviso
Zanker Rd
Coyote Creek
Guadalupe Slough
A8
Disk Dr
N 1st St
Alviso Slough
Nortech Pkwy
San Jose
A4
A8S
Mountain View Alviso Rd
237
Sunnyvale Baylands Park
Renaissance
Santa Clara
Santa Clara County
Figure 1 Shoreile Study Area
Shoreline Phase I Study Area
N
0 250 500 1,000 Meters
0 1,250 2,500 5,000 Feet
Sources: NAIP 2010
Alameda County
San Mateo County
Santa Clara County
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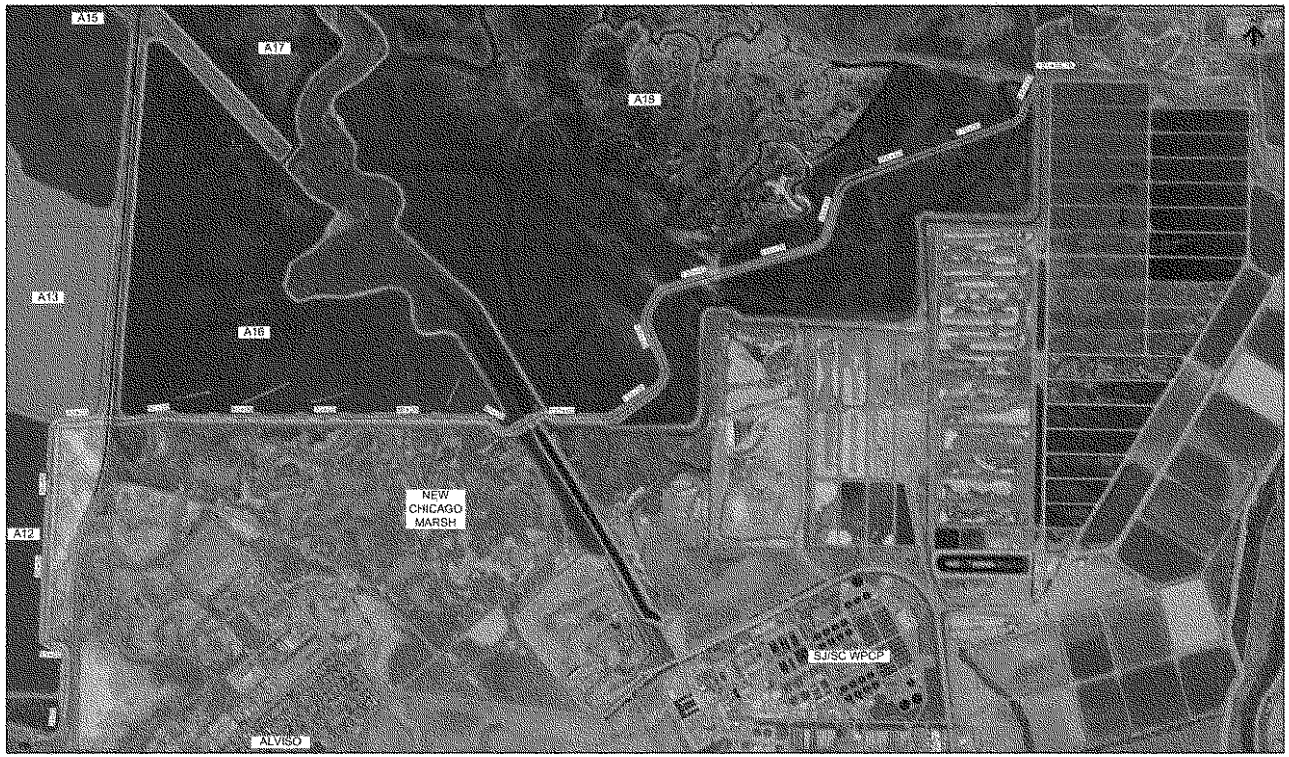
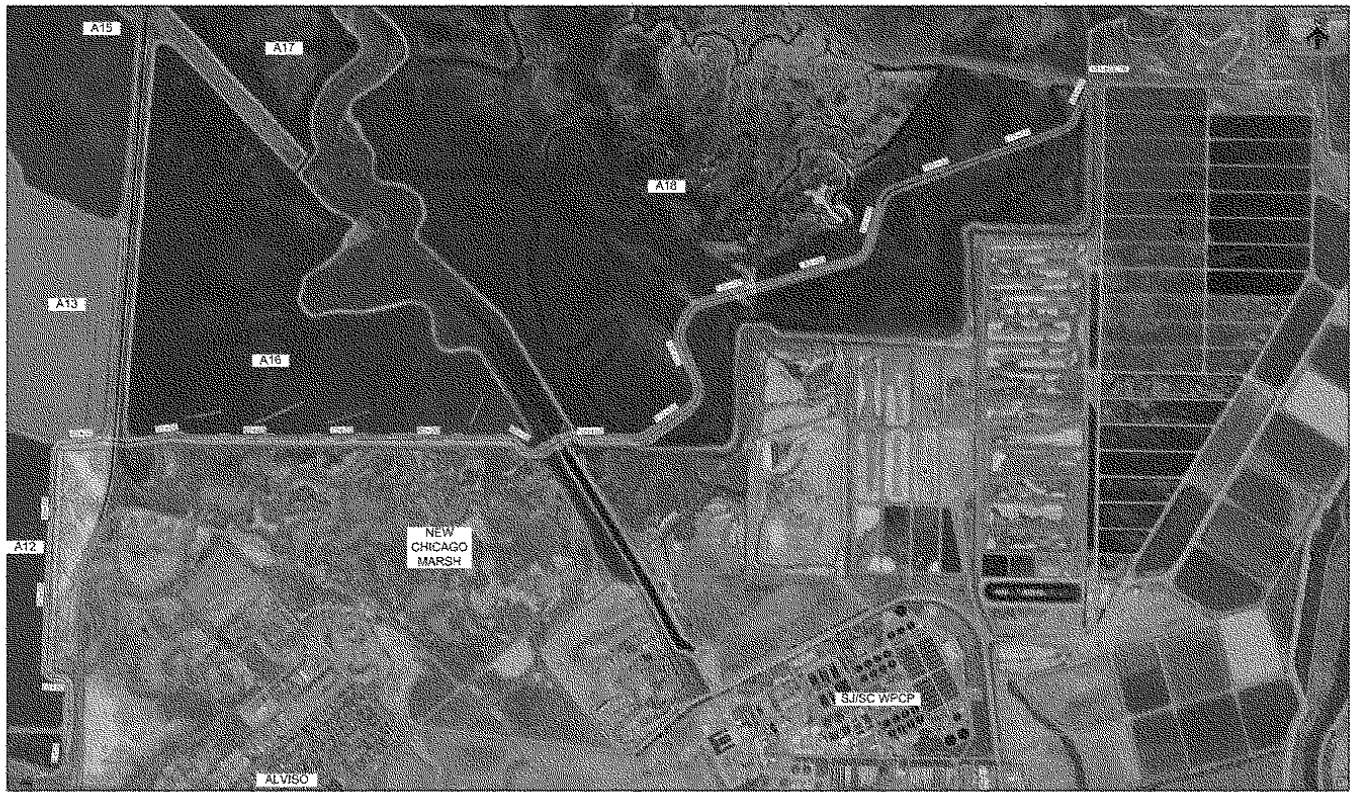
Sacramento
San Jose
Fresno
Los Angeles



Alviso North, WPCP North, 200-Year
Plan View

Figure 2. Option 1A Plan View

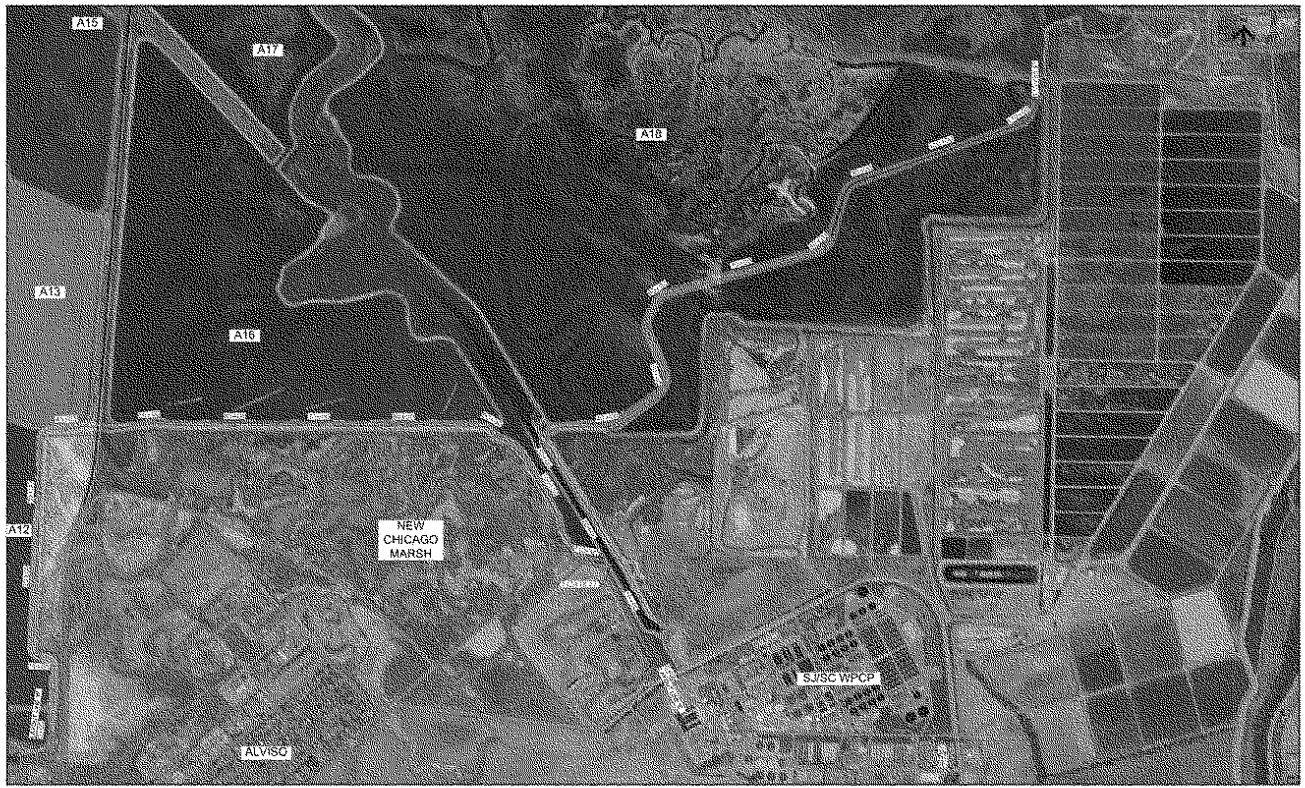
HDR US Army Corps of Engineers



Alviso North, WPCP North, 100-Year
Plan View

Figure 3. Option 1B Plan View

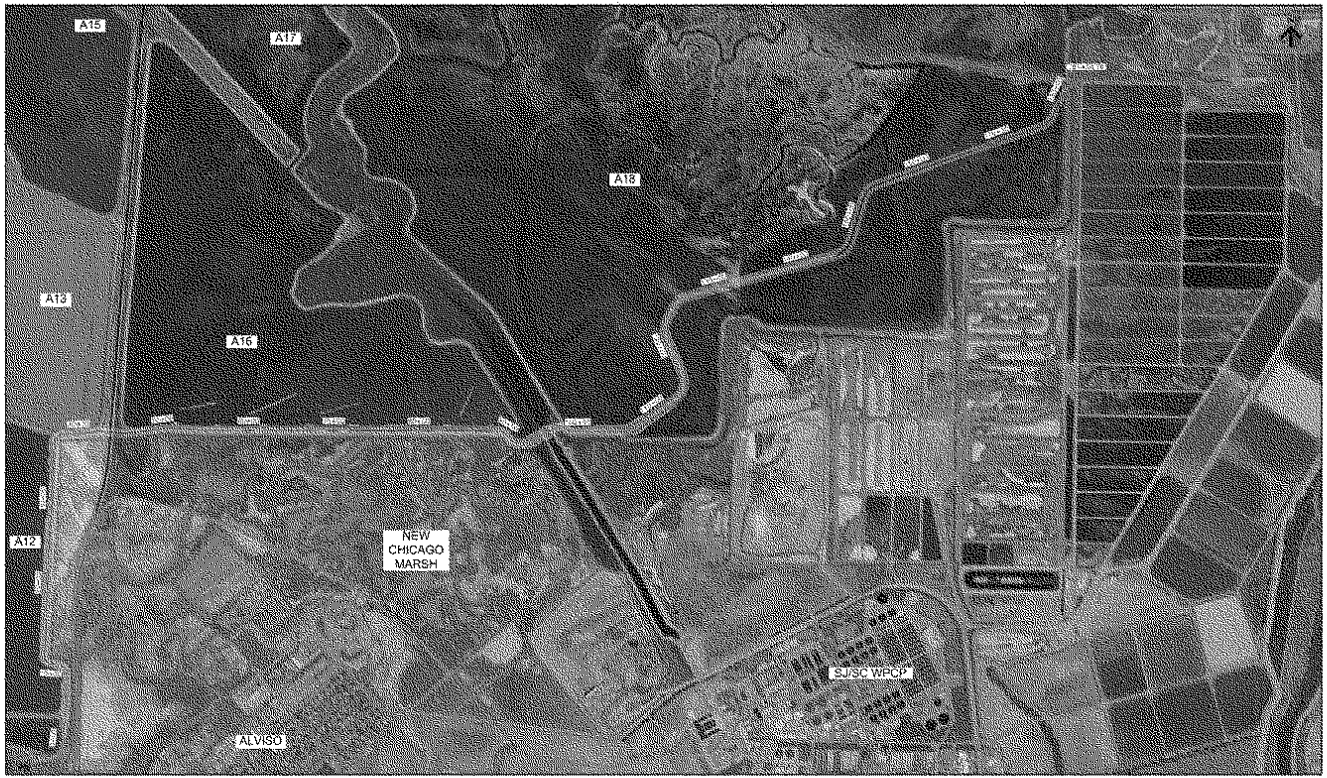
HDR US Army Corps of Engineers



Alviso North, WPCP North, 50-Year
Plan View

Figure 4. Option 1C Plan View

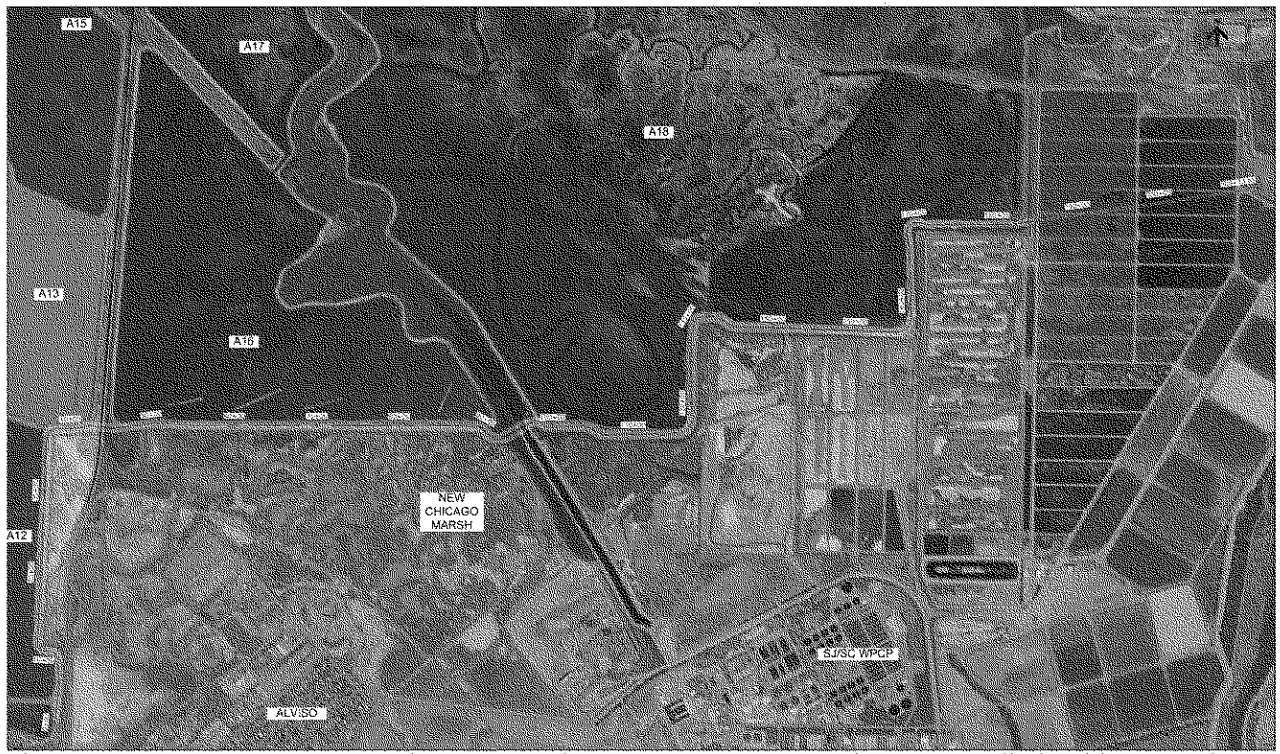
HDR US Army Corps of Engineers



Alviso North, WPCP North, 25-Year
Plan View

Figure 5. Option 1D Plan View

HDR US Army Corps of Engineers



Alviso North, WPCP South, 100-Year
Plan View

Figure 6. Option 2 Plan View

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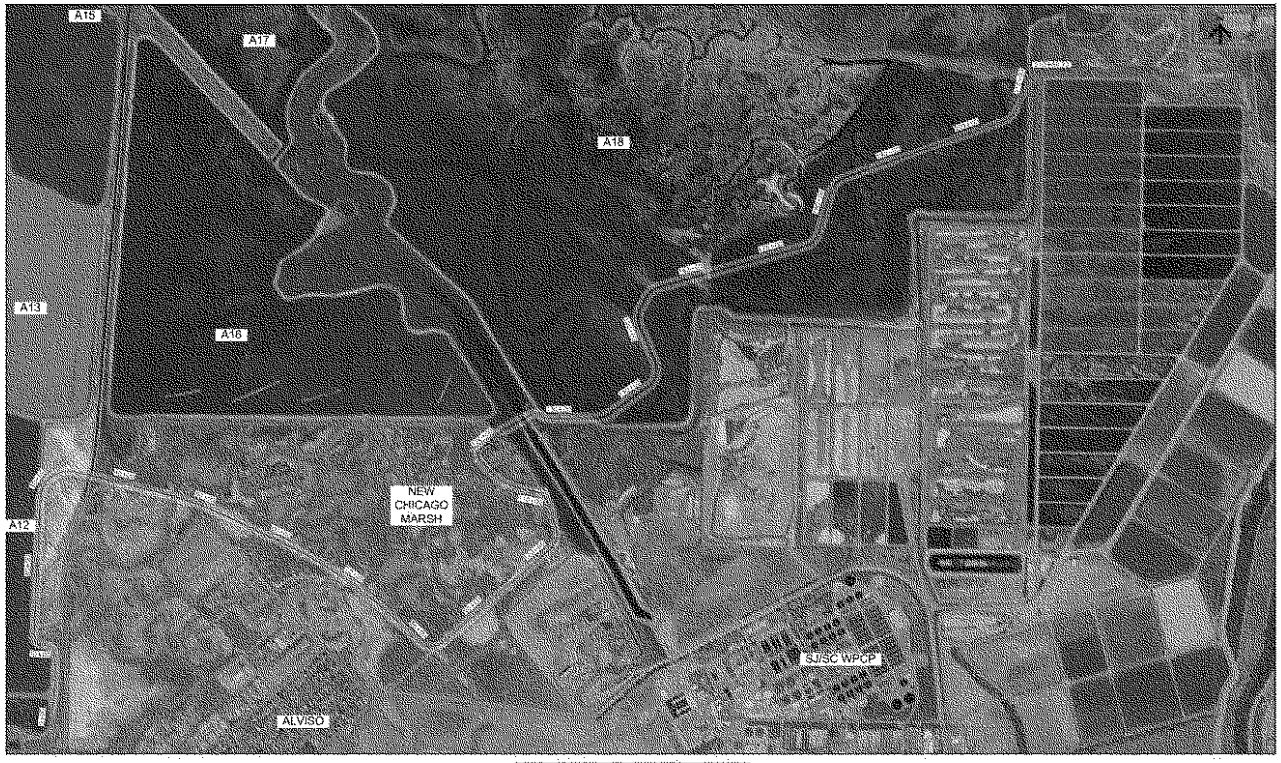
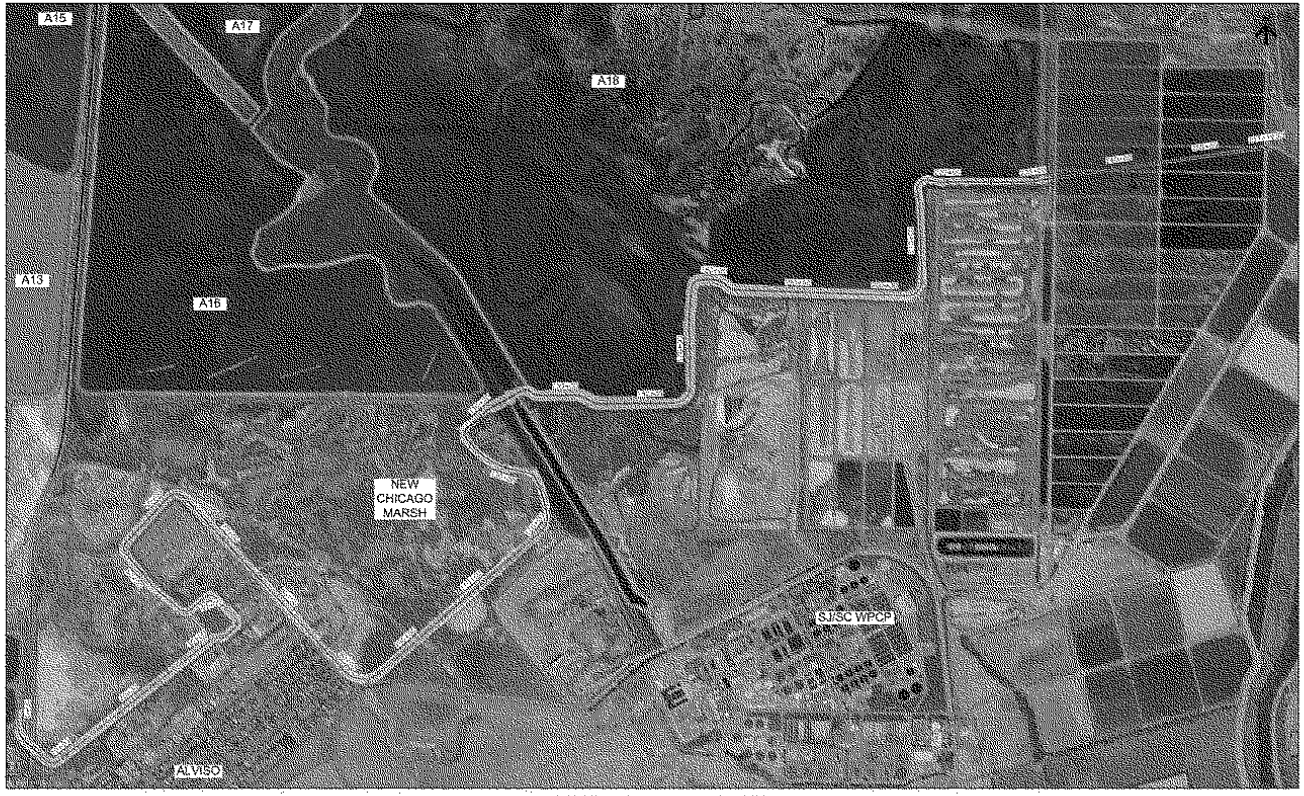


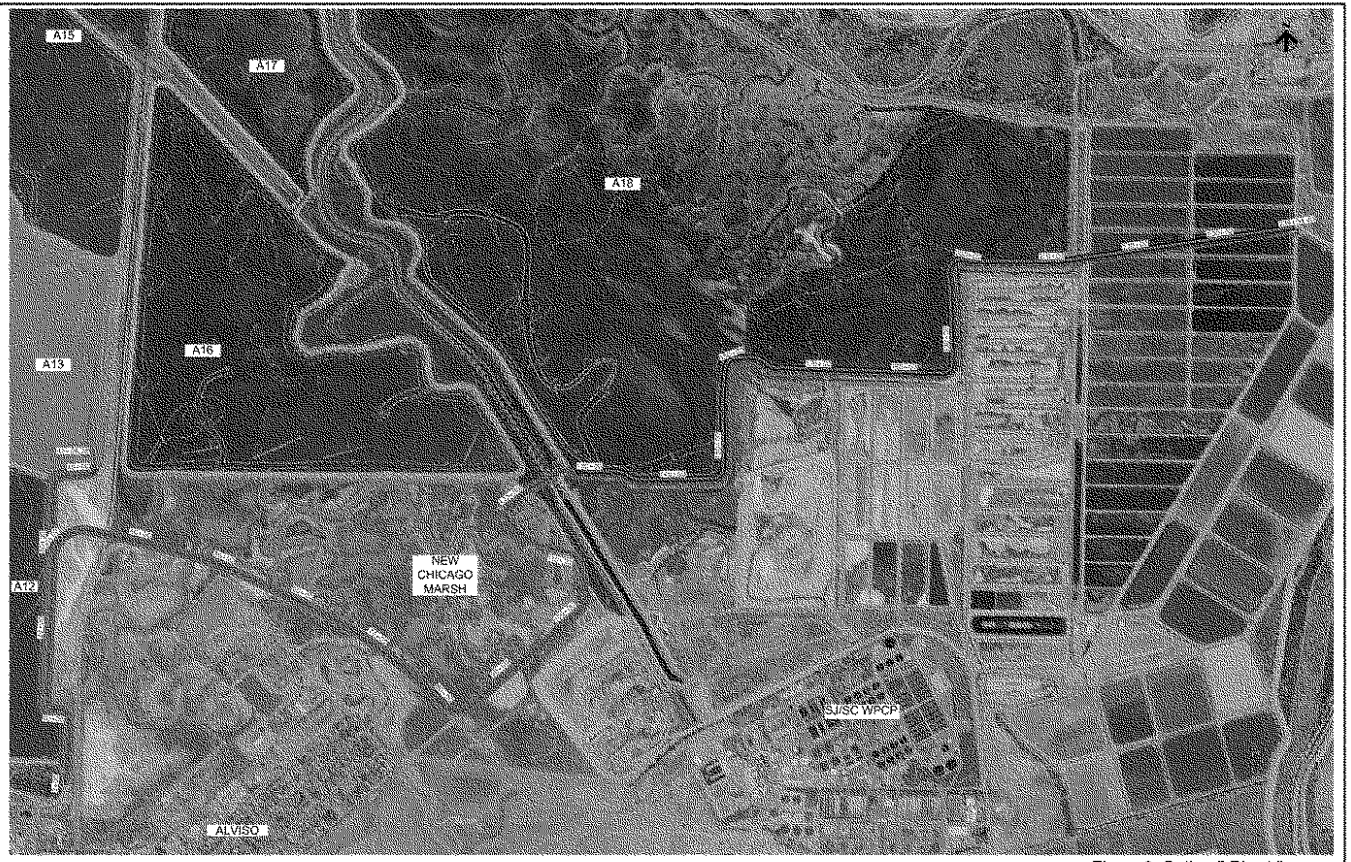
Alviso RR, WPCP North, 200-Year
Plan View

Figure 7. Option 3 Plan View



Alviso South, WPCP South, 50-Year
Plan View

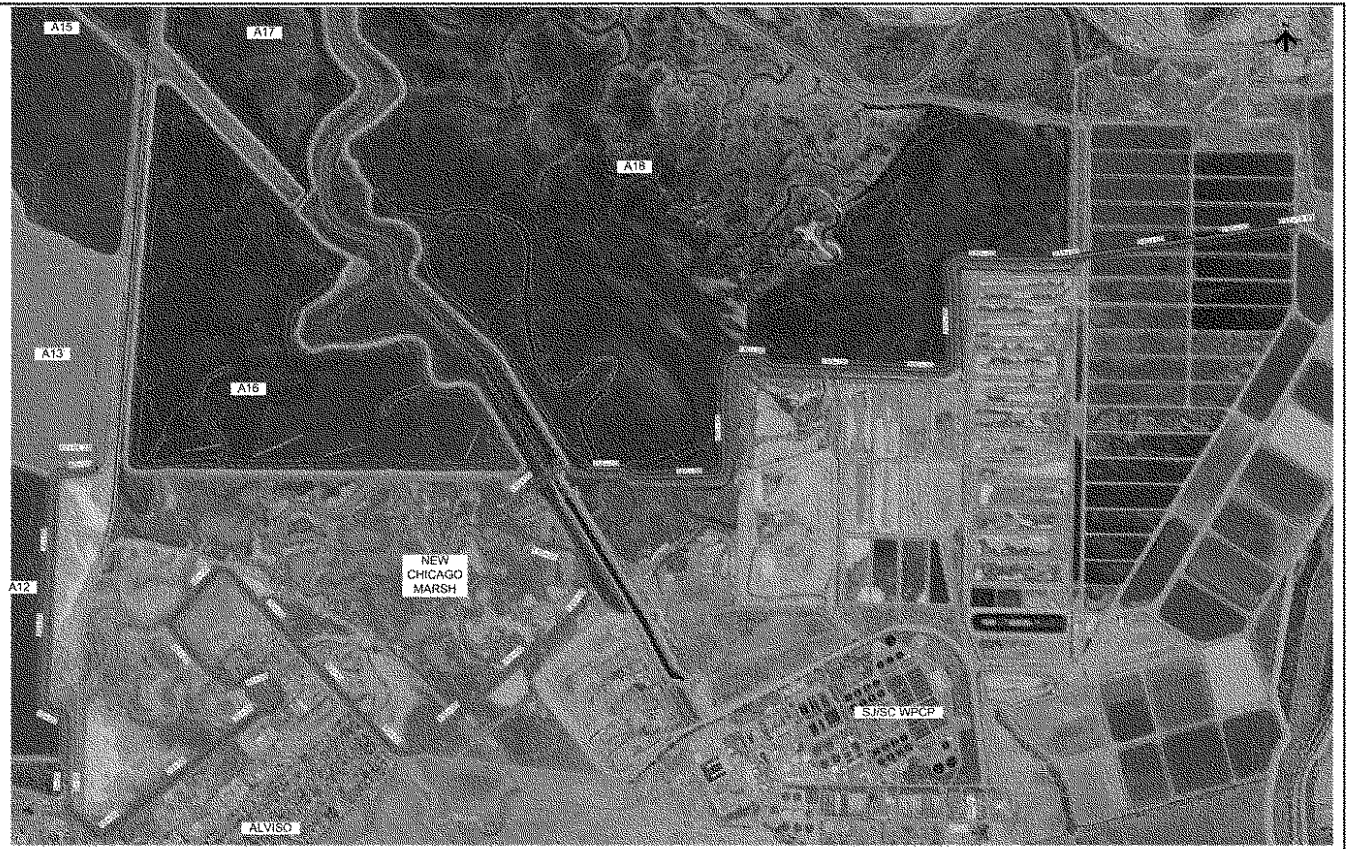
Figure 8. Option 4 Plan View



ALVISO RR WPCP SOUTH, 100-Yr
PLAN

Figure 9. Option 5 Plan View 01

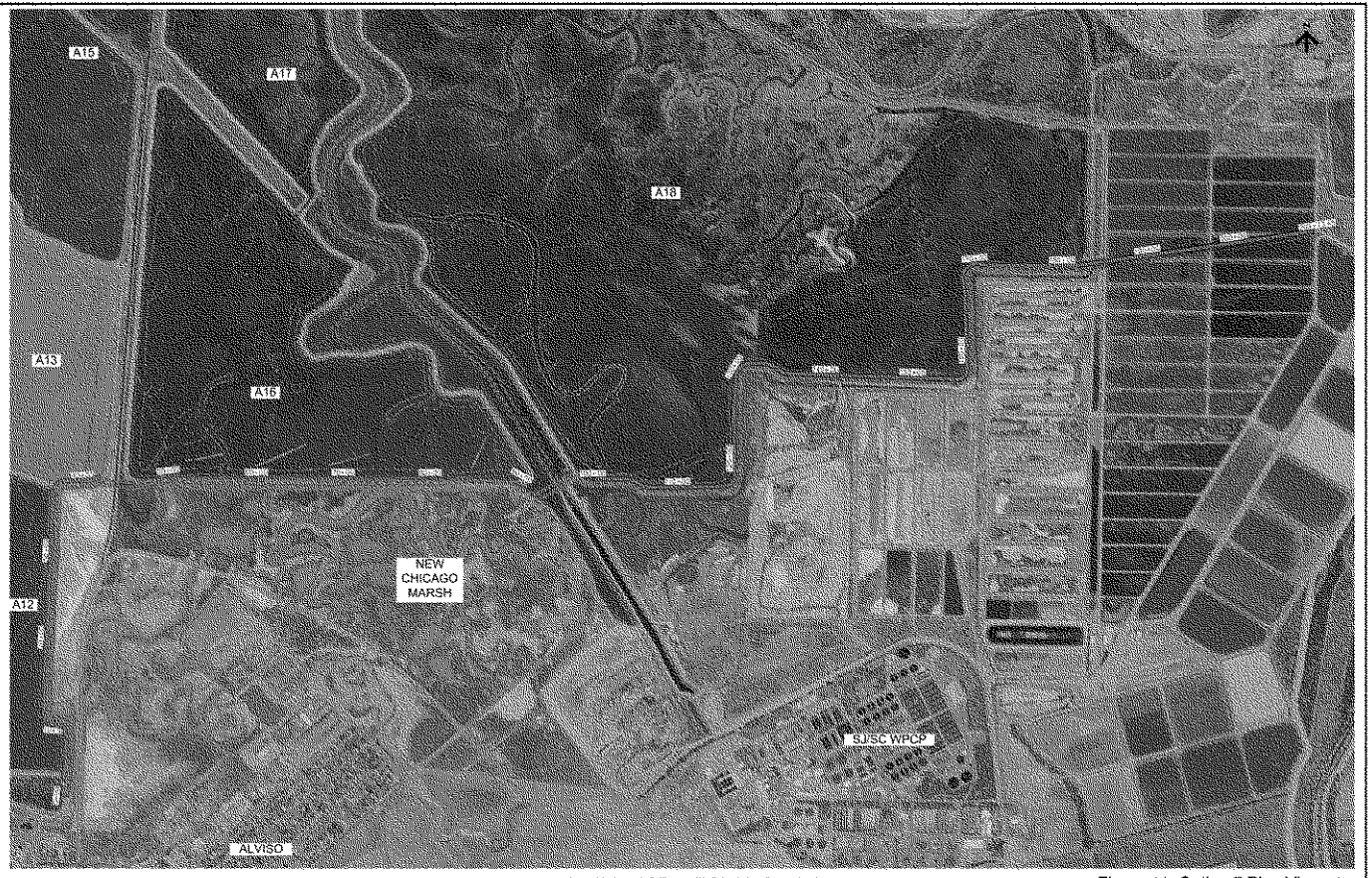
HDR US Army Corps of Engineers



ALVISO SOUTH WPCP SOUTH, 100-Yr
PLAN

Figure 10. Option 6 Plan View 01

HDR US Army Corps of Engineers



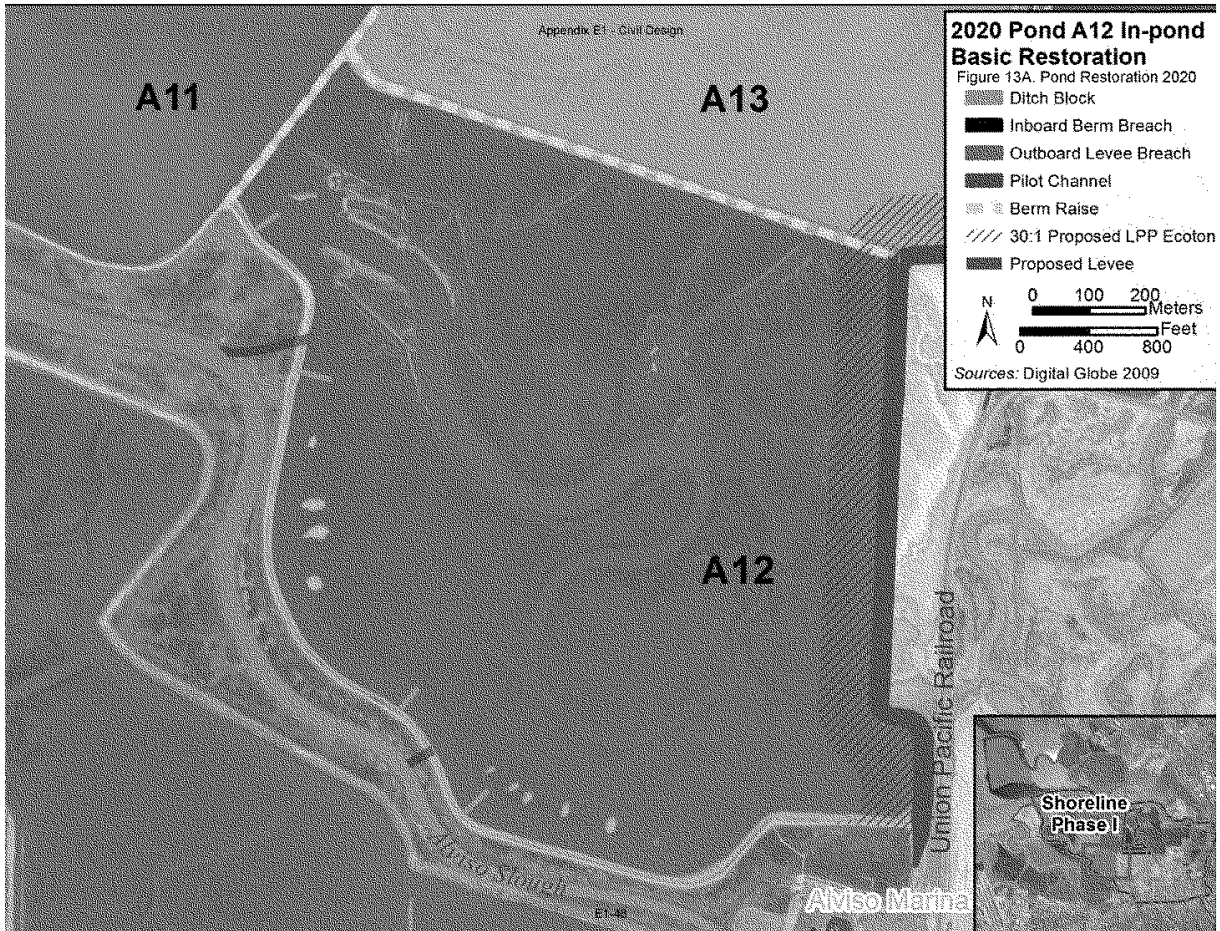
ALVISO NORTH WPCP SOUTH, 25-Yr
PLAN

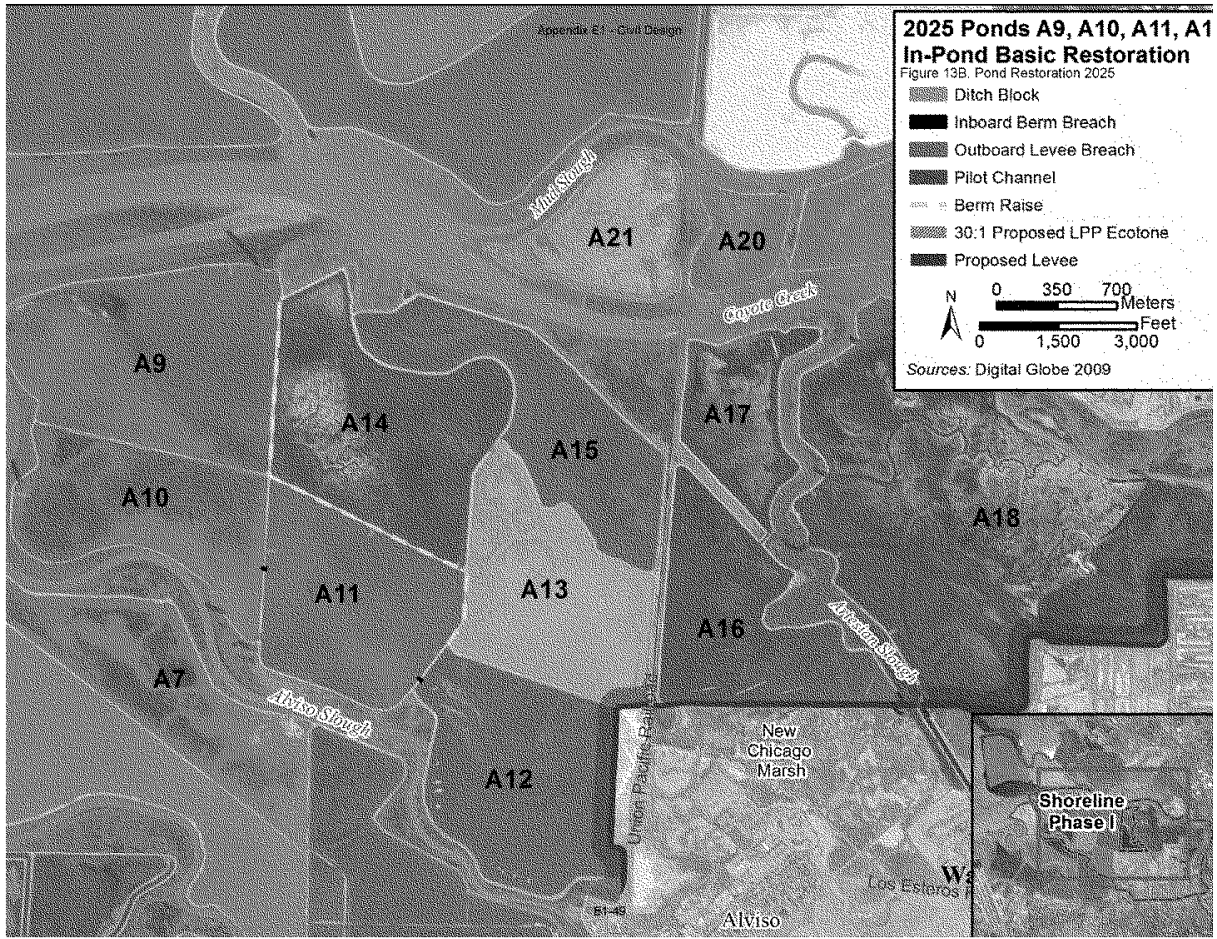
Figure 11. Option 7 Plan View 01

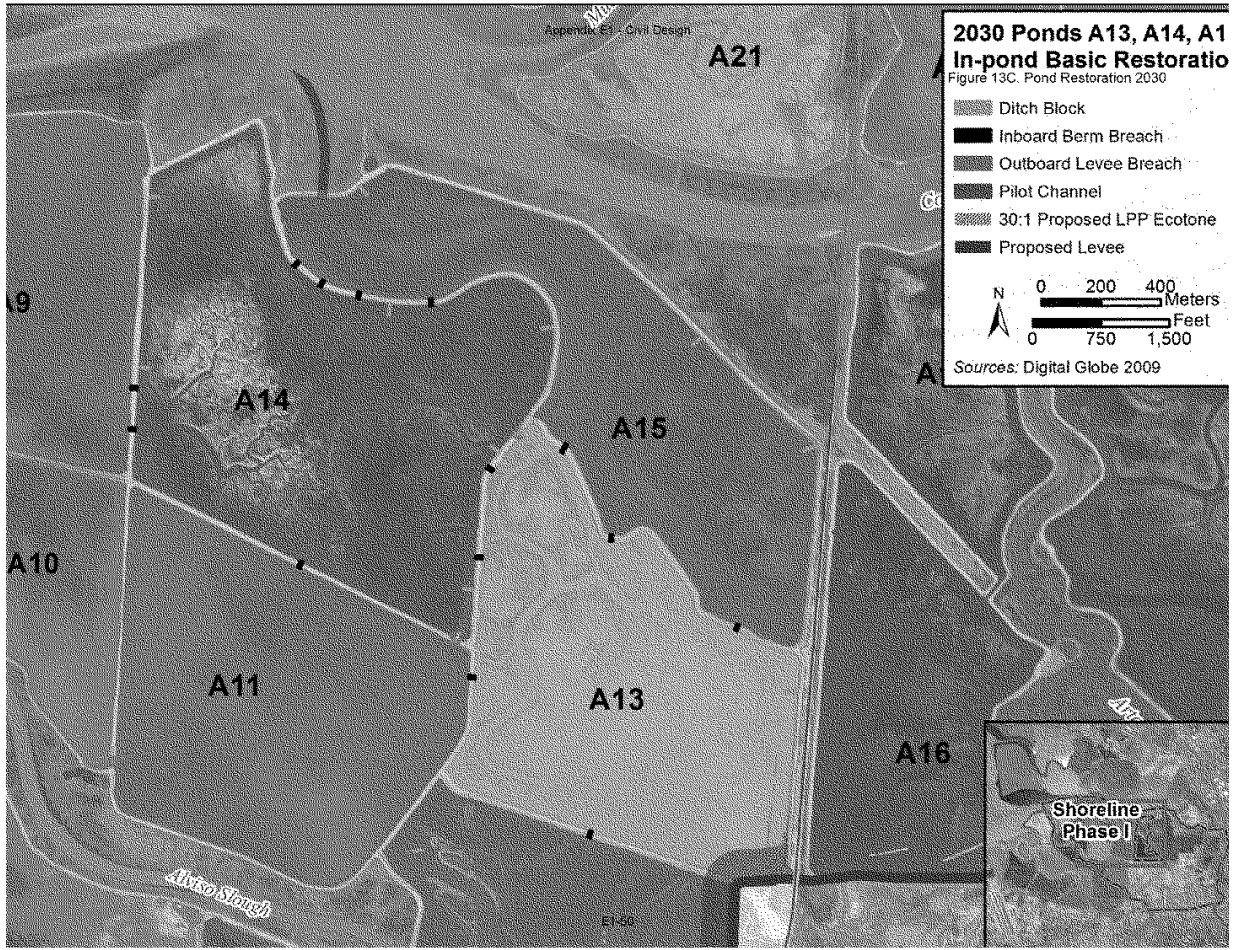
HDR US Army Corps of Engineers

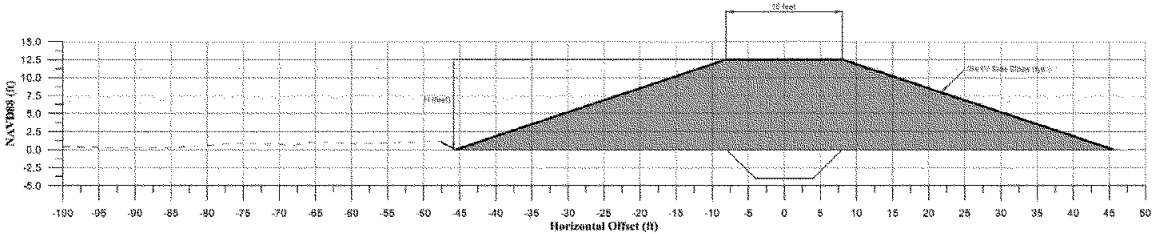
ALVISO NORTH WPCP SOUTH, 200-Yr
PLAN

Figure 12. Option 8 Plan View


2020 Pond A12 In-pond Basic Restoration
Figure 13A. Pond Restoration 2020
Ditch Block
Inboard Berm Breach
Outboard Levee Breach
Pilot Channel
Berm Raise
30:1 Proposed LPP Ecoton
Proposed Levee
N
0 100 200 Meters
0 400 800 Feet
Sources: Digital Globe 2009
A11
A13
A12
Union Pacific Railroad
Shoreline Phase I
Almo Marina

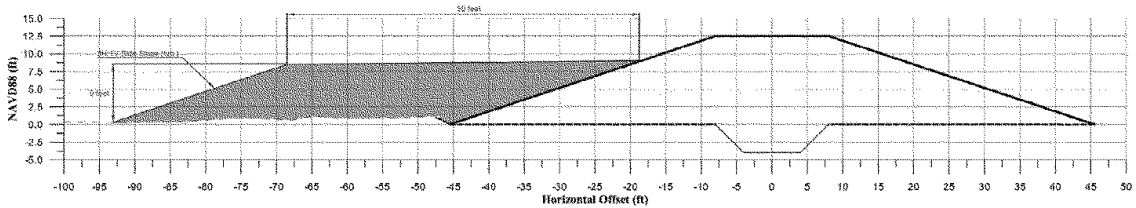

Appendix E1 - Civil Design
2025 Ponds A9, A10, A11, A1
In-Pond Basic Restoration
Figure 13B. Pond Restoration 2025
Ditch Block
Inboard Berm Breach
Outboard Levee Breach
Pilot Channel
Berm Raise
30:1 Proposed LPP Ecotone
Proposed Levee
N
0 350 700 Meters
0 1,500 3,000 Feet
Sources: Digital Globe 2009
Mud Slough
Coyote Creek
Alviso Slough
Artesian Slough
Union Pacific Railroad
New Chicago Marsh
Los Esteros
Alviso
Shoreline Phase I
A21
A20
A9
A14
A15
A17
A10
A18
A11
A13
A16
A7
A12
51-43


2030 Ponds A13, A14, A1
In-pond Basic Restoratio
Figure 13C. Pond Restoration 2030
Ditch Block
Inboard Berm Breach
Outboard Levee Breach
Pilot Channel
30:1 Proposed LPP Ecotone
Proposed Levee
N
0 200 400 Meters
0 750 1,500 Feet
Sources: Digital Globe 2009
A21
A14
A15
A10
A11
A13
A16
Shoreline Phase I
Alviso Slough



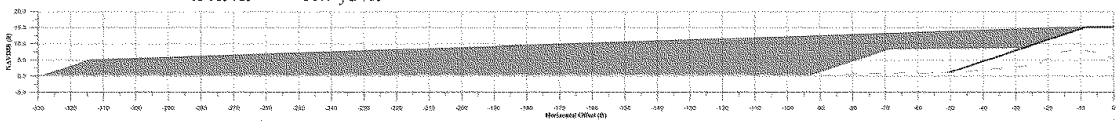
Levee Fill (yd^3/ft) = {Inspection Trench ft^3/ft + [16H + 3H(H)]} / 27

Figure 14 – Levee Volume Sample Calculations



50-ft Bench (yd^3/ft) = 9ft * 50ft

= $450ft^3/ft$ ~ 16.7 yd^3/ft

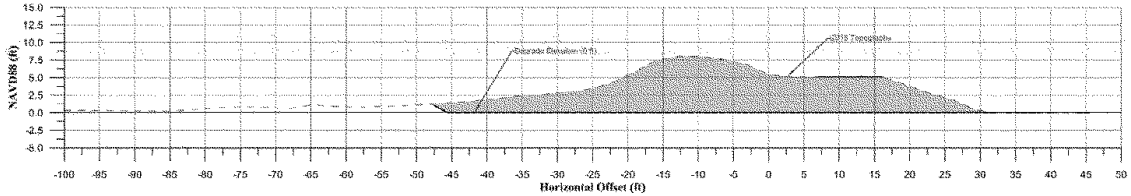


Ecotone (yd^3/ft) = {(0.5 * 5 ft * 3 * 5 ft) + [5 ft * 30 * (15.2 – 5) ft] + [0.5 * (15.2 – 5) ft * 30 * (15.2 – 5) ft]} – [50-ft Bench + 0.5 * 15.2 ft * 3 *15.2 ft]

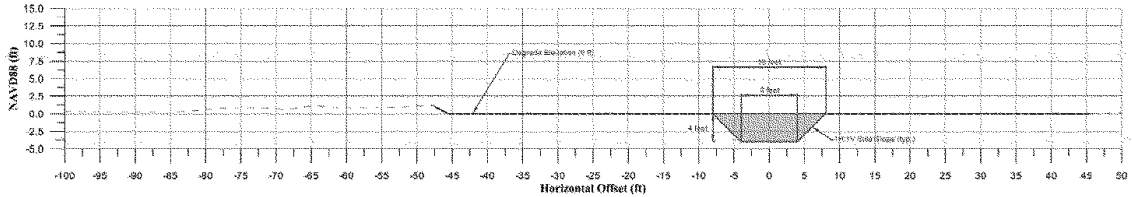
= [37.5 + 1530 + 1560.6] – [450 + 346.6]

= 3128.1 – 796.6 = $2331.5 ft^3/ft$ ~ 86.4 yd^3/ft

Figure 15 – Transitional Habitat Fill Sample Calculations



Degrade of existing levee (yd^3) = 2010 LiDAR – Surface at EL 0 ft (Surface calculation in Autodesk Civil3D)

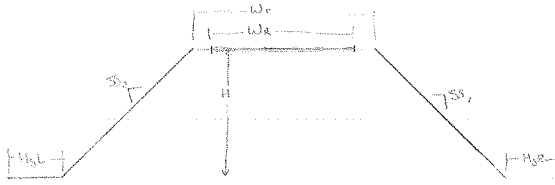


Inspection Trench (yd^3/ft of levee) = 8 ft * 4 ft + 4 ft * 4 ft
= 48 ft^3/ft ~ 1.8 yd^3/ft

Figure 16 – Existing Levee and Foundation Excavation Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline	Computed:	Date:
Subject: Hydroseeding	Checked:	Date:
Task:	Page:	of:
Job #:	No:	



Cross Sectional Width of Hydroseeding, Why

$$W_{hy} = \sqrt{H^2 + (S_p H)^2} + \sqrt{H^2 + (S_s H)^2} + H_s R + H_s L + W_p + W_R$$

Area of Hydroseeding = Why × Length

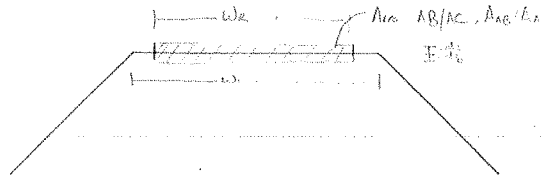
Assumed HsR and HsL = 5 feet
Paved Width, WR = 16 feet where applicable

Note: WR = 16' + Wp = 20' when a paved road is proposed. Otherwise, Wp = 16' + WR = 0'

Figure 17. Hydroseeding Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoal Line	Computed:	Date:
Subject: AB / AC	Checked:	Date:
Task:	Page:	of:
Job #:	No:	



$A_{AB} = W_R \times d_b$

Volume of AB = A_{AB} × Length

$A_{AC} = W_R \times d_c$

Volume of AC = A_{AC} × Length

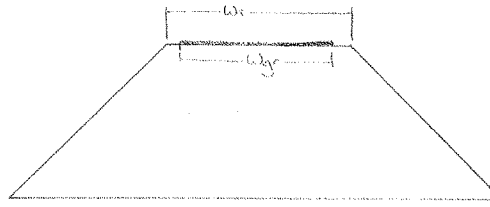
Note: W_R = 20' when a paved road is proposed.

Assumed d_b = 6"
d_c = 2"
W_R = 16'

Figure 18. Aggregate Base Asphault Concrete Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline		Computed:	Date:
Subject: Gravel		Checked:	Date:
Task:		Page:	of:
Job #:		No: -	



$A_{gr} = W_{gr} \times d_{gr}$

Assume $d_{gr} = .5'$

$W_{gr} = 12'$

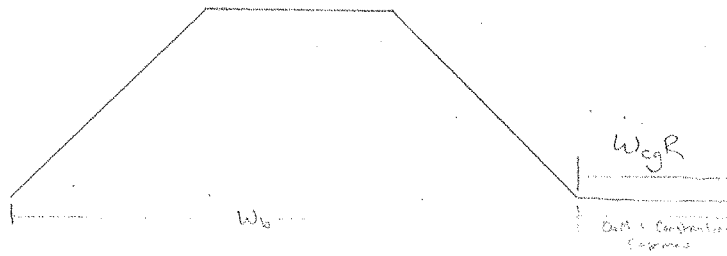
Volume of gravel = A_{gr} × Length

Note: $W_r = 16'$ when a gravel roadway is proposed.

Figure 19. Gravel Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline		Computed:	Date:
Subject: Clearing + Grubbing		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



Clearing + Grubbing Width = $W_b + W_{cgR}$

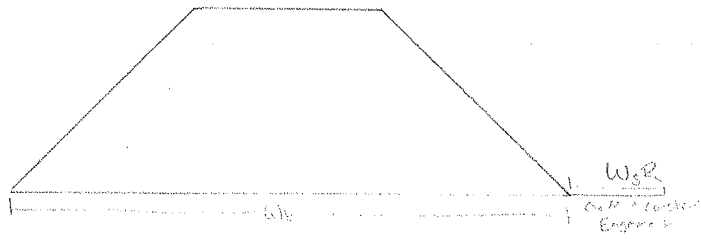
Assume $W_{cgR} = 30'$

Area of C+G = $(W_b + W_{cgR}) \times$ Length

E1-57 Figure 20. Clearing and Grubbing Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline		Computed:	Date:
Subject: Stripping		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



Assume $W_{SR} = 30'$

Assume depth of Stripping $d_S = 1'$

Width of Stripping $W_S = W_S + W_{SR}$

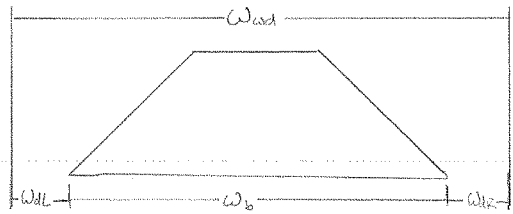
Cross Sectional Area of Stripping, $A_S = W_S \times d_S$

Volume of Stripping = Length × A_S

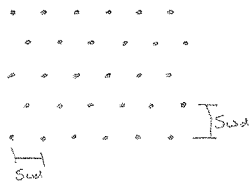
Figure 21. Stripping Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline	Computed:	Date:
Subject: Wick Drains	Checked:	Date:
Task:	Page:	of:
Job #:	No:	



Wick Drain Configuration: Plan View



Width of Wick Drain Spacing, Wwd

$W_{wd} = W_b + W_{dR} + W_{dL}$

Length of Wick Drain Placement, Lwd

L_{wd} = Segment Length + 5' + 5'

Area Wick Drains Placement, Awd

$A_{wd} = W_{wd} \times L_{wd}$

Total Wick Drains, Twd

$T_{wd} = A_{wd} / S_{wd}^2$

Total Linear Footage of Wick Drains

= Twd x (Bay Mud Depth + 5')

CMP Pipes:

Total number of Pipes, $T_c = L_{wd} / S_{wd}$

Total Length of Pipes, $L_c = T_c(W_{wd} + 1' + 1')$

Figure 22. Wick Drains Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline		Computed:	Date:
Subject: Concrete Encase Utility in Place		Checked:	Date:
Task:		Page:	of:
Job #:		No:	

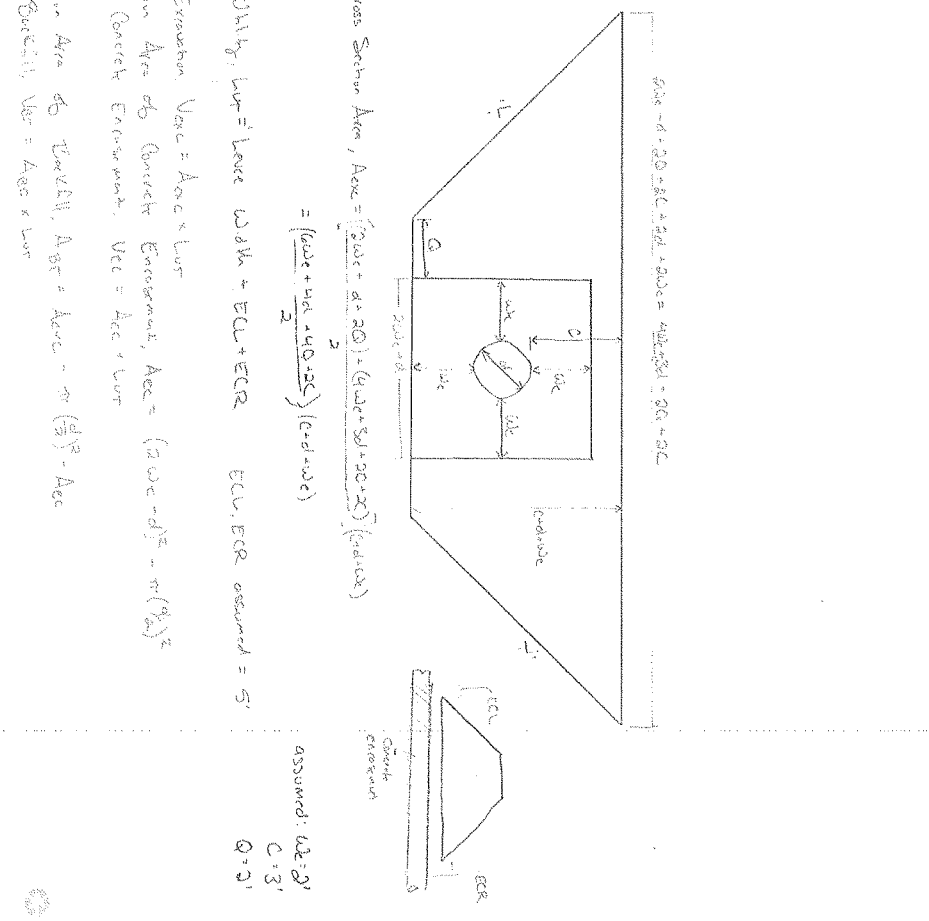
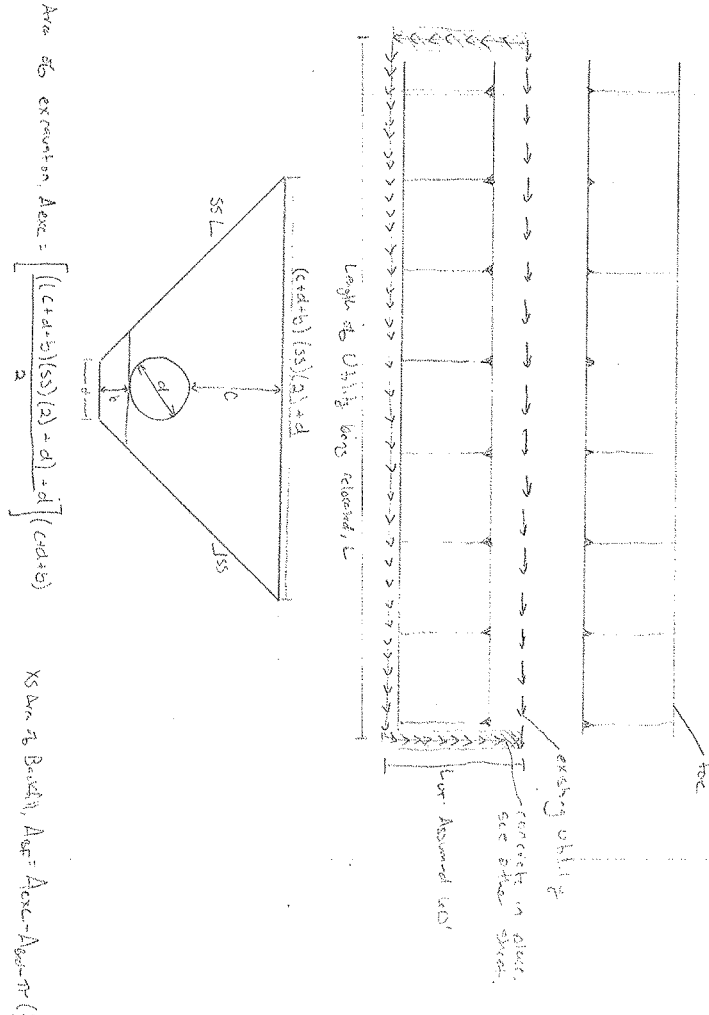


Figure 23. Utilities Relocation Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Sherline		Computed:	Date:
Subject: Relocate Utilities Underground		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



XS Area of excavation, $A_{exc} = \left[\frac{\left[\frac{(c+d+b)(ss)(2)+d}{2}\right]+d}{2}\right](c+d+b)$

Volume of excavation = $A_{exc} \times L$

XS Area of Bedding, $A_{bed} = \left[\frac{\left[d+(b)(ss)(2)\right]+d}{2}\right]b$

Volume of Bedding = $A_{bed} \times L$

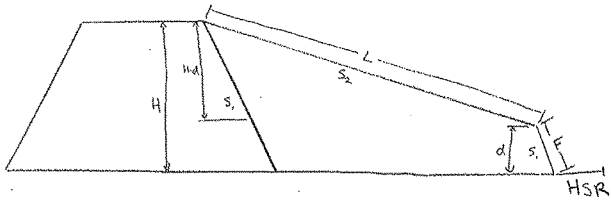
XS Area of Backfill, $A_{BF} = A_{exc} - A_{bed} - \pi\left(\frac{d}{2}\right)^2$

Volume of Backfill = $A_{BF} \times L$

Figure 24. Utilities Relocation Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline - Ecotones		Computed:	Date:
Subject: Ecotone Hydroseeding		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



$$L = \sqrt{(H-d)^2 + [(H-d)(S_2)]^2}$$

$$F = \sqrt{d^2 + (dS_1)^2}$$

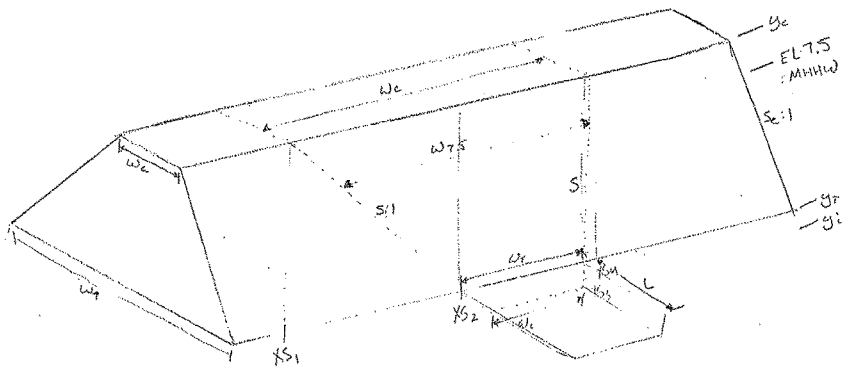
Total Cross Sectional Width of Hydroseeding = HSR + L + F = W_S

Area of hydroseeding = W_S × Length

Figure 25. Ecotone Hydroseeding Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline - Pond Restoration		Computed:	Date:
Subject: Internal Berm Breaches /		Checked:	Date:
Task: Outboard Levee Breaches		Page:	of:
Job #:		No:	



$W_i = W_{7.5} - (MHHW - y_i)(S)(2)$

$W_c = W_i + (y_c - y_i)(S)(2)$

Average End Method:

$XS1 = XS4 = 0$

$XS2 = XS3 = W_c(y_c - y_T) + (y_c - y_T)^2(S_c)$

Volume of Levee Excavation, X_L

$$X_L = \frac{(XS1 + XS2)}{2} \times \frac{(W_c - W_i)}{2} + \frac{(XS2 + XS3)}{2} \times (W_i) + \frac{(XS3 + XS4)}{2} \times \frac{(W_c - W_i)}{2}$$

Cross Sectional Area of extension, A_e

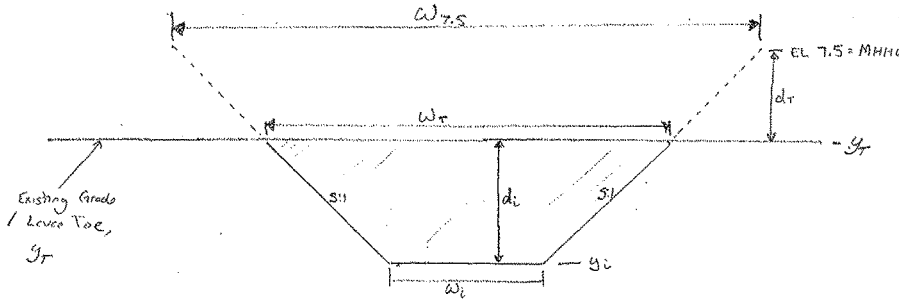
$A_e = (W_i)(y_T - y_i) + (y_T - y_i)^2(S)$

Volume $= A_e \times L$

Figure 26. Levee Breaches Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline - Pond Restoration		Computed:	Date:
Subject: Pilot Channels		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



$$\omega_i = (\omega_{7.5}) - (MHHW - y_i)(S) - (MHHW - y_i)(S)$$

$$A_{7.5} = (MHHW - y_i)(\omega_i) + (MHHW - y_i)^2(S)$$

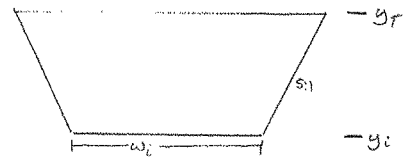
$$A_T = (y_T - y_i)(\omega_i) + (MHHW - y_i)^2(S)$$

Excavation Volume = A_T × Length

Figure 27. Pilot Channels Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline - Pond Restoration		Computed:	Date:
Subject: Ditch Blocks		Checked:	Date:
Task:		Page:	of:
Job #:		No:	



Area = $w_i(y_T - y_i) + (y_T - y_i)^2(5)$

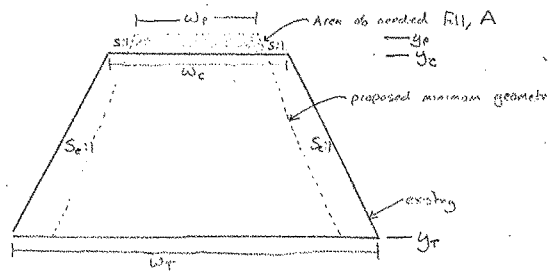
Volume = Area x Length

Figure 28. Ditch Blocks Sample Calculations

HDR | ONE COMPANY *Many Solutions*

Project: Shoreline - Pond Restoration		Computed:	Date:
Subject: Internal Berm Interim Raising		Checked:	Date:
Task:		Page:	of:
Job #:		No:	

estimated Cross Section Geometry:



For areas where proposed top width < existing top width

Excavation Volume (Lower reshaping volume)/

$$A = W_p(y_p - y_c) + (y_p - y_c)^2(S)$$

Volume = A x length

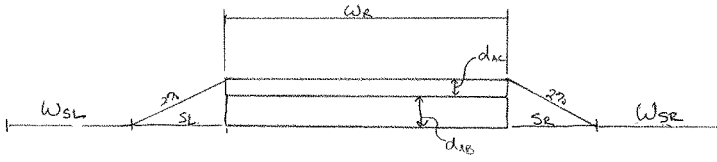
For area where proposed top width > existing top width: An AutoCAD model was used for estimating

Figure 29. Internal Berm Interim Raising Sample Calculations

Appendix E1 - Civil Design

Project: Shoreline - Recreation		Computed:	Date:
Subject: Bay Trails		Checked:	Date:
Task:		Page:	of:
Job #:		No: Figure 41	

NTS



Area Asphalt Concrete = $d_{AC} \times W_R = A_{AC}$

Volume AC = A_{AC} x Length

Area Ag. Base = $d_{AB} \times W_R = A_{AB}$

Volume AB = A_{AB} x Length

Stripping depth = d_s

Stripping Volume = $(S_L + W_R + S_R) \times d_s \times$ Length

Area C+G = $(W_{SL} + S_L + W_R + S_R + W_{SR})$ x Length

Figure 30. Bay Trails Recreation Mitigation Sample Calculations

Quantity Tables

Qunatities 01 - South San Francisco Bay Shorline - NED Levee Quantities

12.5 ft Levee Height with 50 ft Wide Bench

	Project Station				
Reach	Begin	End	Length (ft)	Height (ft)	Fill (CY)
1	0+00	43+80	4,380	13.5	123,735
2	43+80	65+00	2,120	13.5	59,890
3	65+00	94+75	2,975	16.0	112,830
4	94+75	150+00	5,525	16.0	209,541
5	150+00	197+75	4,775	12.7	121,510

	Project Station			Cut (CY)			Fill (CY)						Obtain Offsite Borrow	Place & Compact
Reach	Begin	End	Length (ft)	Degrade	Inspection Trench	TOTAL	Levee	50-ft Bench	Turnout	50% Cut	50% Cut	50% Cut Compacted		
1	0+00	43+80	4,380	60,807	7,787	68,594	131,522	73,000	302	34,297	34,297	27,438	104,386	131,824
2	43+80	65+00	2,120	37,795	3,769	41,564	63,659	--	570	20,782	20,782	16,626	47,603	64,229
3	65+00	94+75	2,975	64,381	5,289	69,670	118,119	--	--	34,835	34,835	27,868	90,251	118,119
4	94+75	150+00	5,525	154,817	9,822	164,639	219,363	92,083	302	82,320	82,320	65,856	153,809	219,665
5	150+00	197+75	4,775	164,712	8,489	173,201	129,998	79,583	--	86,601	86,601	69,280	60,718	129,998

Quantities 02 - South San Francisco Bay Shorline - LPP Levee Quantities

15.2 ft Levee Height with 30:1 Ecotone

Reach	Project Station Begin	Project Station End	Length (ft)	Height (ft)	Fill (CY)
1	0+00	43+80	4,380	16.7	179,072
2	43+80	65+00	2,120	16.7	86,674
3	65+00	94+75	2,975	19.7	163,016
4	94+75	150+00	5,525	19.7	302,743
5	150+00	197+75	4,775	15.2	165,590

	Project Station			Cut (CY)			Fill (CY)							Levee Only	
Reach	Begin	End	Length (ft)	Degrade	Inspection Trench	TOTAL	Levee	50-ft Bench	Turnout	Ecotone	50% Cut	50% Cut	50% Cut Compact	Obtain Offsite Borrow	Place & Compact
1	0+00	43+80	4,380	60,807	7,787	68,594	186,859	73,000	416	378,228	34,297	34,297	27,438	159,837	187,275
2	43+80	65+00	2,120	37,795	3,769	41,564	90,443	--	684	--	20,782	20,782	16,626	74,502	91,127
3	65+00	94+75	2,975	64,381	5,289	69,670	168,305	--	--	--	34,835	34,835	27,868	140,437	168,305
4	94+75	150+00	5,525	154,817	9,822	164,639	312,566	92,083	416	477,102	82,320	82,320	65,856	247,126	312,982
5	150+00	197+75	4,775	164,712	8,489	173,201	174,079	79,583	--	412,337	86,601	86,601	69,280	104,798	174,079

1066

South San Francisco Bay Shoreline Study - Quantities

LPP - 100 year (1%) Level of Protection

Pond Restoration Quantities - Outboard Levee Breaches

Watershed	Existing Top Elevation (ft.)	Levee Toe Elevation (ft.)	Existing Levee Side Slopes (H:V)	Existing Levee Top Width (ft.)	Existing Levee Bottom Width (ft.)	Breach top Width @ Existing Top Elevation	Breach invert Elevation (ft.)	Breach Top Width @ EL 7.5	Breach XS Area @ EL 7.5	Breach Bottom Width (ft.)	Breach Slopes (H:V)	Excavation Volume Breach of Levee Only (CY)	Cross Sectional Area of Breach Extension (SF)	Total Extension Length (ft.)	Excavation Volume (CY)
Pond A12 (1) (A11 in memo)	12.0	2.0	5.8	10.0	172.0	186.7	-6.3	145.0	865.0	17.2	4.6	120,367.7	159.6	100.0	5,485.9
Pond A12 (2)	12.0	5.0	18.4	24.0	171.0	191.5	-6.5	150.0	910.0	21.0	4.6	41,430.5	1,273.2	100.0	6,249.8
Phase 1 Total:	--	--	--	--	--	--	--	--	--	--	--	**173,298.2**	--	**200.0**	**11,650.8**
Pond A9*	12.0	0.0	3.9	10.0	100.0	232.4	-8.6	190.0	1,300.0	38.4	4.7	89,355.0	678.4	100.0	5,822.2
West Pond A9*	12.0	0.0	3.9	10.0	100.0	232.4	-8.6	190.0	1,300.0	38.4	4.7	89,355.0	678.4	100.0	5,822.2
Pond A10*	12.0	0.0	3.8	10.0	100.0	180.3	-8.0	140.0	820.0	19.0	4.5	65,780.0	276.3	100.0	3,495.0
Pond A10West*	12.0	0.0	3.8	10.0	100.0	180.3	-8.0	140.0	820.0	19.0	4.5	65,780.0	276.3	100.0	3,495.0
North A10	14.0	1.0	5.0	7.0	137.0	156.1	-3.9	100.0	520.0	1.6	4.3	73,906.1	111.5	100.0	3,146.4
Central A10	14.0	5.0	2.9	7.7	80.0	193.4	-5.9	135.0	805.0	14.6	4.5	31,884.1	692.9	100.0	3,729.8
West A10	14.0	5.0	3.9	11.0	80.0	205.0	-8.4	145.0	890.0	16.6	4.6	45,381.4	789.5	100.0	4,604.6
East A10	16.0	9.0	5.4	30.0	100.0	223.5	-8.4	145.0	890.0	16.6	4.6	57,148.1	1,351.0	100.0	7,120.3
Southwest A10	14.0	5.0	3.8	11.0	80.0	205.0	-8.4	145.0	890.0	16.6	4.6	45,381.4	789.5	100.0	4,604.6
South A10	14.0	5.0	3.8	11.0	80.0	205.0	-8.4	145.0	890.0	16.6	4.6	45,381.4	789.5	100.0	4,604.6
Phase 2 Total:	--	--	--	--	--	--	--	--	--	--	--	**518,288.6**	--	**800.0**	**37,167.9**
Pond A13-15	12.0	2.0	4.4	23.0	195.0	305.6	-11.6	260.0	2,080.0	85.4	5.1	202,330.3	1,431.7	100.0	14,277.7
Phase 3 Total:	--	--	--	--	--	--	--	--	--	--	--	**202,330.3**	--	**100.0**	**14,277.7**

*Values for these ponds are assumed due to lack of topographical data

MHHW: 7.5

Note: **Phase 1** Construction: 2020 - 2021

Phase 2 Construction: 2025 - 2026

Phase 3 Construction: 2030 - 2031

1067

Quantities 03 - Quantities for Pond Restoration Outboard Levee Breaches

South San Francisco Bay Shoreline Study - Quantities

LPP - 100 year (1%) Level of Protection

Pond Restoration Quantities - Internal Berm Breaches

Watershed	Number of Breaches	Existing Top Elevation (ft)	Levee Toe Elevation (ft)	Existing Levee Side Slope (H:1)	Existing Levee Top Width (ft)	Existing Levee Bottom Width (ft)	Breach Top Width @ Existing Top Elevation (ft)	Breach Invert Elevation (ft)	Breach Top Width @ El. 7.5 (ft)	Breach XS Area @ El. 7.5 (SF)	Breach Bottom Width (ft)	Breach Slopes (H:V)	Volume of Excavation of Breach at Levee Only (CY)	Cross Sectional Area of Breach Extension (SF)	Total Extension Length (ft)	Volume of Breach Extension (CY)	Excavation Volume (CY)
Pond A16-W*	3.0	10.0	9.0	4.0	16.0	80.0	80.0	1.6	85.3	1,103.0	32.4	3.0	921.7	24.2	100.0	90.1	1,011.8
A16BU1*	1.0	9.0	9.0	4.0	16.0	80.0	68.0	1.6	86.0	1,103.0	36.4	3.0	1,027.6	36.2	100.0	259.7	1,194.1
Phase 1 Total:	3.0	--	--	--	--	--	--	--	--	--	--	--	2,758.1	--	200.0	449.8	4,210.3
Pond A18-W*	1.0	10.0	9.0	4.0	16.0	80.0	60.0	4.4	140.0	600.0	36.2	4.0	1,065.1	32.6	100.0	194.7	1,102.8
Phase 2 Total:	1.0	--	--	--	--	--	--	--	--	--	--	--	1,065.1	--	100.0	0.0	1,102.8
Pond A13-S	1.0	7.8	0.2	4.4	20.0	85.2	72.0	4.1	75.0	905.0	37.4	1.0	635.4	71.0	100.0	270.4	1,063.3
Phase 3 Total:	1.0	--	--	--	--	--	--	--	--	--	--	--	635.4	--	100.0	270.4	1,063.3

*Values for these ponds are assumed due to lack of topographical data

MHHW 7.5

Note: **Phase 1** Construction: 2020 - 2021

Phase 2 Construction: 2025 - 2026

Phase 3 Construction: 2030 - 2031

1068

Quantities 04 - Quantities for Pond Restoration Internal Berm Breaches

South San Francisco Bay Shoreline Study - Quantities

LPP - 100 year (1%) Level of Protection

Pond Restoration Quantities - Pilot Channels

Watershed	Levee Toe Elevation (ft.)	Pilot Channel Invert Elevation (ft.)	Pilot Channel Top Width @ EL 7.5 (ft.)	Pilot Channel Slopes (H:V)	Pilot Channel Bottom Width (ft.)	Pilot Channel XS Area @ EL 7.5	Pilot Channel XS Area @ Grade (SF)	Length of Pilot Channel (ft.)	Excavation Volume (CY)
Pond A12 (1) (A11 in memo)	0.0	-5.0	100.0	3.0	17.2	808.7	227.4	155.0	1,305.6
Pond A12	8.0	-8.5	105.0	3.0	21.0	982.0	431.3	575.0	9,184.0
Phase 1 Total:	--	--	--	--	--	--	--	730.0	10,489.6
Pond A0*	0.0	-4.5	135.0	3.0	38.4	1,395.9	552.1	1,490.0	30,264.4
West Pond A0*	0.0	-8.0	135.0	3.0	38.4	1,395.9	552.1	1,490.0	30,264.4
Pond A10*	0.0	-6.0	100.0	3.0	19.0	803.3	222.0	285.0	2,178.9
Pond A10West*	0.0	-6.0	100.0	3.0	19.0	803.3	222.0	300.0	2,466.7
North A18	1.0	-3.9	70.0	3.0	1.6	406.1	53.5	130.0	257.4
Central A18	5.0	-5.9	95.0	3.0	14.6	734.3	263.8	175.0	1,708.3
West A18	5.0	-6.4	100.0	3.0	16.6	810.4	312.1	330.0	3,814.8
East A18	5.0	-6.4	100.0	3.0	16.6	810.4	378.5	490.0	6,869.4
Southwest A18	5.0	-6.4	100.0	3.0	16.6	810.4	312.1	0.0	0.0
Phase 2 Total:	--	--	--	--	--	--	--	4,690.0	77,824.3
Pond A13-15	-2.0	-11.8	160.0	3.0	65.4	2,343.6	1,031.5	1,110.0	42,406.9
Phase 3 Total:	--	--	--	--	--	--	--	1,110.0	42,406.9

*Values for these ponds are assumed due to lack of topographical data

MHHW: 7.5

Note: **Phase 1** Construction: 2020 - 2021

Phase 2 Construction: 2025 - 2026

Phase 3 Construction: 2030 - 2031

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Quantities 05 - Quantities for Pond Restoration Pilot Channels

South San Francisco Bay Shoreline Study - Quantities

LPP - 100 year (1%) Level of Protection

Pond Restoration Quantities - Ditch Blocks

Pond	Number of Ditch Blocks	Top Elevation (ft.)	Toe Elevation (ft.)	Side Slopes (H:V)	Top Width (ft.)	XS Area (SF)	Approx. Avg Length (ft.)	Volume per Block (CY)	Required Fill (CY)	Bank Run (CY)
Pond A12 (1) (A11 in memo)	2.0	0.0	-4.3	5.0	50.0	513.5	20.0	380.3	760.7	950.8
Pond A12 (2)	2.0	8.0	-8.5	5.0	50.0	1,776.3	25.0	1,315.7	2,631.5	3,289.4
Phase 1 Total:	**4.0**	–	–	–	–	–	–	–	**3,392.1**	**4,240.2**
Pond A9	1.0	0.0	-3.6	5.0	50.0	709.5	20.0	592.4	592.4	740.5
Pond A10	2.0	0.0	-8.0	5.0	50.0	480.0	20.0	355.6	711.1	888.9
Pond A11	4.0	0.0	-5.6	5.0	50.0	436.8	20.0	323.6	1,294.2	1,617.8
Pond A18 North	1.0	1.0	-3.9	5.0	50.0	365.1	20.0	270.4	270.4	338.0
Pond A18 Central	1.0	5.0	-5.0	5.0	50.0	1,139.1	20.0	843.7	843.7	1,054.7
Pond A18 Southwest	1.0	5.0	-6.4	5.0	50.0	1,219.8	20.0	903.6	903.6	1,129.4
Pond A18 East	1.0	9.0	-8.4	5.0	50.0	1,955.8	20.0	1,448.7	1,448.7	1,810.9
Phase 2 Total:	**11.0**	–	–	–	–	–	–	–	**6,064.2**	**7,580.3**
Pond A13	2.0	0.7	-2.1	5.0	50.0	176.2	20.0	132.7	265.5	331.9
Pond A14	8.0	1.0	-3.1	5.0	50.0	286.1	20.0	214.1	1,284.7	1,605.8
Pond A15	3.0	3.0	-11.6	5.0	50.0	940.8	20.0	695.9	2,090.7	2,613.3
Phase 3 Total:	**11.0**	–	–	–	–	–	–	–	**3,640.9**	**4,551.0**

*Values for these ponds are assumed due to lack of topographical data

Note: **Phase 1** Construction: 2020 - 2021
Phase 2 Construction: 2025 - 2026
Phase 3 Construction: 2030 - 2031

South San Francisco Bay Shoreline Study - Quantities

LPP - 100 year (1%) Level of Protection

Pond Restoration Quantities - Internal Berm Interim Raising

Pond	Length (ft.)	Existing Top Elevation (ft.)	Levee Toe Elevation (ft.)	Existing Levee Top Width (ft.)	Existing Levee Bottom Width (ft.)	Existing Levee Slopes (H:V)	Existing Levee XS Area (SF)	Proposed Top Elevation (ft.)	Proposed Top Width (ft.)	Proposed Slope (H:V)	Proposed XS Area (SF)	Existing Levee Volume (CY)	Proposed In-Place Volume (CY)	Required Borrow (CY)	Difference in Geometry Volume (CY)	Excavation Volume (CY)**
Pond A12 North & Northwest	4,590.0	9.5	0.0	10.0	90.5	4.7	425.0	9.8	12.5	2.5	362.5	72,250.0	81,642.0	0.0	10,608.0	5,045.6
Phase 1 Total:	**4,590.0**	--	--	--	--	--	--	--	--	--	--	**72,250.0**	**81,642.0**	--	**10,608.0**	**5,045.6**
Pond A8 East*	4,440.6	9.0	0.0	15.0	80.0	3.6	427.5	9.8	12.5	2.5	362.5	54,460.7	46,197.9	0.0	8,269.7	1,477.5
Pond A11 North and East*	4,300.0	9.0	0.0	15.0	80.0	3.6	427.5	9.8	12.5	2.5	362.5	77,593.3	86,805.2	0.0	11,778.1	2,106.2
Phase 2 Total:	**8,340.0**	--	--	--	--	--	--	--	--	--	--	**132,050.0**	**112,003.1**	**0.0**	**20,046.5**	**3,583.1**

*Values for these ponds are assumed due to lack of topographical data

**Existing berm geometry provides for a larger cross sectional area despite the shorter berm height. Exacation Volume is for reshaping of the existing berm.

Note: **Phase 1** Construction: 2020 - 2021

Phase 2 Construction: 2025 - 2026

Phase 3 Construction: 2030 - 2031

Quantities 07 - Quantities for Pond Restoration Internal Berm Interim Raising

South San Francisco Bay Shoreline Study - Restoration Quantities

Bay Trails Recreation Mitigation

Length	Paved Width (ft)	Compacted Dirt Shoulder, Width (each side, ft)	Total Width (ft)	Aggregate Base (CY)	Asphault Concrete (CY)	Clearing and Grubbing (AC)	Stripping (CY)
12,200.0	10.0	3.0	16.0	2,259.3	903.7	10.1	7,229.6

South San Francisco Bay Shoreline Study - Restoration Quantities

Alviso North WPCP South, 100-YR

Pedestrian Bridges

Reach	Length (ft)	Excavation (Bridge) (CY)	Excavation (Type D) (CY)	Excavation (Retaining Wall) (CY)	Backfill (Bridge) (CY)	Backfill (Retaining Wall) (CY)	16" Steel Pipe Piling Total Length (ft)	# 16" Steel Pipe Piling	48" Cast-in-Steel-Shell Piling Total Length (ft)	# 48" Cast-inSteel-Shell Piling	Concrete (CY)	Box Truss Length (ft)	# of Box Truss	Bar Reinforcing Steel (bridge) (lb)	Ornamental Railing (ft)	Pedestrian Gateway Enhancements	Bird Exclusion Measures
Rail Road Crossing	350	60	29	116	44	203	917	10	262	4	291	127	3	28088	27	1	1
WPCP Discharge Crossing	100	21	8	31	12	54	252	4	70	4	75	100	1	7395	69	1	1

Note: These numbers are developed based on a 2006 report titled "Alviso Slough Pedestrian Bridge Feasibility Study, Bay Trail Reach 9B" prepared for the City of San Jose. Values are scaled/estimated based on overall bridge length and other factors unique to each project. These numbers are for cost estimating purposes only.

Existing Utility Information Technical Memo Appendix

HDR

Technical Memorandum

EXISTING UTILITY INFORMATION

South San Francisco Bay Shoreline Study ***September 29, 2011***

Reviewed by: Sergio Jimenez, PE

Prepared by: Daniel Teak, EIT

1.0 Introduction

Under task item 3b from the Schedule of Services for *South San Francisco Bay Shoreline Study* dated 17 May 2011, the contractor is required to gather utility data that may be impacted by the project. The following utility information is a preliminary accounting and summary of the existing utilities in the project area that may be impacted by flood risk management features. Following identification of the NED/NER and Locally Preferred Plan, more focused utility surveys and site visit will be conducted to update the technical memo.

2.0 Sources of Utility Information

Multiple sources were used to gather information on existing utilities in the project area. They are listed and described below:

- Water Pollution Control Plant (WPCP) GIS Database – HDR was provided with a GIS database from the City of San Jose. The database included descriptions and locations of underground utilities operated by the WPCP. This information has been summarized in Tables 1A, and 1B (**Attachment 1**) and has been mapped in Figures 1A, 1B, and 1C (**Attachment 2**).

- City of San Jose Utility Database (https://cpms.sanjoseca.gov/emap/) – This website was recommended for use for as a preliminary accounting of utilities. It consists of maps showing location and use of existing utilities. The information gathered from this website has been summarized in Table 2 (**Attachment 1**) and mapped in Figure 2 (**Attachment 2**).

- Aerial and street level photography – A series of aerial and street level photography was used to identify approximate locations of utilities not identified by either of the previous databases. This information has been summarized in Table 3 (**Attachment 1**) and Figure 3 (**Attachment 2**).

3.0 Existing Utilities

In total, there are over 80 known utilities that may be impacted by construction of flood control features. Utilities operated by the WPCP comprise of a large portion of the existing utilities potentially impacted. The majority of the WPCP's 61 known utilities in the project footprint are sited along both sides of Artesian Slough between the WPCP and the Don Edwards Center.

A PG&E owned power line runs south through Pond A18, crosses Artesian Slough, and runs on the southern side of Grand Blvd. Storm drains, sanitary sewers, and other utilities potentially conflict on the west and east side of Alviso and along Grand Blvd.

Attachment 1 - Tables

Table 1A: Plant Pipeline Utilities

Map Label	Location	Diameter	Material	Use	Status	Owner	Length	Notes	Required Modification						
									1A	1B	1C	1D	2	3	4
1	Buried. East of Artesian Slough, just north of plant.	6"	VCP	Storm Drain	In-Use	–	321.1	–			X				
2	Buried. East of Artesian Slough to proposed tide gate.	6"	STL	Sulfur Dioxide Solution	In-Use	–	353.0	Originates from SO2 Bldg.			X				
3	Buried. East of Artesian Slough to proposed tide gate.	4"	PVC	Sulfur Dioxide Vacuum	In-Use	–	483.4	–			X				
4	Buried. Discharges on east side of Artesian Slough	77" x 121"	RCBC	Plant Effluent	In-Use	–	496.3	–			X				
5	Above Ground. At southern tip of Artesian Slough	1"	PVC	Sodium Bisulfite Solution	In-Use	–	6.8	–			X				
6	Above Ground. At southern tip of Artesian Slough	1"	PVC	Sodium Bisulfite Solution	In-Use	–	7.1	–			X				
7	Buried. Discharges on east side of Artesian Slough	84"	RCP	Plant Effluent	In-Use	–	402.9	–			X				
8	Buried. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	2.4	–			X				
9	Above Ground. South of Artesian Slough.	8"	DIP	Recycled Water	Abandoned	–	1.7	–			X				
10	Above Ground. South of Artesian Slough.	8"	DIP	Recycled Water	Abandoned	–	2.1	–			X				
11	Floating on Water at northern end of eastern side of artesian slough.	1.5"	PVC	Sulfur Dioxide Vacuum	In-Use	–	20.2	Flexible PVC Hose to Sulfur Dioxide Induction Unit located in Outfall Channel			X				
12	Buried. West of Artesian Slough, next to North side of Zamar Road Landfill	10	RCBC	Storm Drain	In-Use	–	20.5	Flows to Outfall Stormwater Pump Station, gates closed. Can flow to Artesian Slough			X				
13	Buried. Along West side of Artesian Slough.	4"	PVC	Sodium Bisulfite Solution	In-Use	–	2,712.7	Terminates at Plant Outfall Channel			X				
14	Buried. Along East side of Artesian Slough.	6"	PVC	Sulfur Dioxide Vacuum	Abandoned	–	2,814.3	Cut and Capped in 2010 as part of Alternative Disinfection Project			X				
15	Buried. Along East side of Artesian Slough.	6"	PVC	Sulfur Dioxide Vacuum	Abandoned	–	478.2	–			X				
16	Buried. Northern on east side at artesian and facility	4"	PVC	Sulfur Dioxide Vacuum	In-Use	–	6.6	–			X				
17	Buried. Northern on east side of artesian and facility	4"	PVC	Sulfur Dioxide Vacuum	In-Use	–	1.6	–			X				
18	Above Ground. South of Artesian Slough.	8"	DIP	Recycled Water	Abandoned	–	8.4	–			X				
19	Floating on Water, ties into 2, 5, or 16.	1.5"	PVC	Sulfur Dioxide Vacuum	In-Use	–	31.1	Flexible PVC Hose to Sulfur Dioxide Induction Unit located in Outfall Channel			X				
20	Buried. Along East side of Artesian Slough	4"	PVC	Sulfur Dioxide Vacuum	In-Use	–	2,865.3	–			X				
21	Buried. At southern tip of Artesian Slough	8"	–	Recycled Water	Abandoned	–	39.1	–			X				
22	Above Ground. At southern tip of Artesian Slough	1"	STL	Sodium Bisulfite Solution	In-Use	–	8.8	–			X				
23	Above Ground. At southern tip of Artesian Slough	1"	STL	Sodium Bisulfite Solution	In-Use	–	9.1	–			X				
24	Buried. Discharges on southwest side of Artesian Slough	48"	RCP	Plant Effluent	Abandoned	–	487.0	Abandoned in 1975			X				
25	Buried. Discharges on east side of Artesian Slough	84"	RCP	Plant Effluent	Abandoned	–	297.6	–			X				
26	Above Ground. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	4.7	–			X				
27	Above Ground. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	4.4	–			X				
28	Above Ground. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	4.7	–			X				
29	Above Ground. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	28.8	–			X				
30	Buried. Southeast of Artesian Slough	8"	–	Recycled Water	Abandoned	–	29.5	–			X				
31	Above Ground. At southern tip of Artesian Slough	8"	DIP	Recycled Water	Abandoned	–	15.1	–			X				
32	Buried. Discharges southeast of Artesian Slough	8"	DIP	Recycled Water	Abandoned	–	71.4	–			X				
33	Above Ground. At southern tip of Artesian Slough	8"	DIP	Recycled Water	Abandoned	–	72.2	–			X				
34	Buried. At southern tip of Artesian Slough	8"	DIP	Recycled Water	Abandoned	–	70.9	–			X				
35	Above Ground. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	7.1	–			X				
36	Buried. South of Artesian Slough.	8"	–	Recycled Water	Abandoned	–	30.8	–			X				
37	Buried. Northern on east side. Connects to 11.	1.5"	PVC	Sulfur Dioxide Vacuum	In-Use	–	44.7	–			X				
38	Buried. Just north of treatment plant.	16"	DIP	Recycled Water	In-Use	–	177.3	–			X				
39	Buried. south of Artesian slough	8"	DIP	Recycled Water	Abandoned	–	105.8	–			X				
40	Above Ground. Runs north south to southeast of artesian slough	8"	DIP	Recycled Water	Abandoned	–	174.8	–			X				
41	Above Ground. South of Artesian Slough.	8"	DIP	Recycled Water	Abandoned	–	11.3	–			X				
42	Above Ground. South of Artesian Slough.	8"	DIP	Recycled Water	Abandoned	–	8.0	–			X				
43	Above Ground. Runs north south to southeast of artesian slough	8"	DIP	Recycled Water	Abandoned	–	167.3	–			X				
44	Buried. To Southeast side of Artesian Slough	1.5"	PVC	Sodium Bisulfite Solution	In-Use	–	618.4	Unable to find Record Drawings for this pipe. Likely goes to the Outfall			X				
45	Buried. To Southeast side of Artesian Slough	16"	DIP	Recycled Water	Abandoned	–	418.7	–			X				

46	Buried. Northern on east side of artesian. Connects to 19.	1.5"	PVC	Sulfur Dioxide Vacuum	In-Use	–	82.8	–	X
47	Buried. From facility at plant connecting to 48.	84"	RCP	Plant Effluent	Abandoned	–	87.2	–	X
48	Buried. Buried, connects 47 and 26.	84"	RCP	Plant Effluent	Abandoned	–	20.7	–	X
49	Buried. Discharges South of Artesian Slough	48" X 78"	ERCP	Storm Drain	In-Use	–	608.0	–	X
50	Buried, along serenities, Los Esteros, and to plant	84"	RCP	Plant Effluent	In-Use	–	79.9	–	X
51	Buried. Runs north out of plant	4"	PVC	Sodium Bisulfite Solution	In-Use	–	65.7	Terminates at Outfall, ran through former 6" SDV pipe when crossing under Los Esteros Rd	X
52	Buried. Runs east-west in front of plant.	10"	ACP	Force Main	In-Use	City of San Jose Department of Public Works	5,666.4	–	X

Note: '–' indications unknown or not provided.

Table 1B: Plant Electrical Utilities

Map Label	Location	Diameter	Status	Owner	Length	Notes	Required Modification						
							1A	1B	1C	1D	2	3	4
1	Buried, along east side of Artesian Slough	--	In-Use	--	2,998.3	--			X				
2	Buried, south of artesian, along front of plant	--	In-Use	--	256.3	--			X				
3	Buried, front plant to 2	--	In-Use	--	194.4'	--			X				
4	Buried, from plant to 1	2-4"	Verify if Abandoned	PG&E	480.5	Electrical supply to now abandoned SBWR Pump Station			X				
5	Buried, along west side of Artesian Slough	??	Verify if Abandoned	PG&E	1,560.7	Electrical supply to Outfall Stormwater Pump/Lift Station			X				
6	Buried, from to south of Artesian	2"	Verify if Abandoned	PG&E	369.1	Electrical Supply to CSC Chlorine Station			X				
7	Buried, between 1 and 9 around structure at proposed tide gate location on east side of alviso slough	--	--	--	80.0	--			X				
8	Buried, along east side of Artesian Slough	--	--	--	658.1	--			X				
9	Buried, along east side of Artesian Slough, north of proposed flood gate	--	Installed	--	684.8	Electrical supply to A18 Weir	X	X	X	X	X	X	X

Note: '--' indications unknown or not provided.

Table 2: City of San Jose Utility Map

Map Label	Sheet	Location	Utility	Status	Owner	Length	Notes	Required Modification						
								1A	1B	1C	1D	2	3	4
1	19	Running North-South between Ponds A15, A11, A12, and Pond A16, NCM, and Alviso	Railroad	In-use	--	~5000'	--	X	X	X	X	X	X	X
2	19, 20	Running East-West through NCM crossing through Grand Blvd	Railroad	In-use	--	~5000'	--	X	X	X	X	X	X	X
3	19D	Crossing RR from NCM to Alviso Slough, and north of city (multiple potential crossing of levee alignment)	Storm Drain	In-use	--	~550'	--							X
4	19D	Crossing Spreckles Ave north of City	Storm Drain	In-use	--	~100'	--							X
5	5, 20	North South through Pond A18 and into WPCP area	Power Lines	In-use	PG&E	~6000'	--	X	X	X	X	X	X	X
6	20	Connecting to powerlines (previous), crossing Artesian Slough, and running across Grand Blvd	Power Lines	In-use	PG&E	~6000'	--			X		X	X	X
7	20C	Crossing Grand Blvd just south of Los Esteros.	Storm Drain	In-use	--	~100'	--							X
8	20C SS	Along Spreckles connecting to Grand Blvd	Sanitary Sewer	In-use	--	~1800'	--							X
9	20C SS	Along Grand Blvd, from RR to Essex	Sanitary Sewer	In-use	--	~3900'	--							X

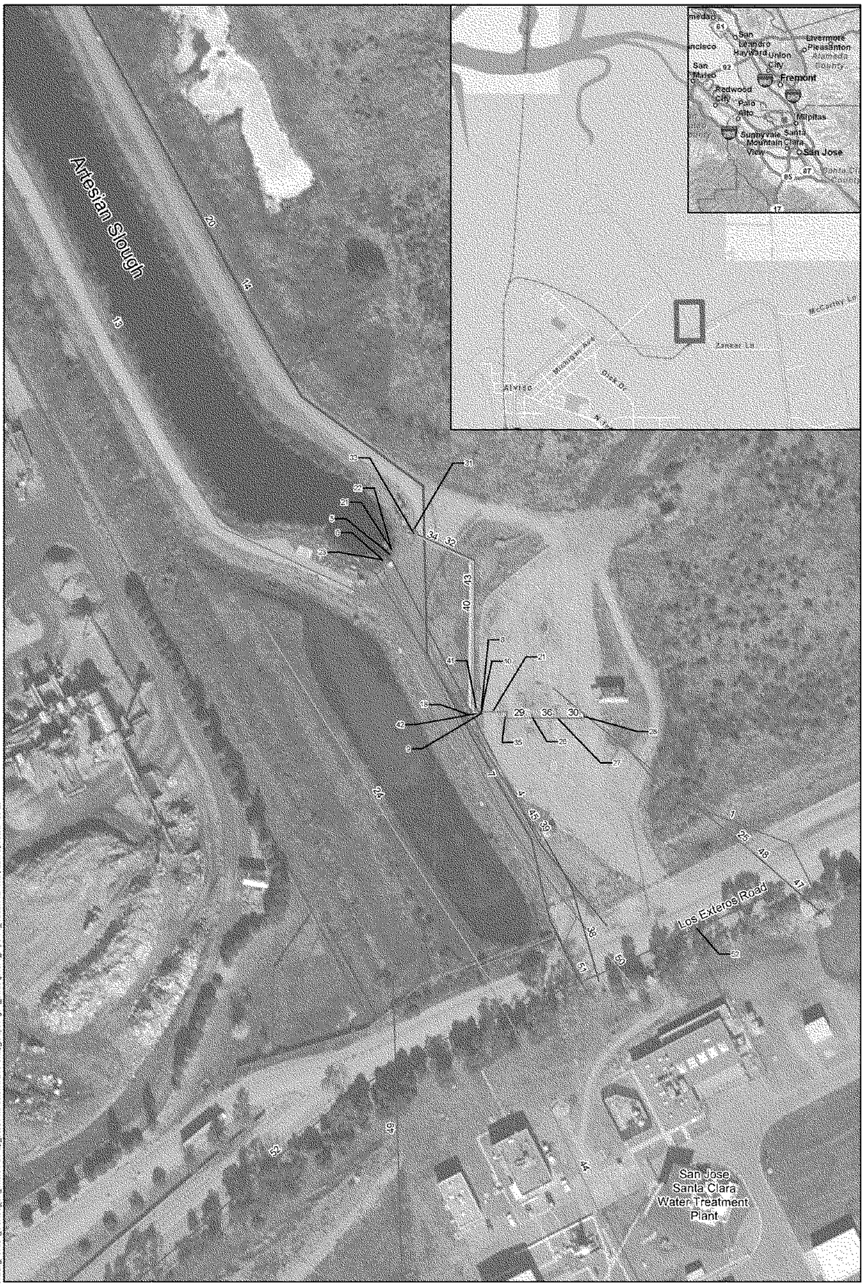
Note: '--' indications unknown or not provided.

Table 3: Aerial and Street Level Photograph Utilities

Sheet	Location	Utility	Status	Owner	Length	Notes	Required Modification						
							1A	1B	1C	1D	2	3	4
1	Grand Blvd, to south of Don Edwards	Utility Access / USA	--	--	--	--			x				
2	Grand Blvd, to south of Don Edwards	Utility Access	--	--	--	--			x				
3	Grand Blvd, to south of Don Edwards	USA	--	--	--	--			x			x	x
4	Grand Blvd, to east of RR	Utility Access	--	--	--	--						x	x
5	Grand Blvd, to east of RR	Utility Access	--	--	--	--						x	x
6	Grand Blvd, just west of RR	SS MH	--	--	--	--						x	x
7	Grand Blvd, near intersection with Los Esteros	USA	--	--	--	--						x	x
8	Grand Blvd, near intersection with Los Esteros	USA	--	--	--	--						x	x
9	Grand Blvd, west of intersection with Los Esteros	Utility Access	--	--	--	--						x	x

Note: '--' indications unknown or not provided.

Attachment 2 - Figures



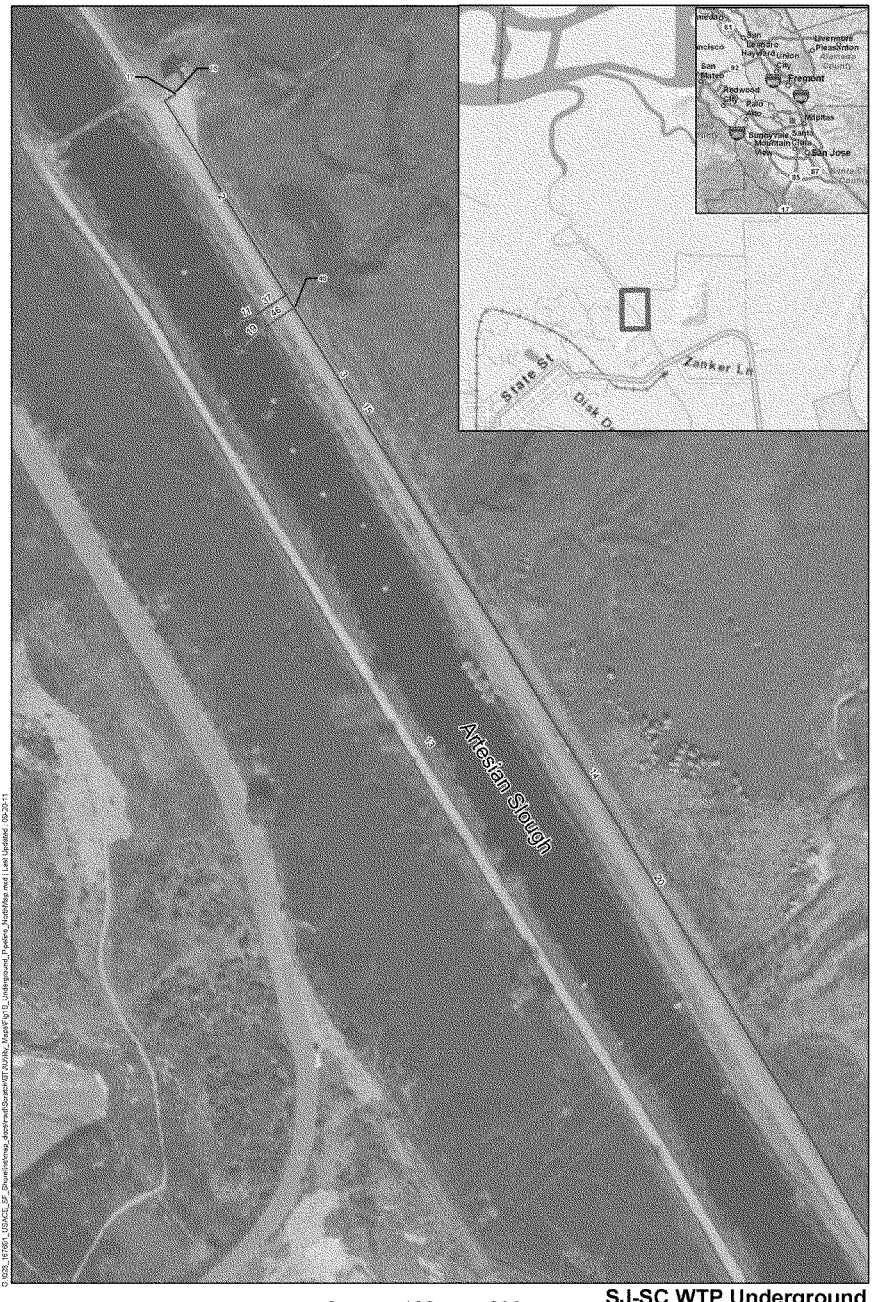
0 100 200 Feet

1 inch = 100 feet

SJ-SC WTP Underground Pipeline Map South Figure 1A

USACE SF Shoreline

HDR ONE COMPANY | *Many Solutions*



0 100 200 Feet

1 inch = 100 feet

SJ-SC WTP Underground Pipeline Map North Figure 1B

USACE SF Shoreline

HDR
ONE COMPANY | *Many Solutions*™

0 500 1,000 Feet

1 inch = 250 feet

HDR
ONE COMPANY | *Many Solutions*

SJ-SC WTP Underground Electrical Figure 1C

USACE SF Shoreline

0 1,000 2,000 Feet

1 inch = 600 feet

City of San Jose Utilities Database Figure 2A

USACE SF Shoreline

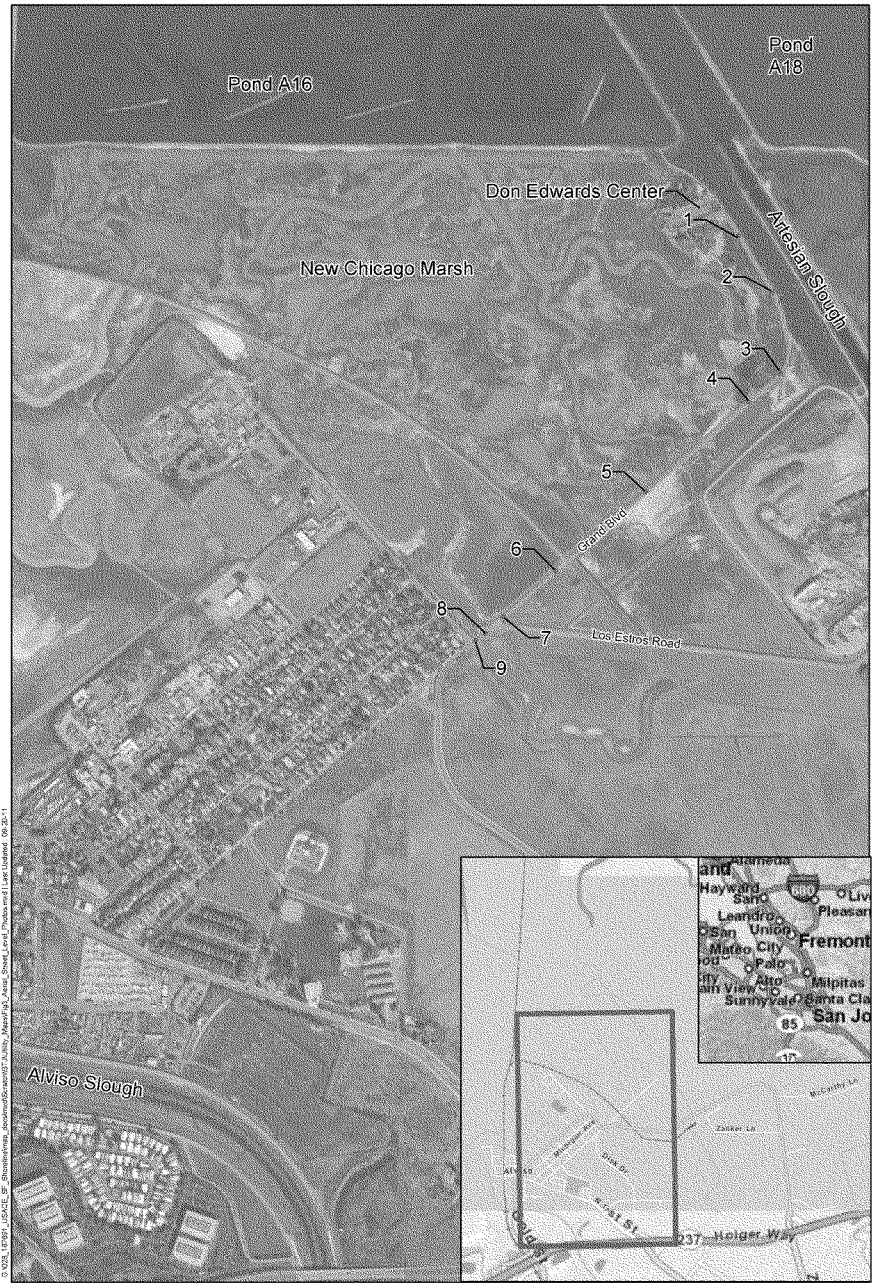
HDR
ONE COMPANY | *Many Solutions*™

0 1,000 2,000 Feet

1 inch = 600 feet

HDR
ONE COMPANY | *Many Solutions*™

City of San Jose
Utilities
Database
Figure 2B
USACE SF Shoreline



0 1,000 2,000 Feet

1 inch = 600 feet

Aerial and Street Level Photos of Utilities
Figure 3
USACE SF Shoreline

HDR
ONE COMPANY | *Many Solutions*™

Attachment I

NED Planset

US Army Corps
of Engineers
San Francisco District

SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

Santa Clara County

California

US Army Corps of Engineers San Francisco District

HR

Sheet reference number: G-01

GENERAL

G-01 COVER SHEET
G-02 INDEX SHEET
G-03 OVERALL SITE PLAN

CIVIL

C-01 PLAN AND PROFILE STA 0+00 TO 10+00
C-02 PLAN AND PROFILE STA 10+00 TO 20+00
C-03 PLAN AND PROFILE STA 20+00 TO 30+00
C-04 PLAN AND PROFILE STA 30+00 TO 40+00
C-05 PLAN AND PROFILE STA 40+00 TO 50+00
C-06 PLAN AND PROFILE STA 50+00 TO 60+00
C-07 PLAN AND PROFILE STA 60+00 TO 70+00
C-08 PLAN AND PROFILE STA 70+00 TO 80+00
C-09 PLAN AND PROFILE STA 80+00 TO 90+00
C-10 PLAN AND PROFILE STA 90+00 TO 100+00
C-11 PLAN AND PROFILE STA 100+00 TO 110+00
C-12 PLAN AND PROFILE STA 110+00 TO 120+00
C-13 PLAN AND PROFILE STA 120+00 TO 130+00
C-14 PLAN AND PROFILE STA 130+00 TO 140+00
C-15 PLAN AND PROFILE STA 140+00 TO 150+00
C-16 PLAN AND PROFILE STA 150+00 TO 160+00
C-17 PLAN AND PROFILE STA 160+00 TO 170+00
C-18 PLAN AND PROFILE STA 170+00 TO 180+00
C-19 PLAN AND PROFILE STA 180+00 TO 190+00
C-20 PLAN AND PROFILE STA 190+00 TO 197+75

C-21 SECTIONS STA 0+00 TO 5+00
C-22 SECTIONS STA 6+00 TO 11+00
C-23 SECTIONS STA 12+00 TO 17+00
C-24 SECTIONS STA 18+00 TO 23+00
C-25 SECTIONS STA 24+00 TO 29+00
C-26 SECTIONS STA 30+00 TO 35+00
C-27 SECTIONS STA 36+00 TO 41+00
C-28 SECTIONS STA 42+00 TO 47+00
C-29 SECTIONS STA 48+00 TO 53+00
C-30 SECTIONS STA 54+00 TO 59+00
C-31 SECTIONS STA 60+00 TO 65+00
C-32 SECTIONS STA 66+00 TO 71+00
C-33 SECTIONS STA 72+00 TO 77+00
C-34 SECTIONS STA 78+00 TO 83+00
C-35 SECTIONS STA 84+00 TO 89+00
C-36 SECTIONS STA 90+00 TO 95+00
C-37 SECTIONS STA 96+00 TO 101+00
C-38 SECTIONS STA 102+00 TO 107+00
C-39 SECTIONS STA 108+00 TO 113+00
C-40 SECTIONS STA 114+00 TO 119+00
C-41 SECTIONS STA 120+00 TO 125+00
C-42 SECTIONS STA 126+00 TO 131+00
C-43 SECTIONS STA 132+00 TO 137+00
C-44 SECTIONS STA 138+00 TO 143+00
C-45 SECTIONS STA 144+00 TO 149+00
C-46 SECTIONS STA 150+00 TO 155+00
C-47 SECTIONS STA 156+00 TO 161+00
C-48 SECTIONS STA 162+00 TO 167+00
C-49 SECTIONS STA 168+00 TO 173+00
C-50 SECTIONS STA 174+00 TO 179+00
C-51 SECTIONS STA 180+00 TO 185+00
C-52 SECTIONS STA 186+00 TO 191+00
C-53 SECTIONS STA 192+00 TO 197+00
C-54 SECTIONS STA 197+75.18

C-55 IN POND WORK

DETAIL

D-01 TYPICAL LEVEE CROSS SECTION
D-02 WWTP DISCHARGE CHANNEL FLOOD WALL 1 - PLAN
D-03 WWTP DISCHARGE CHANNEL FLOOD WALL 2 - SECTIONS I
D-04 WWTP DISCHARGE CHANNEL FLOOD WALL 3 - SECTIONS II
D-05 RR CROSSING FLOOD GATE 1 - PLAN
D-06 RR CROSSING FLOOD GATE 2 - SECTIONS I
D-07 WEST DRAIN DETAILS

BASELINE PROJECT DATUMS

HORIZONTAL
- CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III

VERTICAL
- NAVD88

US Army Corps of Engineers
San Francisco District

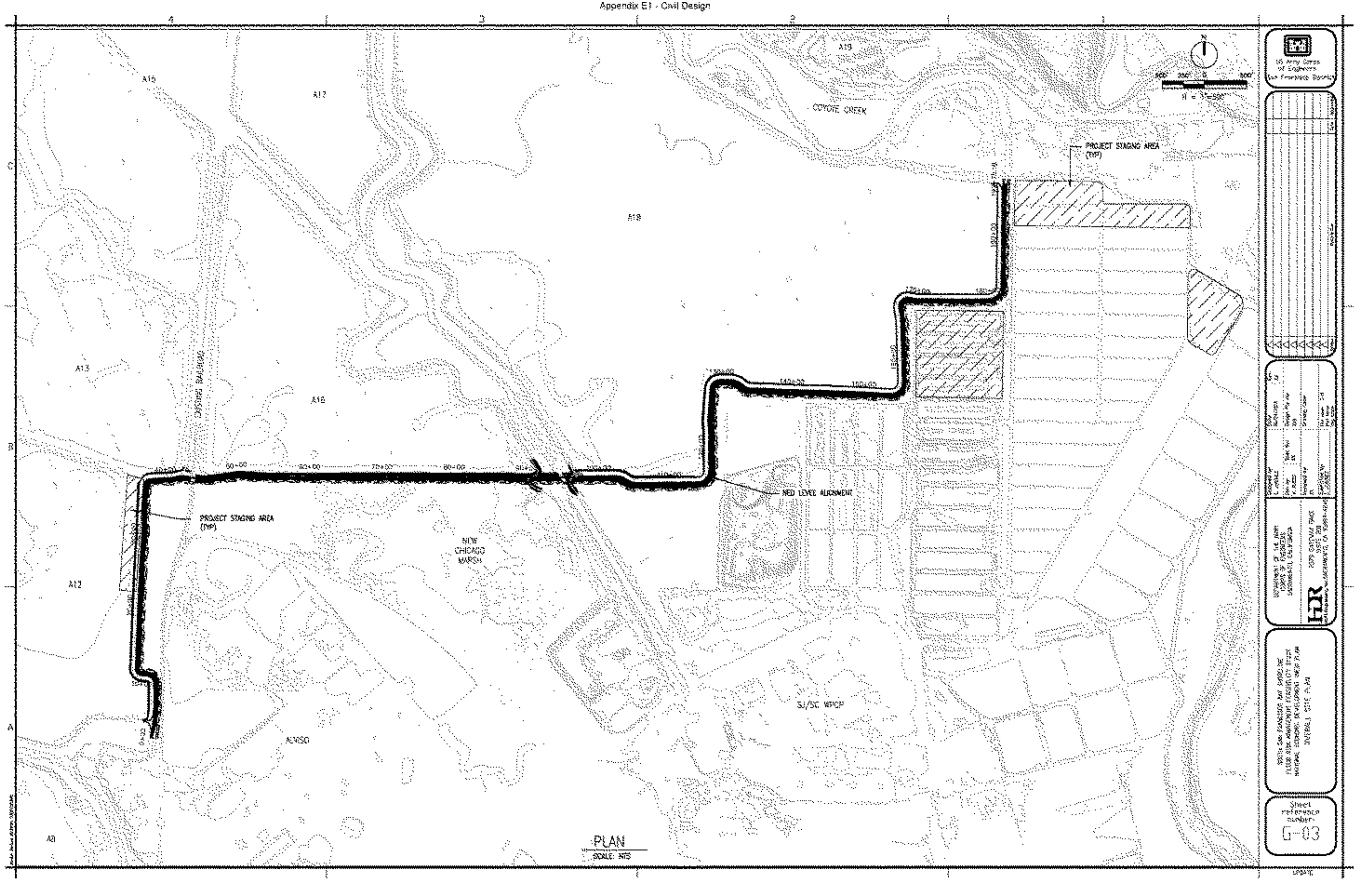
CONTRACT 72 SLAPPY CREEK & FEATHERS
SACRAMENTO, CALIFORNIA

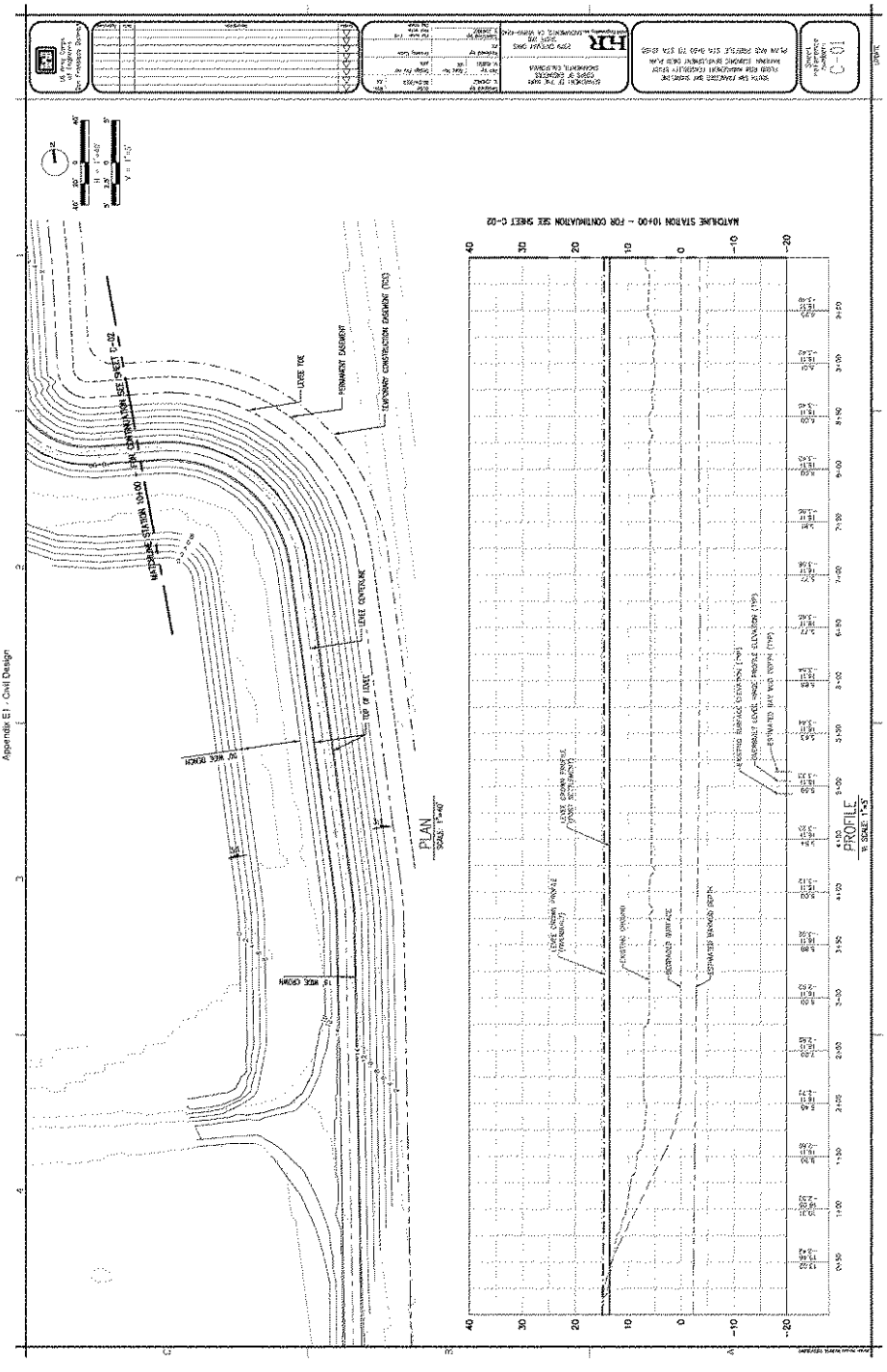
HDR
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4347

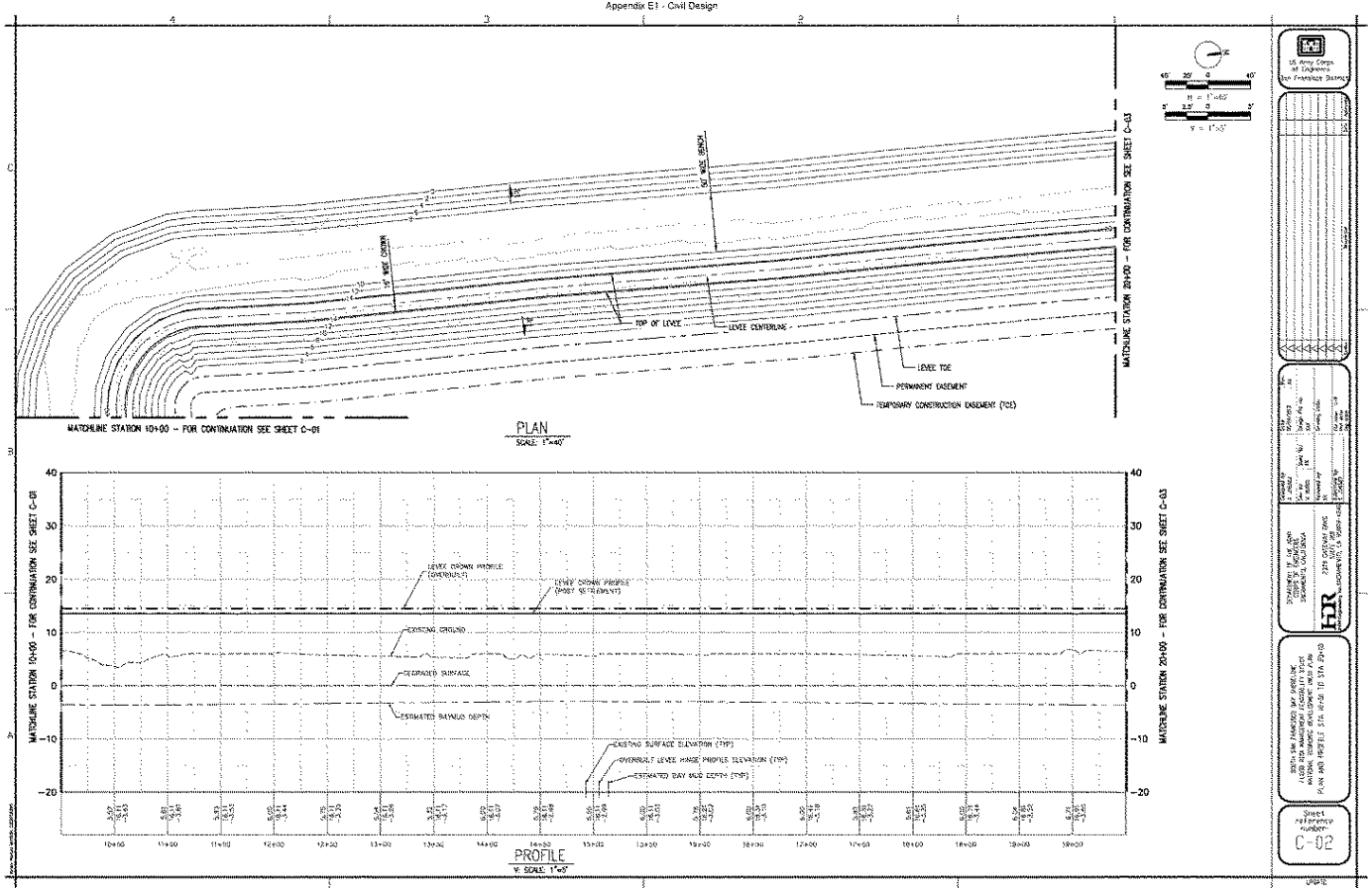
SACRAMENTO RIVER WEST SIDE LEVEE IMPROVEMENTS PROJECT
SACRAMENTO COUNTY, CALIFORNIA
INDEX SHEET

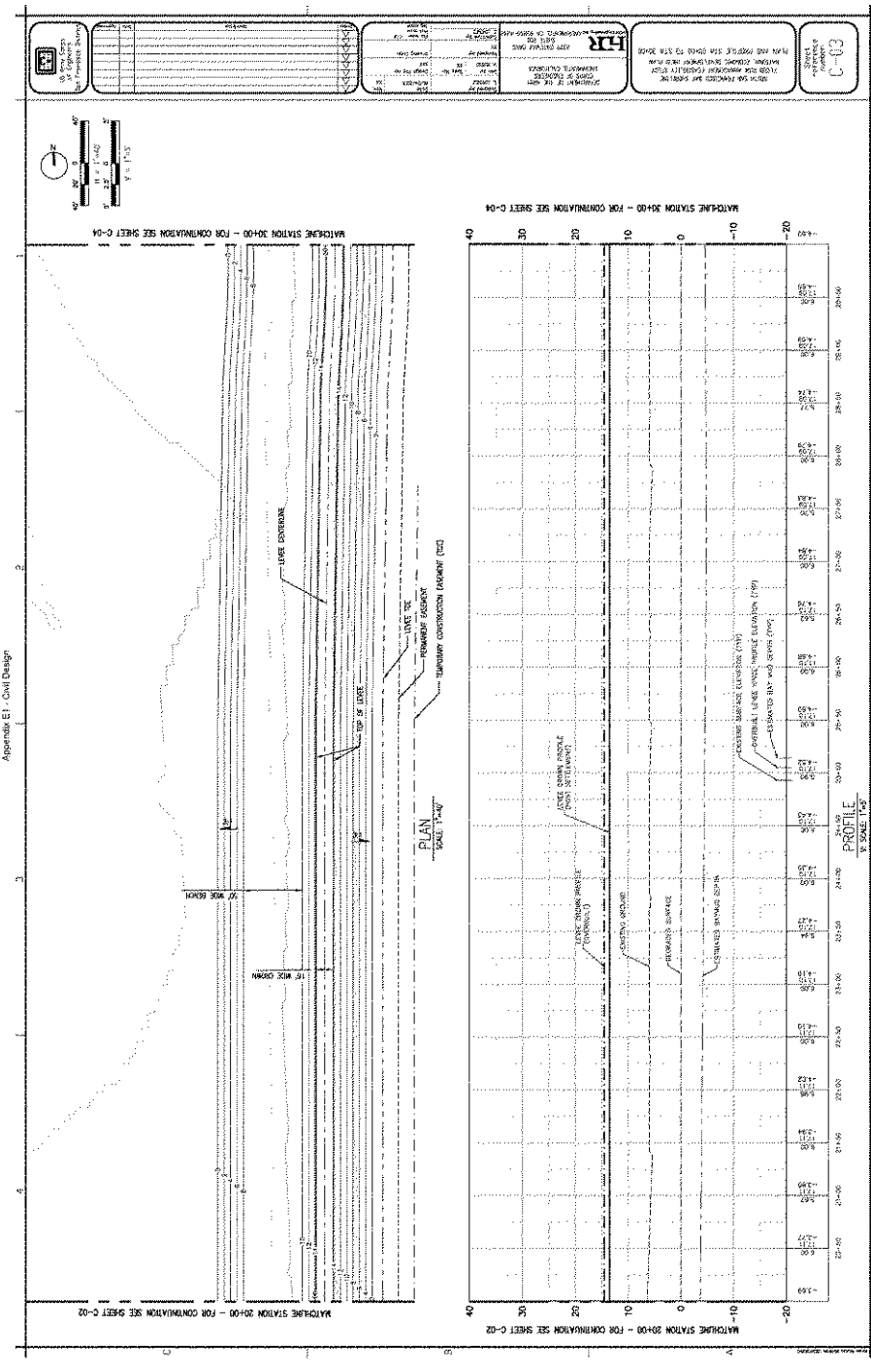
Sheet reference number:
G-02

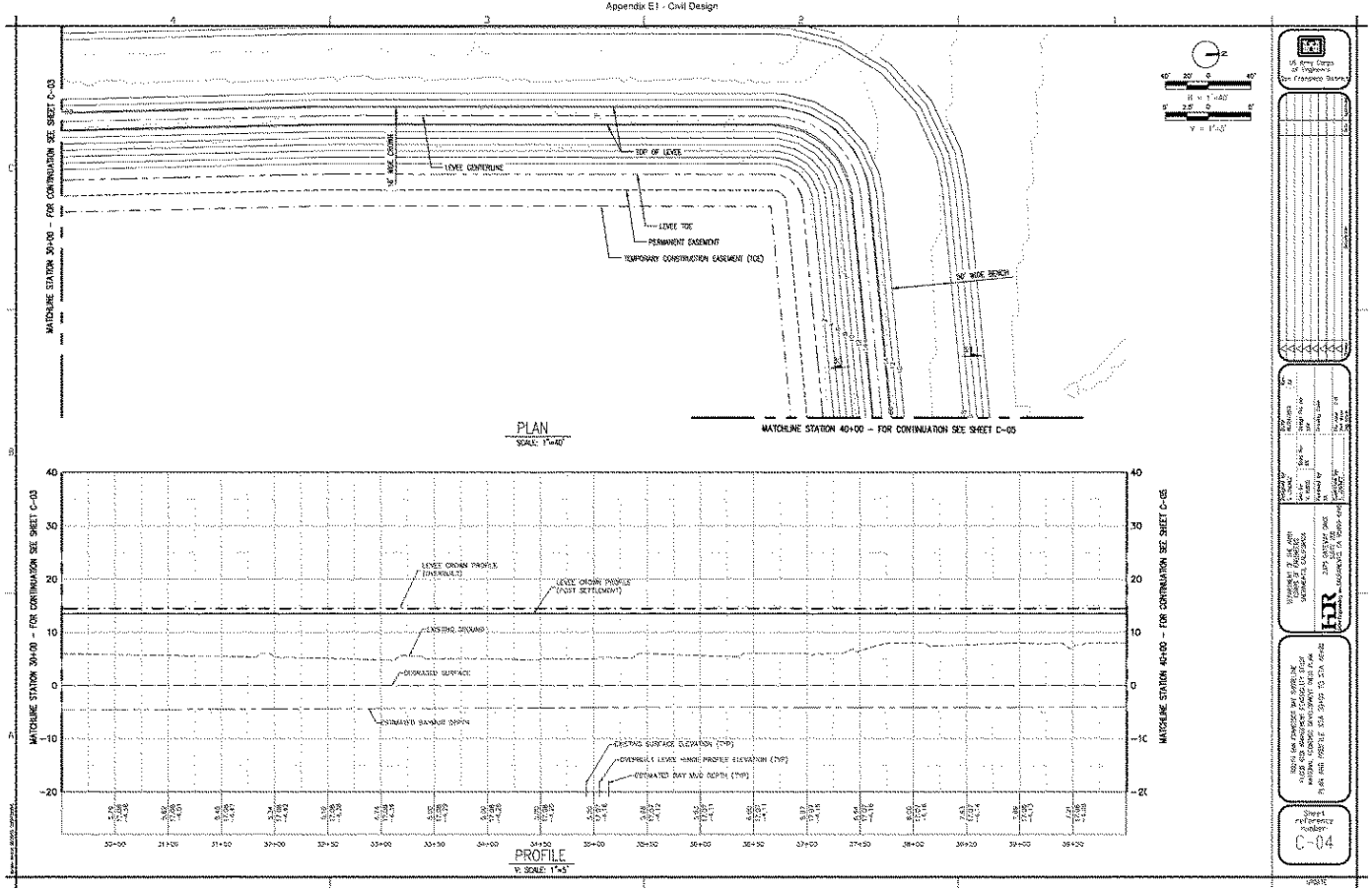
Appendix E1 - Civil Design

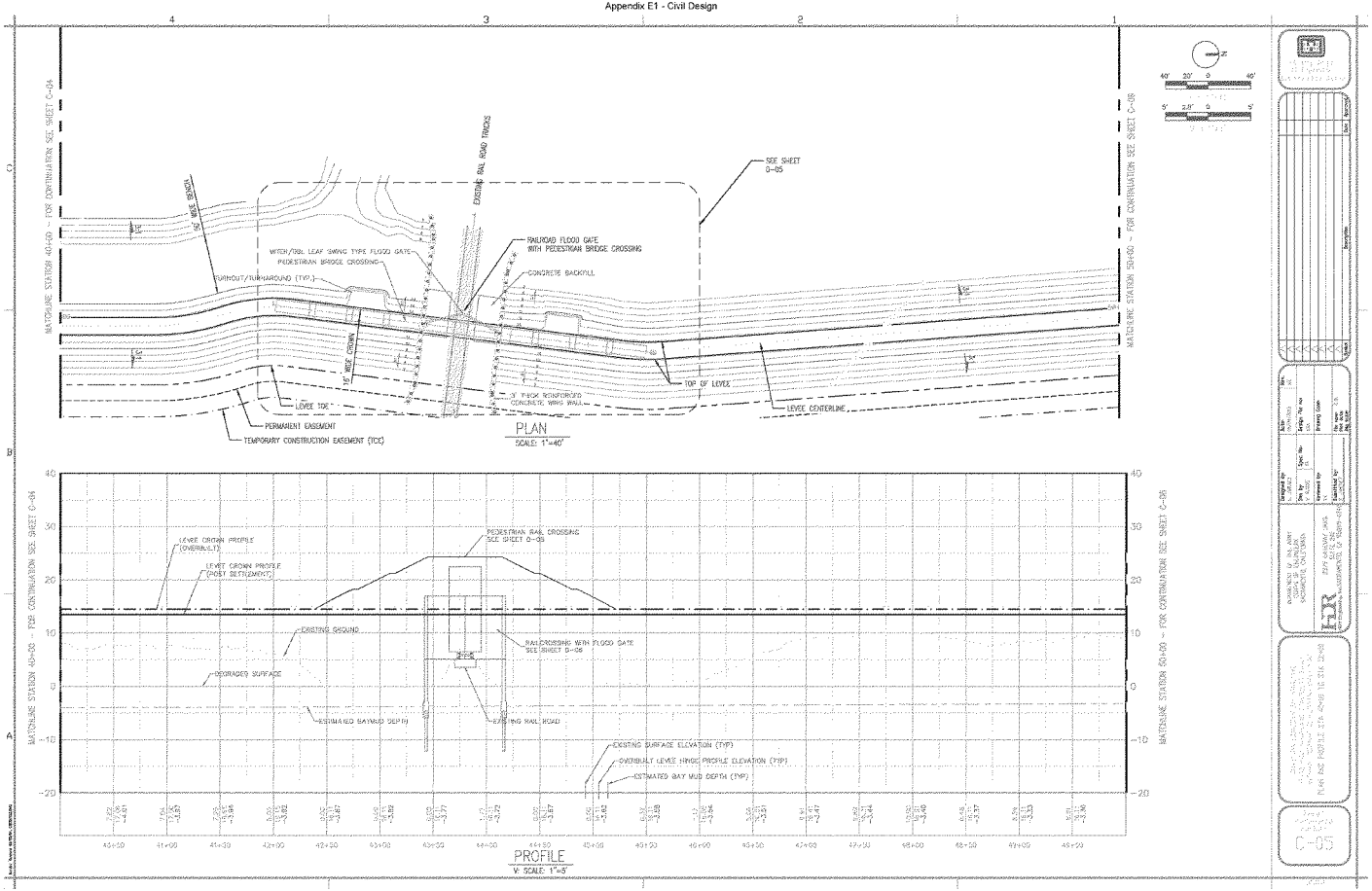


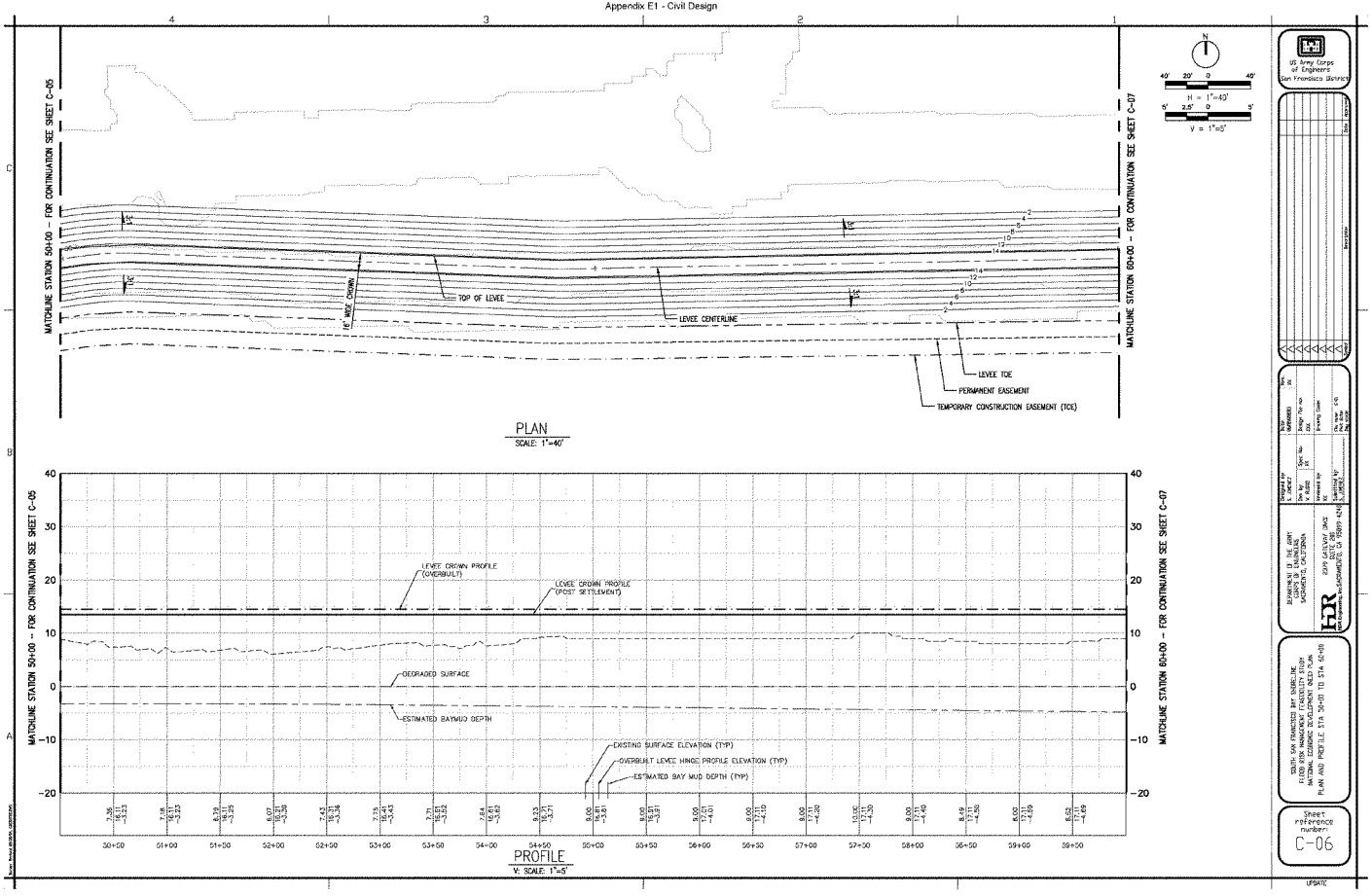

Appendix E1 - Civil Design
E1-102
PLAN
PROFILE
MATCHLINE STATION 10+00 - FOR CONTINUATION SEE SHEET C-02
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
TOP OF LEVEE
30' WIDE BENCH
15' WIDE BENCH
EXISTING GROUND
BEDROCK SURFACE
ESTIMATED WAVWALL DEPTH
C-01

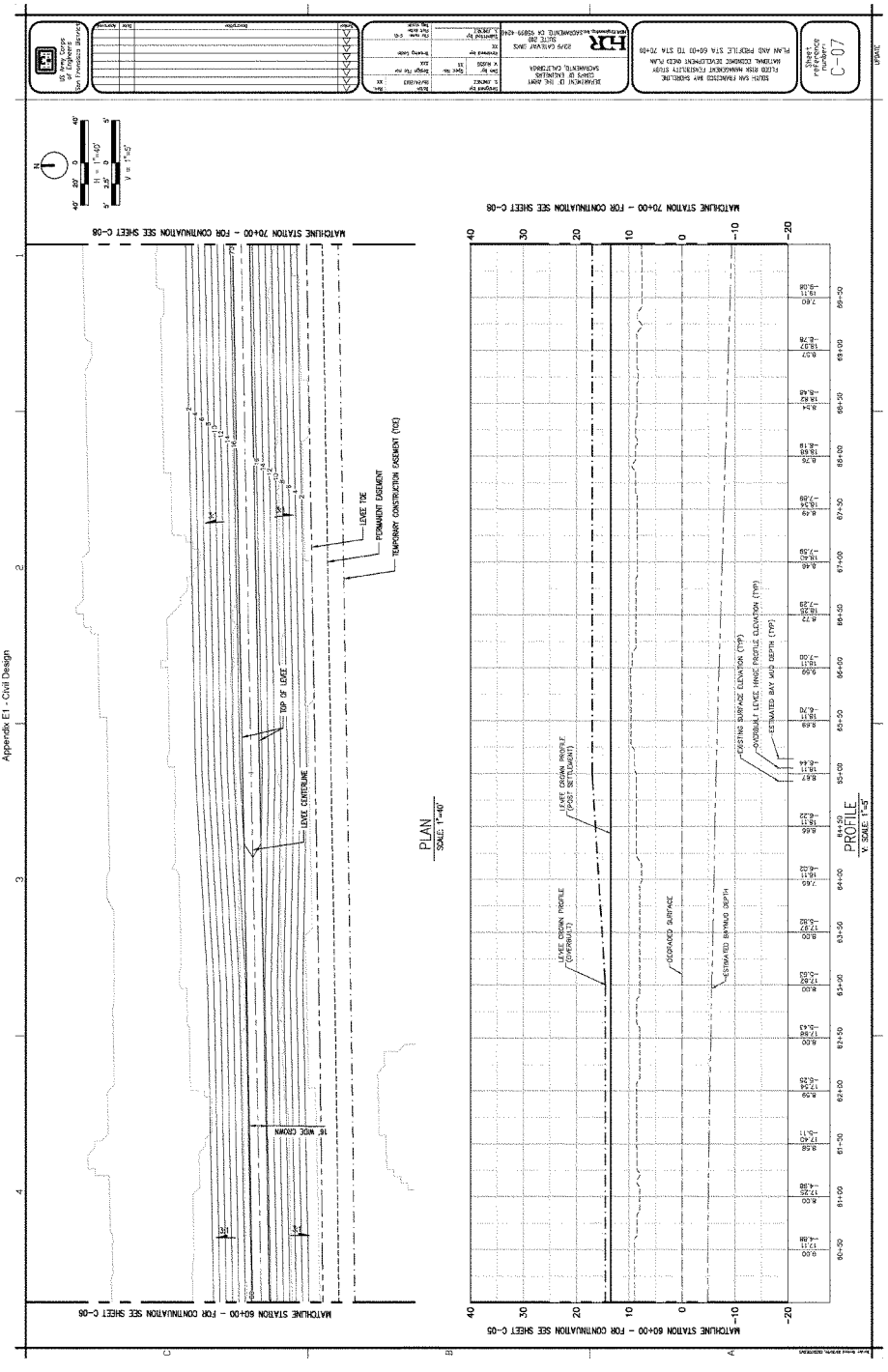

MATCHLINE STATION 10+00 – FOR CONTINUATION SEE SHEET C-01
MATCHLINE STATION 20+00 – FOR CONTINUATION SEE SHEET C-03
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
HDR
Sheet reference number
C-02

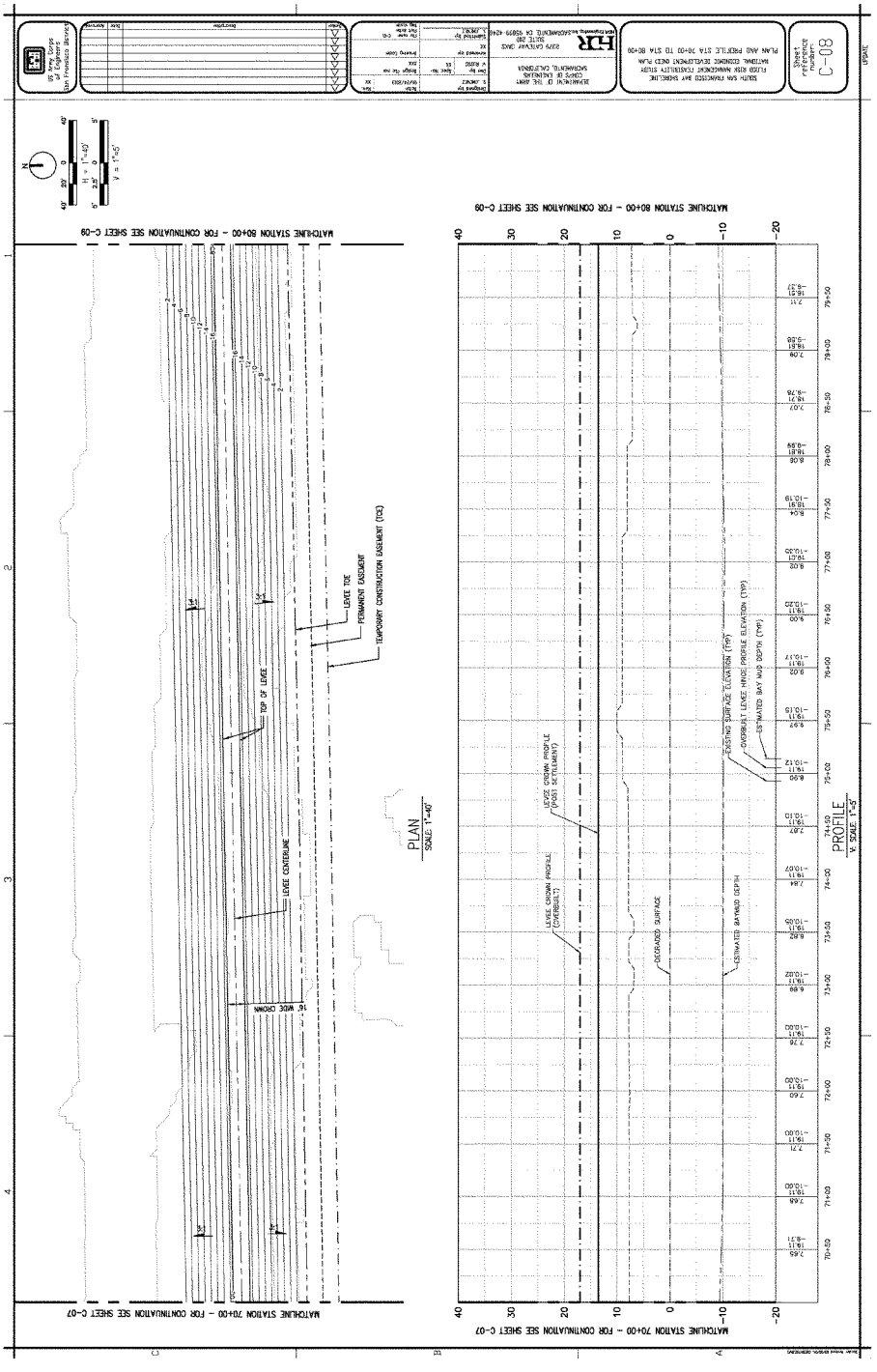

Appendix E1 - Civil Design
MATCHLINE STATION 30+00 - FOR CONTINUATION SEE SHEET C-04
MATCHLINE STATION 20+00 - FOR CONTINUATION SEE SHEET C-02
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
50' WIDE BENCH
16' WIDE CROWN
PLAN
SCALE: 1"=40'
PROFILE
SCALE: 1"=5'
C-03
E1-104

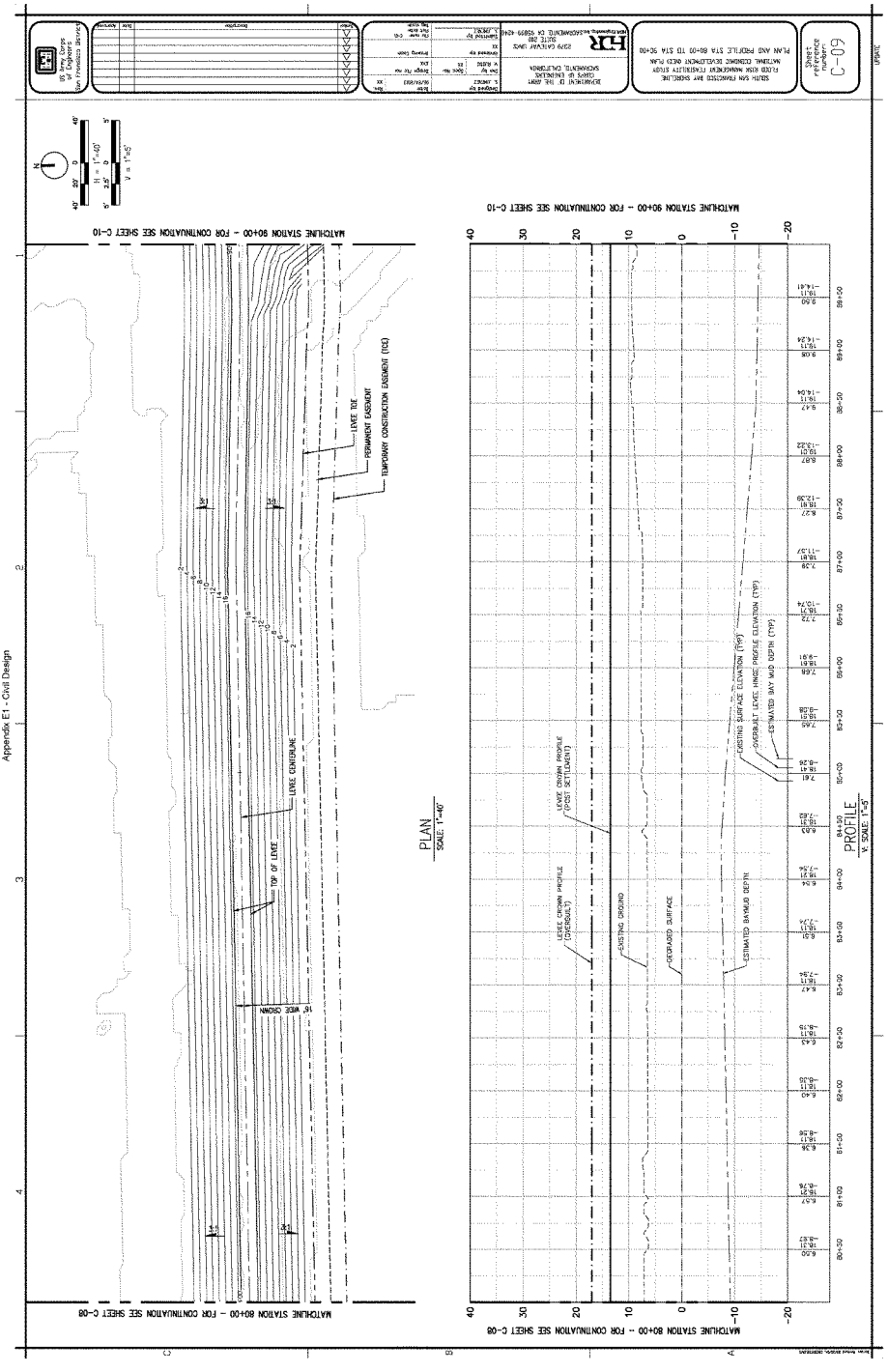

MATCHLINE STATION 30+00 - FOR CONTINUATION SEE SHEET C-03
MATCHLINE STATION 40+00 - FOR CONTINUATION SEE SHEET C-05
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (INTERIM)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DREDGED SURFACE
ESTIMATED BANQUE DEPTH
ESTIMATED SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
HR
Sheet reference number
C-04

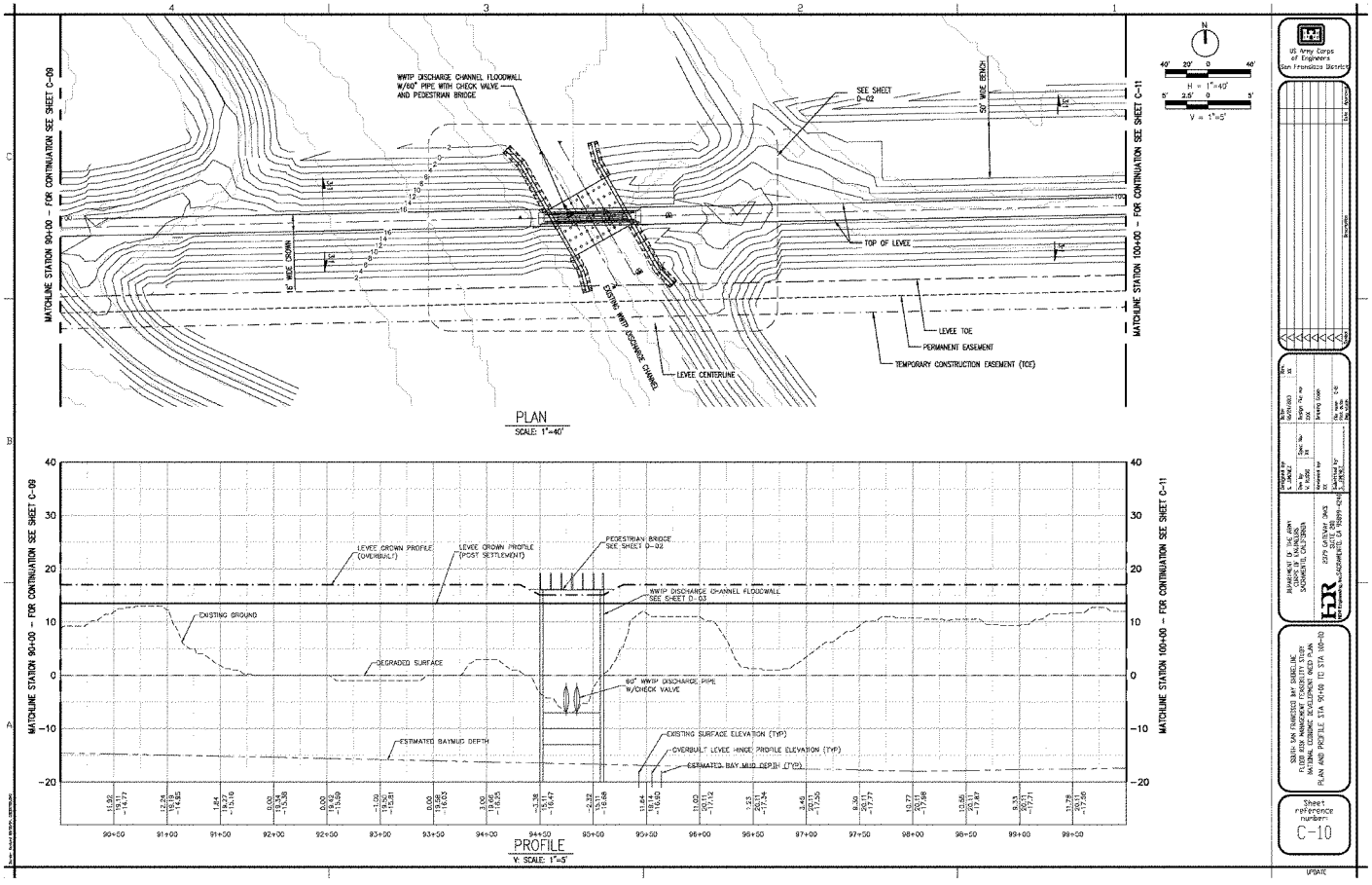

MAINLINE STATION 40+00 - FOR CONTINUATION SEE SHEET C-04
MAINLINE STATION 54+00 - FOR CONTINUATION SEE SHEET C-06
SEE SHEET C-05
EXISTING RAIL ROAD TRACKS
RAILROAD FLOOD GATE WITH PEDESTRIAN BRIDGE CROSSING
WITCH/TOOL LEAF SWING TYPE FLOOD GATE
PEDESTRIAN BRIDGE CROSSING
CONCRETE BACKFILL
SHROUT/TURNAROUND (TYP.)
10' WIDE CROWN
TOP OF LEVEE
LEVEE TOE
LEVEE CENTERLINE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
PEDESTRIAN RAIL CROSSING SEE SHEET C-05
EXISTING GROUND
RAILCROSSING WITH FLOOD GATE SEE SHEET C-05
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING RAIL ROAD
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE CROWN PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'

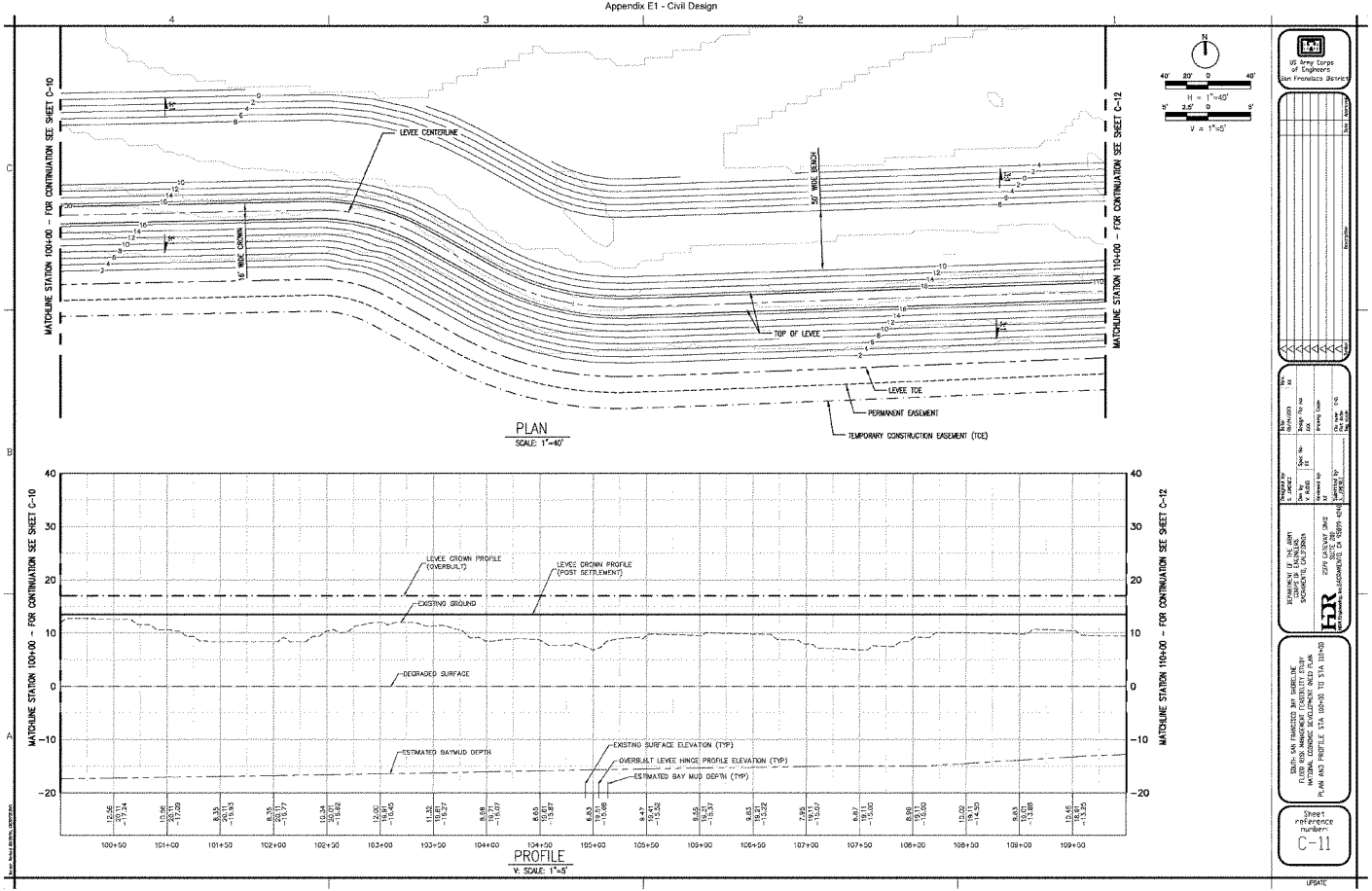

MATCHLINE STATION 50+00 - FOR CONTINUATION SEE SHEET C-05
MATCHLINE STATION 60+00 - FOR CONTINUATION SEE SHEET C-07
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number: C-06
UPDATE

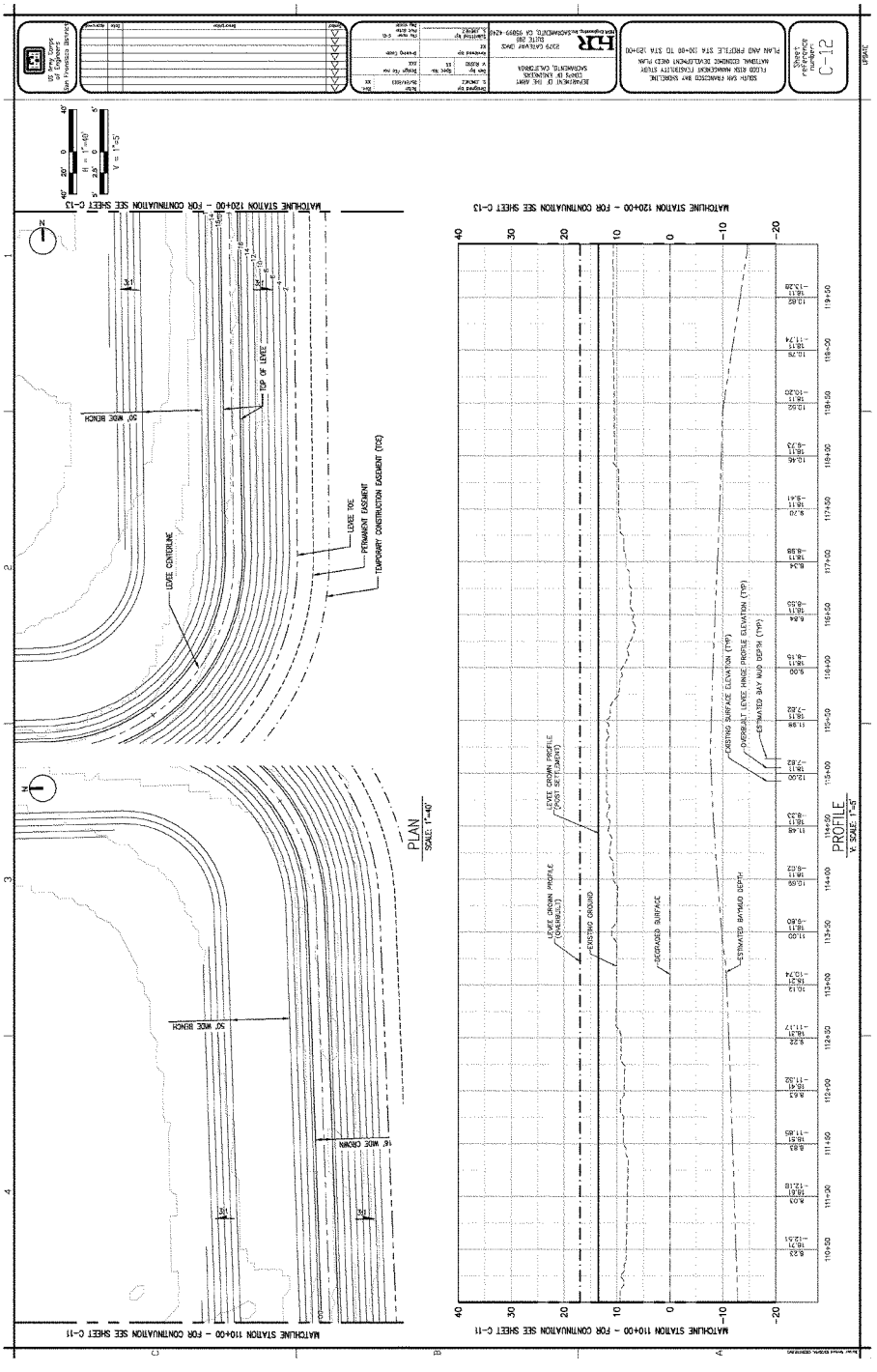

Appendix E1 - Civil Design
US Army Corps of Engineers San Francisco District
HR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
MATERIAL ECONOMIC DEVELOPMENT DIKES PLAN
PLAN AND PROFILE STA 60+00 TO STA 70+00
Sheet reference number
C-07
UPDATE
MATCHLINE STATION 70+00 - FOR CONTINUATION SEE SHEET C-08
MATCHLINE STATION 60+00 - FOR CONTINUATION SEE SHEET C-05
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
E1-108


US Army Corps of Engineers
San Francisco District
HR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL COMMAND DEVELOPMENT DATA PLAN
PLAN AND PROFILE STA 70+00 TO STA 80+00
Sheet reference number
C-08
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TOE)
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
MATCHLINE STATION 80+00 - FOR CONTINUATION SEE SHEET C-09
MATCHLINE STATION 70+00 - FOR CONTINUATION SEE SHEET C-07
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
H = 1"=40'
V = 1"=5'
Appendix E1 - Civil Design
E1-109

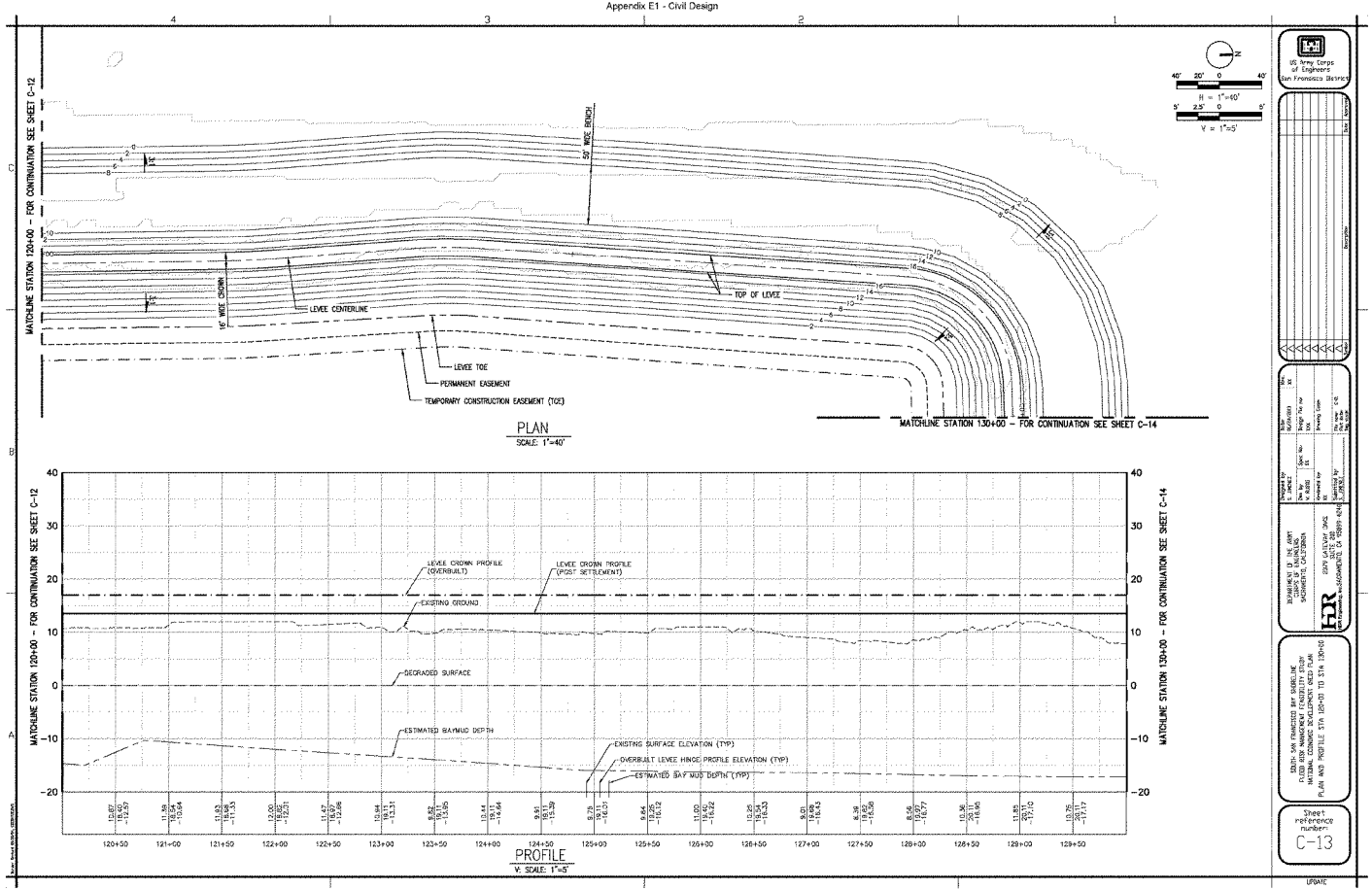

US Army Corps of Engineers San Francisco District
HR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
MATERIAL CONTROL DEVELOPMENT DATA PLAN
PLAN AND PROFILE STA 80+00 TO STA 90+00
Sheet reference number
C-09
LEGEND
MATCHLINE STATION 90+00 - FOR CONTINUATION SEE SHEET C-10
MATCHLINE STATION 80+00 - FOR CONTINUATION SEE SHEET C-08
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
TOP OF LEVEE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
Appendix E1 - Civil Design
E1-110

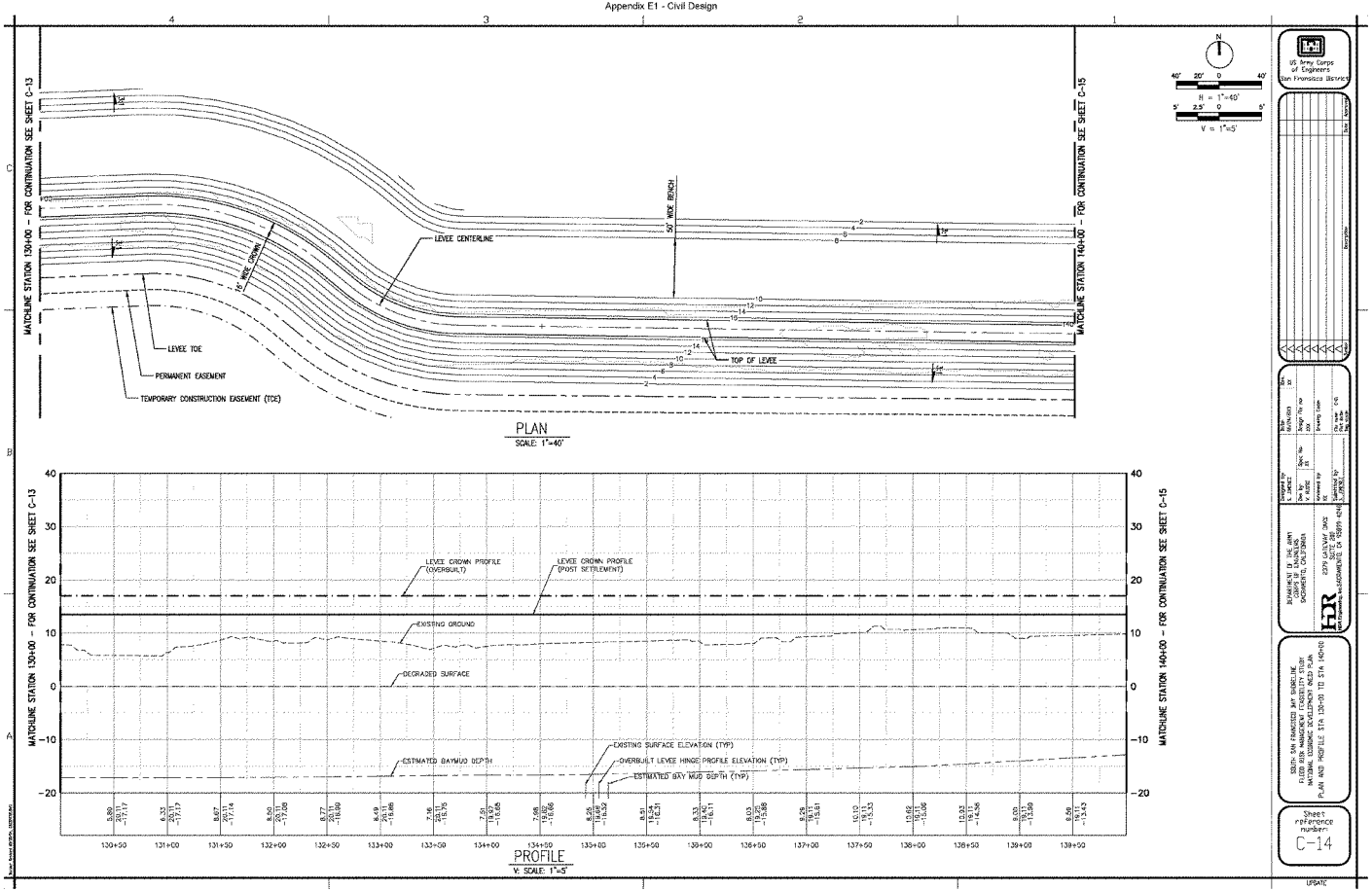

MATCHLINE STATION 90+00 - FOR CONTINUATION SEE SHEET C-09
MATCHLINE STATION 100+00 - FOR CONTINUATION SEE SHEET C-11
WWTP DISCHARGE CHANNEL FLOODWALL W/60" PIPE WITH CHECK VALVE AND PEDESTRIAN BRIDGE
SEE SHEET D-02
50' WIDE BENCH
16' WIDE CROWN
TOP OF LEVEE
EXISTING WWTP DISCHARGE CHANNEL
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
PEDESTRIAN BRIDGE SEE SHEET D-02
WWTP DISCHARGE CHANNEL FLOODWALL SEE SHEET D-03
EXISTING GROUND
DEGRADED SURFACE
60" WWTP DISCHARGE PIPE W/CHECK VALVE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
JEFFERSON CITY OF TAXPAYERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
PLAN AND PROFILE STA 90+00 TO STA 100+00
Sheet reference number: C-10
UPDATE

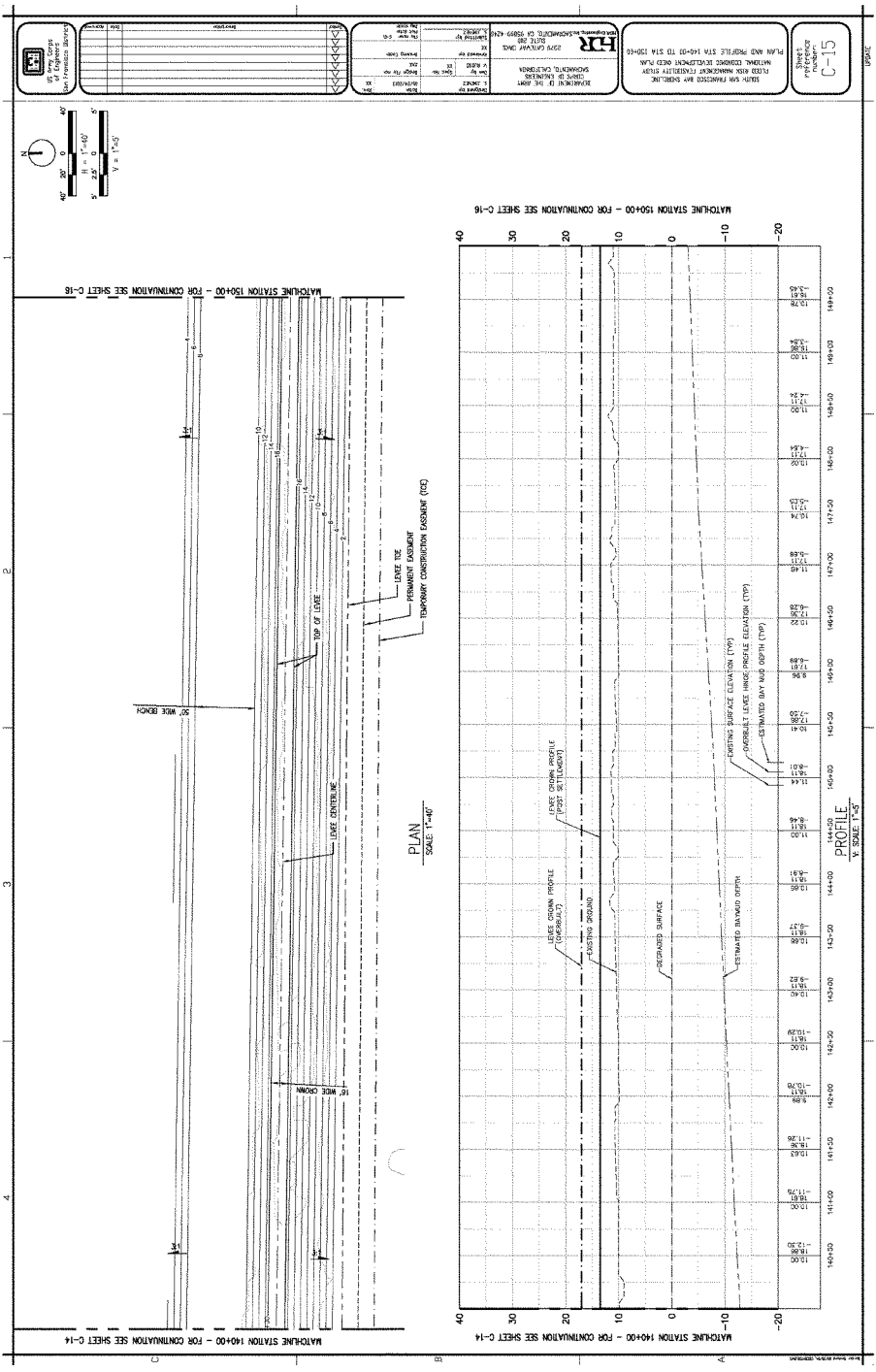

MATCHLINE STATION 100+00 - FOR CONTINUATION SEE SHEET C-10
MATCHLINE STATION 110+00 - FOR CONTINUATION SEE SHEET C-12
LEVEE CENTERLINE
16' WIDE CROWN
50' WIDE BENCH
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT AREA PLAN
PLAN AND PROFILE STA 100+00 TO STA 110+00
Sheet reference number: C-11
UPDATE

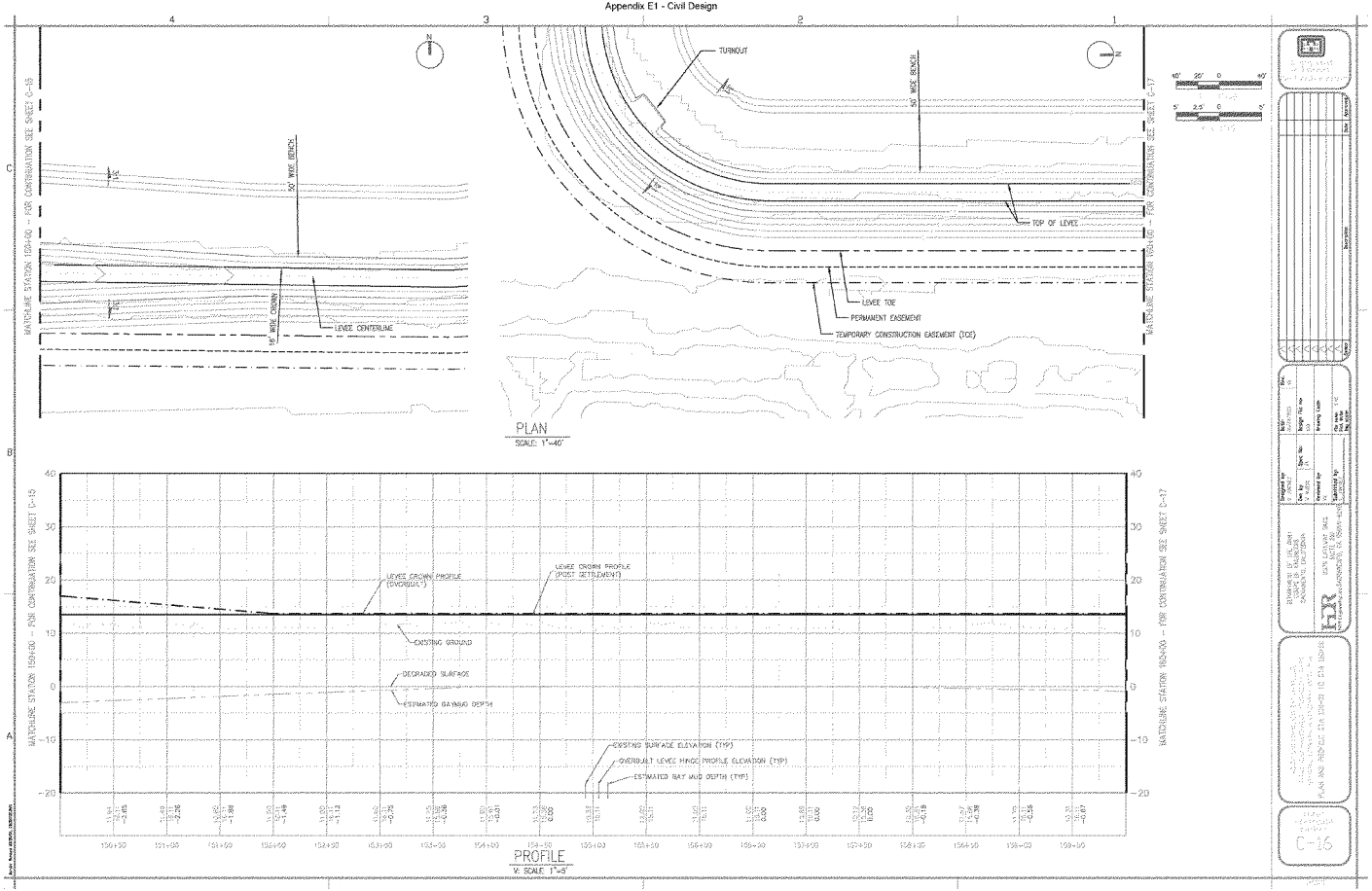


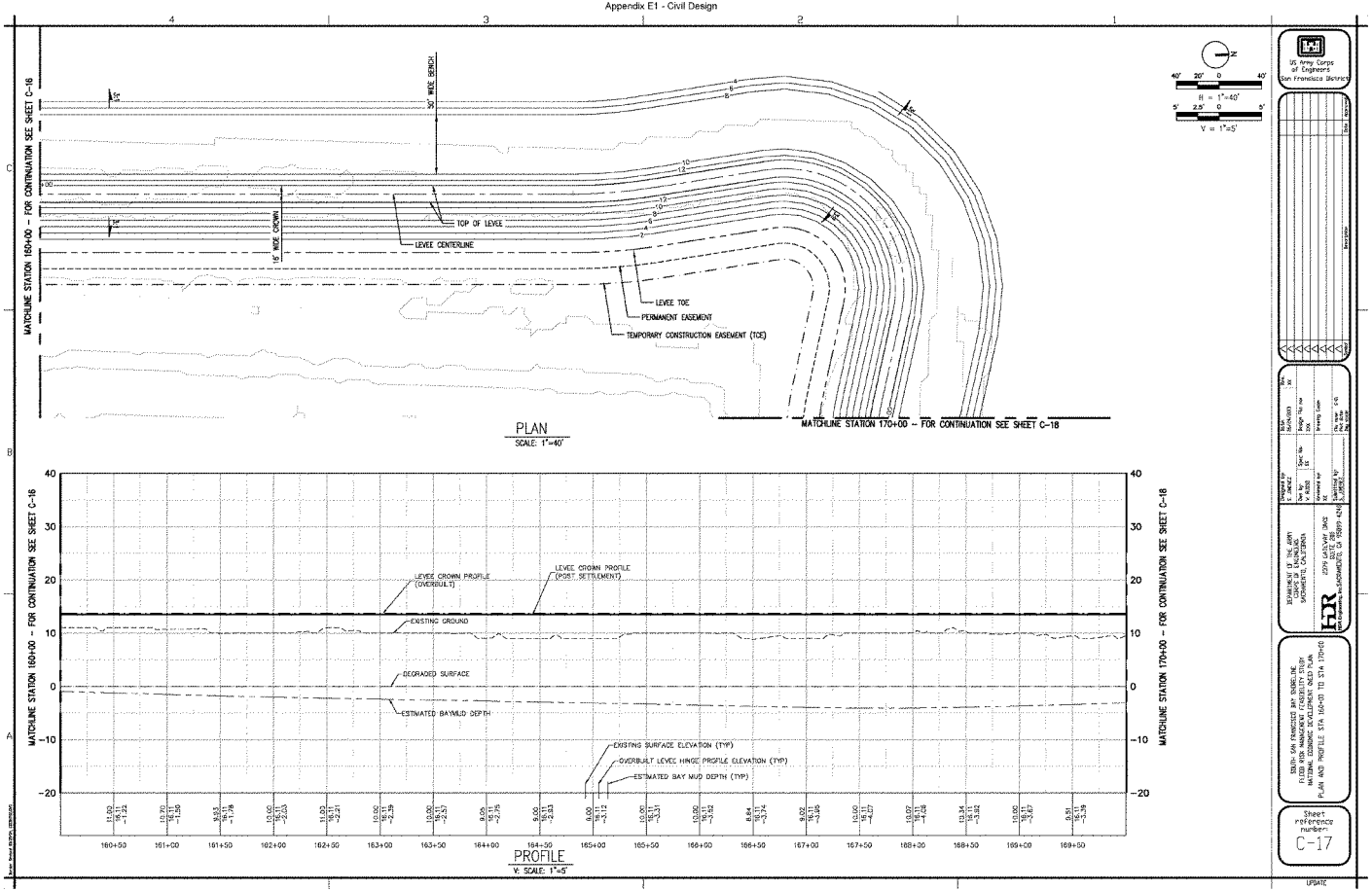
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL EDIMENT DEVELOPMENT DEED PLAN
PLAN AND PROFILE STA 100+00 TO STA 120+00
Sheet reference number: C-12
UPDATE
MATCHLINE STATION 120+00 - FOR CONTINUATION SEE SHEET C-13
MATCHLINE STATION 110+00 - FOR CONTINUATION SEE SHEET C-11
H = 1"=40'
V = 1"=5'
30' WIDE BENCH
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
16' WIDE CROWN
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'

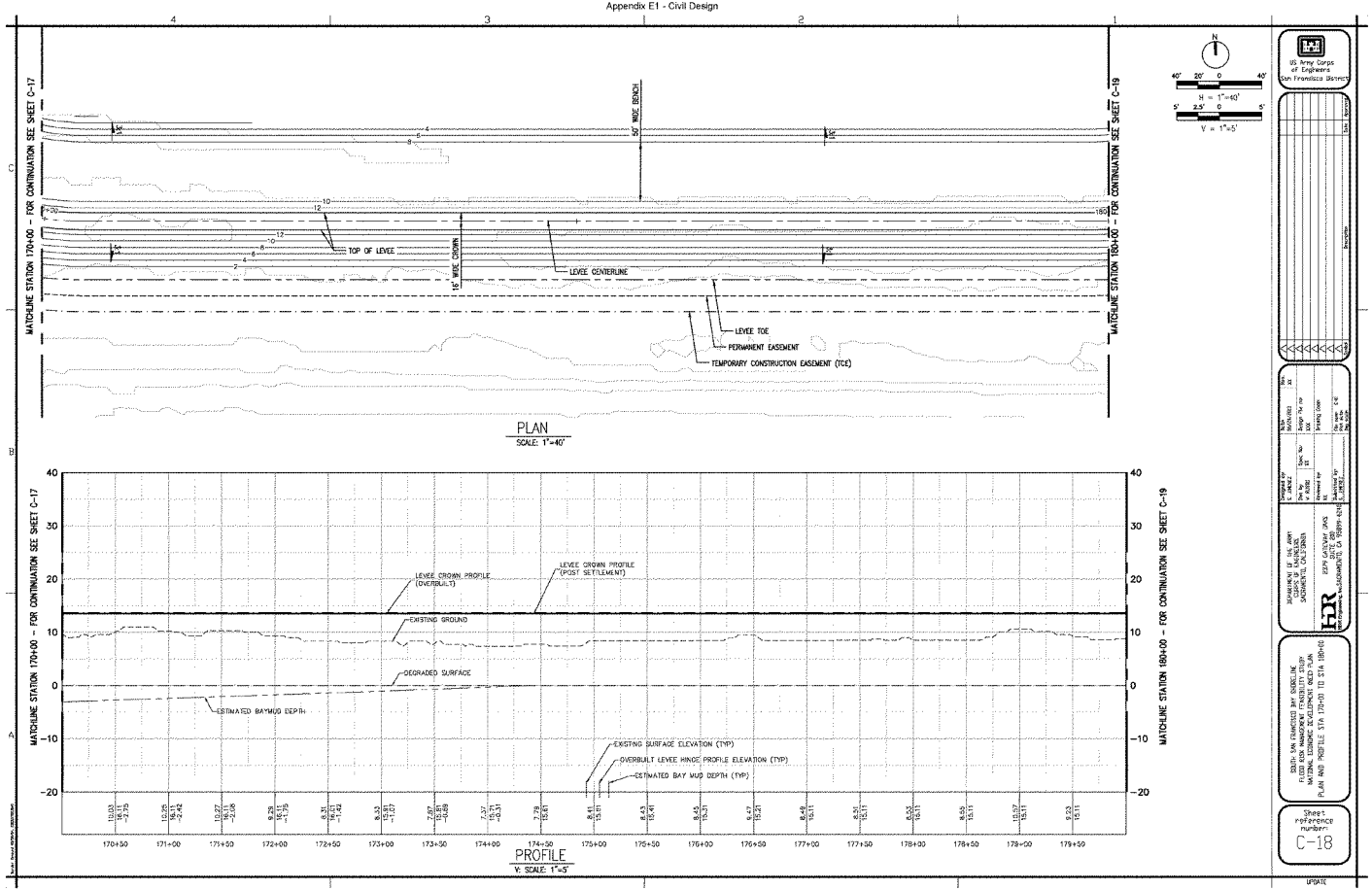

MATCHLINE STATION 120+00 - FOR CONTINUATION SEE SHEET C-12
50' WIDE BENCH
16' WIDE CROWN
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TOE)
MATCHLINE STATION 130+00 - FOR CONTINUATION SEE SHEET C-14
H = 1"=40'
V = 1"=5'
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
PLAN AND PROFILE STA 120+00 TO STA 130+00
Sheet reference number:
C-13
UPDATE

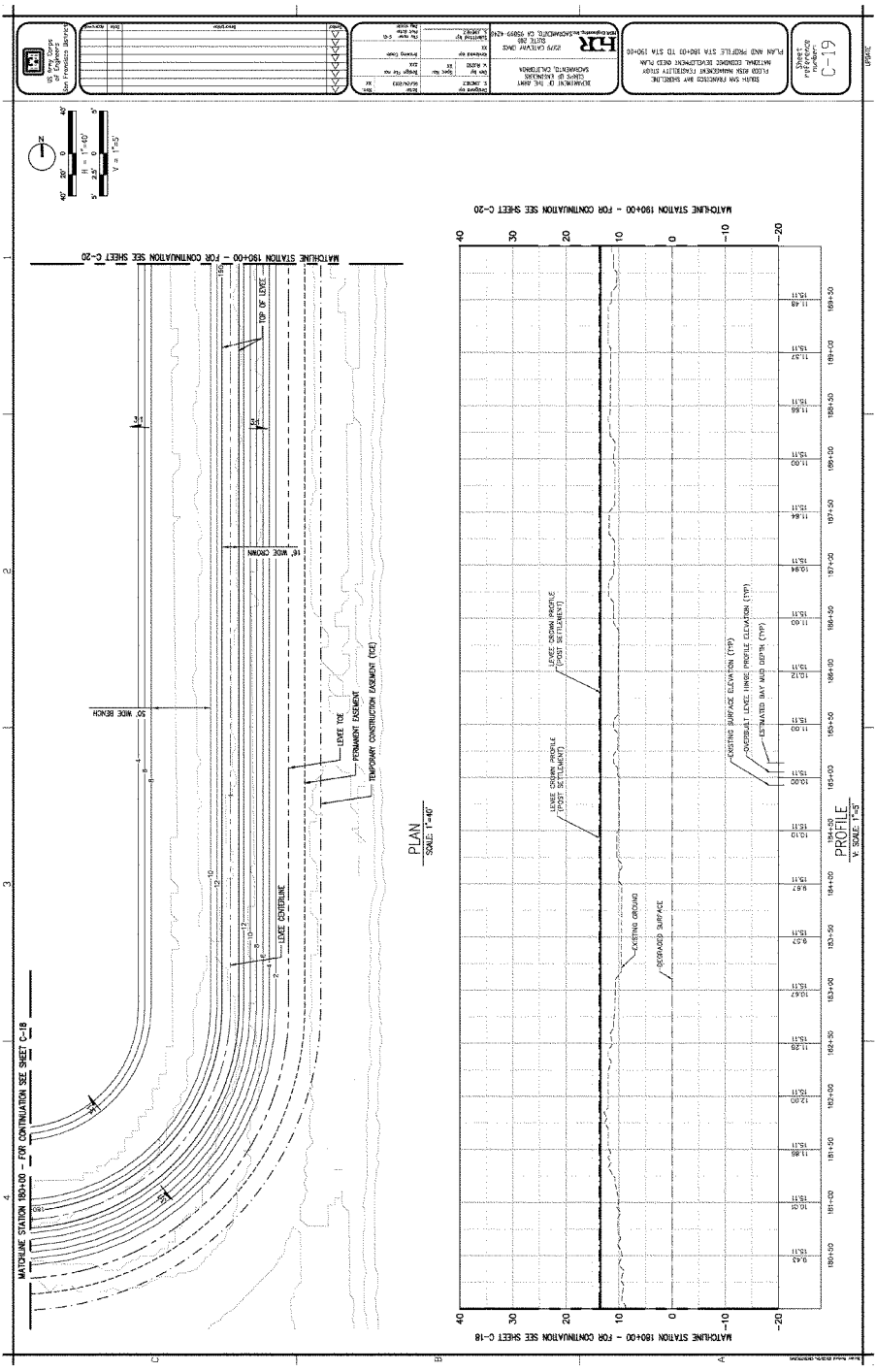

MATCHLINE STATION 130+00 - FOR CONTINUATION SEE SHEET C-13
MATCHLINE STATION 140+00 - FOR CONTINUATION SEE SHEET C-15
LEVEE CENTERLINE
50' WIDE BENCH
15' WIDE CROWN
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number:
C-14
UPDATE


Appendix E1 - Civil Design
E1-116
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
MATCHLINE STATION 150+00 - FOR CONTINUATION SEE SHEET C-16
MATCHLINE STATION 140+00 - FOR CONTINUATION SEE SHEET C-14
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
50' WIDE BENCH
16' WIDE CROWN
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
HR
Sheet Reference Number
C-15
UPDATE

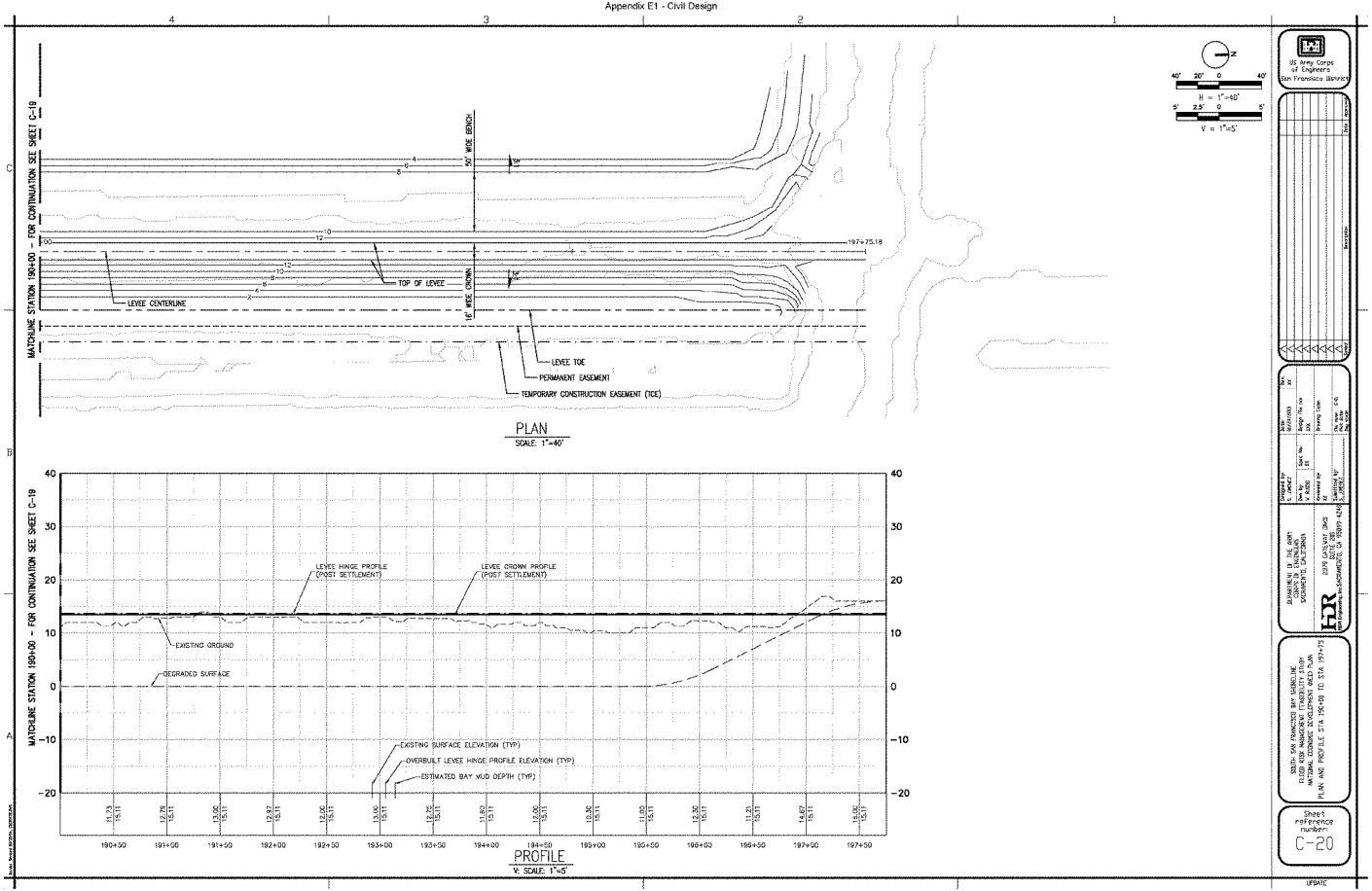

TURNOUT
50' WIDE BENCH
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE CROWN PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE 1"=5'
C-16

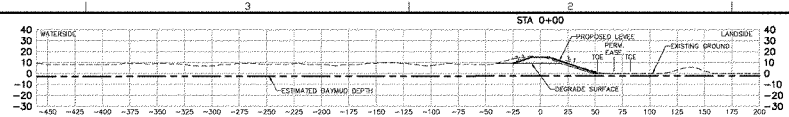

MATCHLINE STATION 160+00 - FOR CONTINUATION SEE SHEET C-16
MATCHLINE STATION 170+00 - FOR CONTINUATION SEE SHEET C-18
50' WIDE SEARCH
15' WIDE CROWN
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
PLAN AND PROFILE STA 160+00 TO STA 170+00
Sheet reference number: C-17
UPDATE

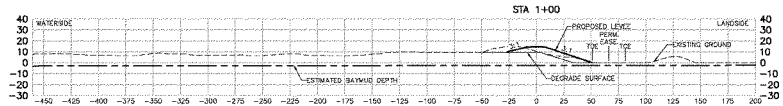

MATCHLINE STATION 170+00 - FOR CONTINUATION SEE SHEET C-17
MATCHLINE STATION 180+00 - FOR CONTINUATION SEE SHEET C-19
50' WIDE BENCH
16' WIDE CROWN
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
EDPR GATEWAY DRIVE SUITE 200 SACRAMENTO, CA 95899-4210
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT ONLY PLAN
PLAN AND PROFILE STA 170+00 TO STA 180+00
Sheet reference number: C-18
UPDATE

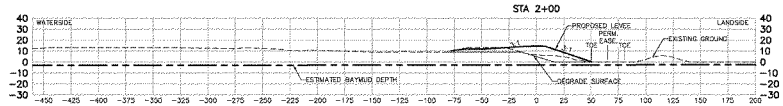


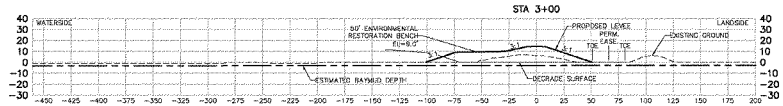
Appendix E1 - Civil Design

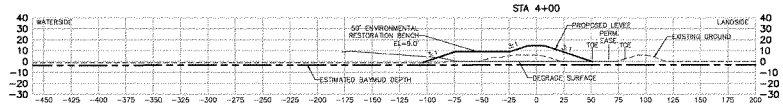

MATCHLINE STATION 190+00 - FOR CONTINUATION SEE SHEET C-19
50' WIDE BENCH
16' WIDE CROWN
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
197+75.18
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE HINGE PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4245
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT SHEET PLAN
PLAN AND PROFILE STA 190+00 TO STA 197+75
Sheet reference number:
C-20
UPDATE

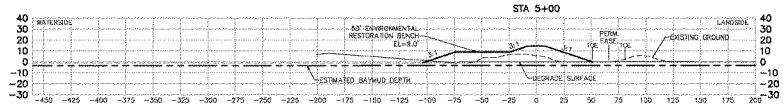












US Army Corps of Engineers
San Francisco District

Date | Description

Date: 04/04/2013
Scale: No Scale
Survey Crew:
Drawn by: BH
Sheet No: E2
Reviewed by: JS
Approved by: JL
Date: 04/04/2013
Scale: No Scale
Sheet No: E2
Reviewed by: JS
Approved by: JL

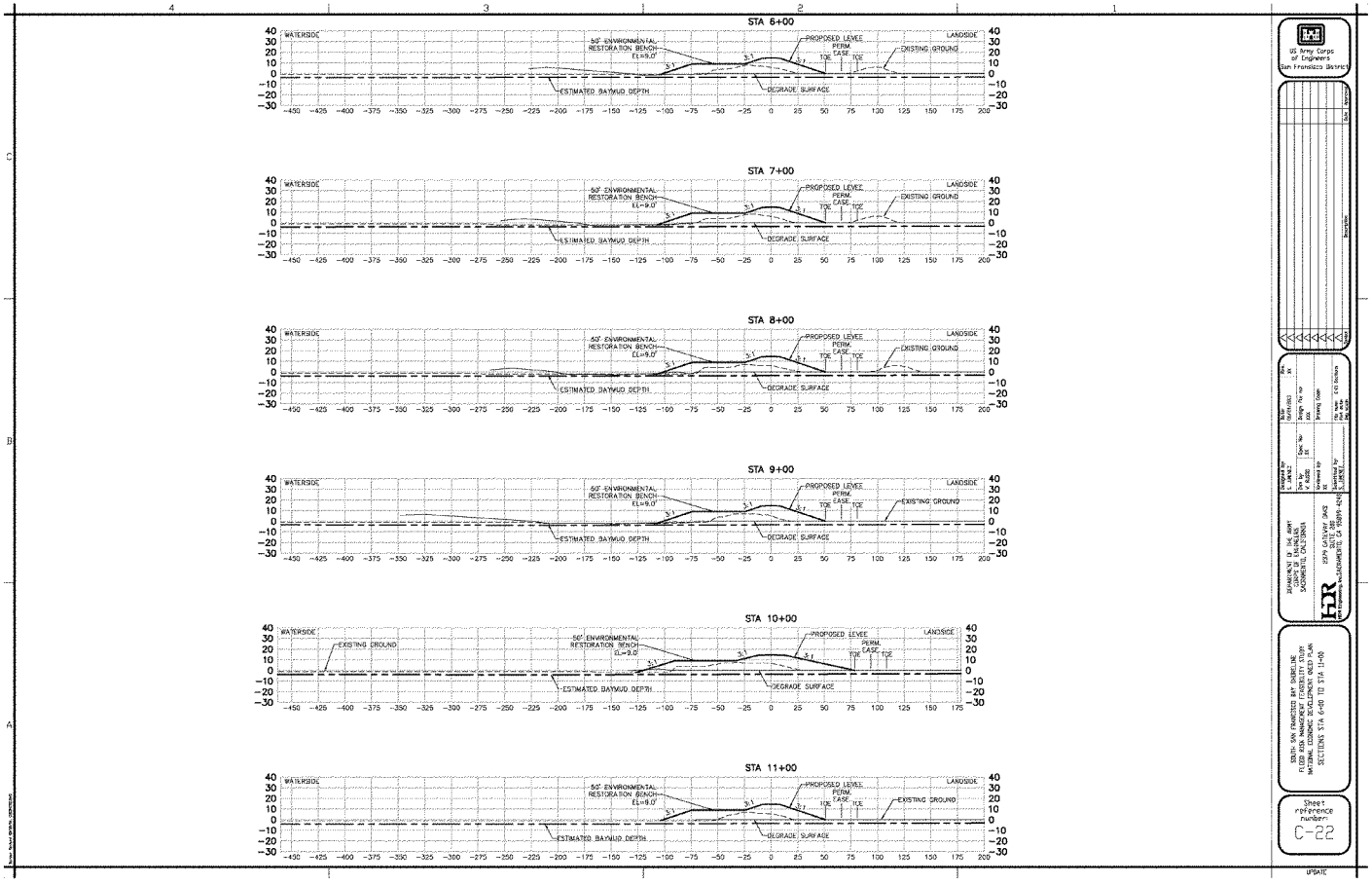
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

EDR Engineering, Inc. SACRAMENTO, CA 95814-4410

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 0+00 TO STA 5+00

Sheet reference number:
C-21

UPDATE


STA 6+00
STA 7+00
STA 8+00
STA 9+00
STA 10+00
STA 11+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT UNDED PLAN
SECTIONS STA 6+00 TO STA 11+00
Sheet reference number:
C-22
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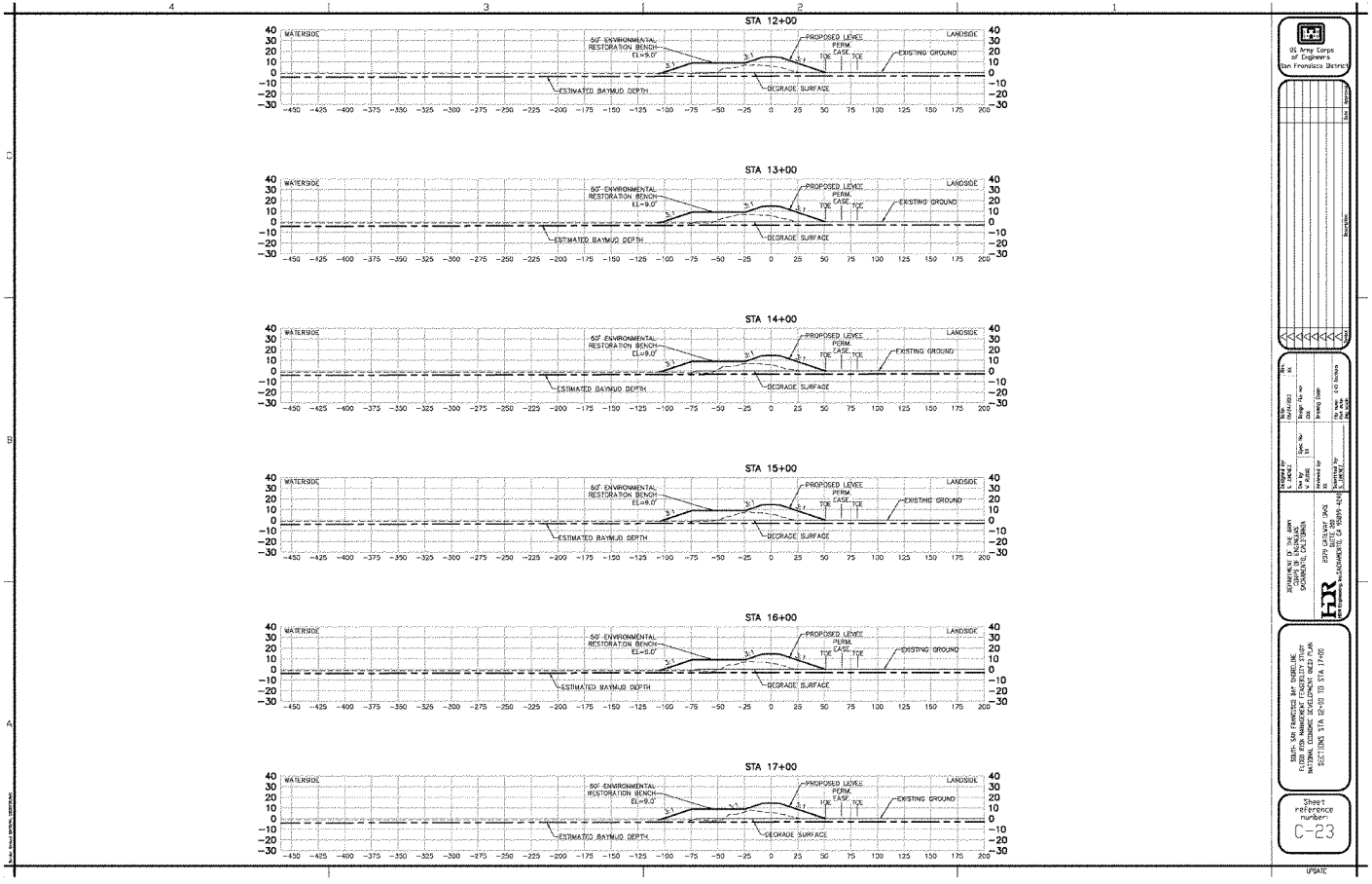
STA 12+00
STA 13+00
STA 14+00
STA 15+00
STA 16+00
STA 17+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT UNDER PLAN
SECTIONS STA 12+00 TO STA 17+00
Sheet reference number:
C-23
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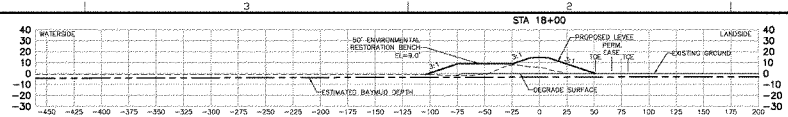
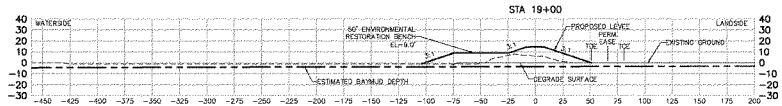
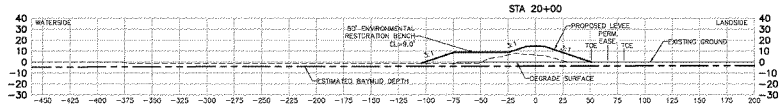
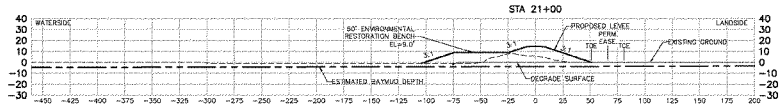
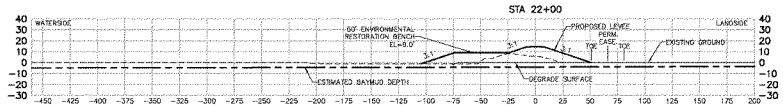
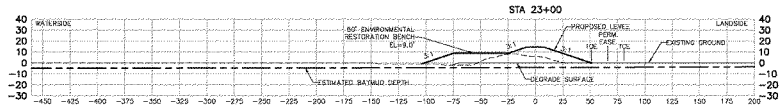












US Army Corps of Engineers
San Francisco District

Sec.	Revision	Date	Description

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 150
SACRAMENTO, CA 95833-4232
HDR Engineering, Inc.

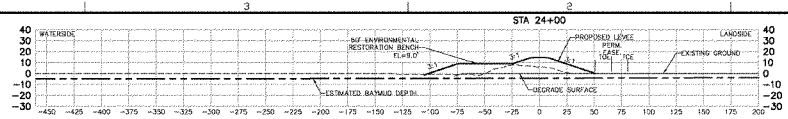
Designed by: D. Chandler
Drawn by: Chi Nguyen
Checked by: M. Lamb
Reviewed by: M.
Approved by: M.
Date: 8/29/2003
Scale: 1:50
Spec. No.: 23
Design file no.: 23
Survey date:
File name: E10 Sections
Plot date:

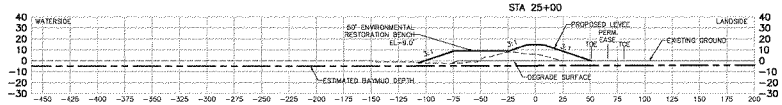
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 18+00 TO STA 23+00

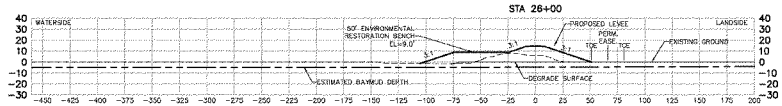
Sheet reference number:
C-24

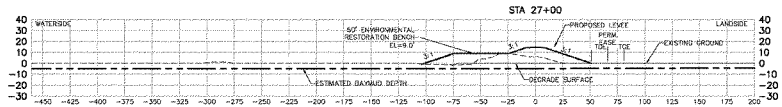
UPDATE

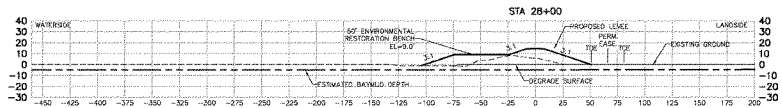
1117

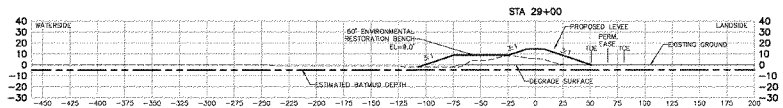












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

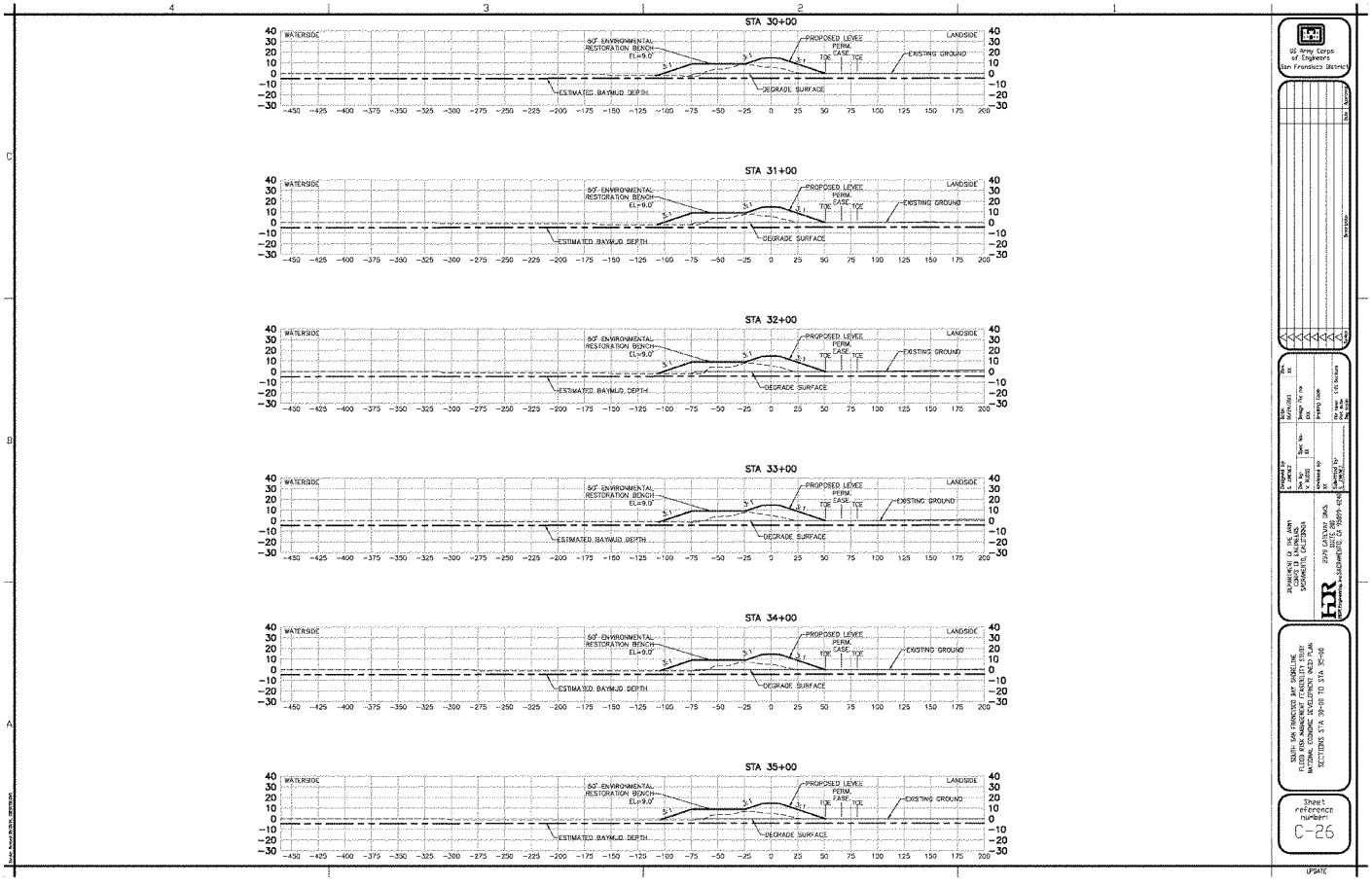
DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT
SACRAMENTO, CALIFORNIA

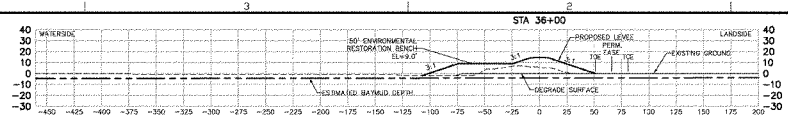
HDR Engineering, Inc. SACRAMENTO, CA 95815-4310
1319 CAPITOL OPAS
SUITE 100

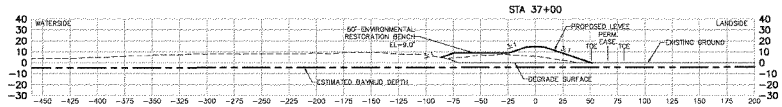
SUISUN-SAN FRANCISCO BAY SUBREGIONS
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 24+00 TO STA 29+00

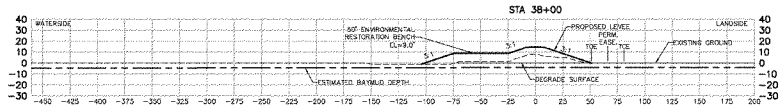
Sheet reference number:
C-25

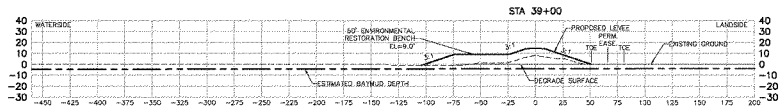
UPDATE

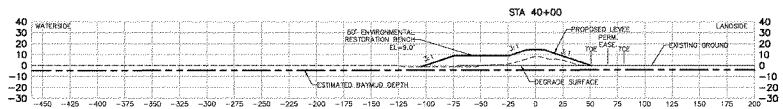

STA 30+00
STA 31+00
STA 32+00
STA 33+00
STA 34+00
STA 35+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT UNDER PLAN
SECTIONS STA 30+00 TO STA 35+00
Sheet reference number:
C-26
UPDATE

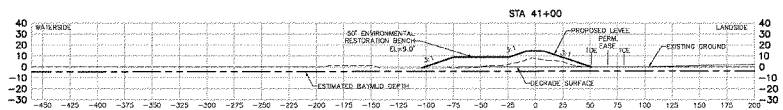












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date

Sheet reference number: C-27

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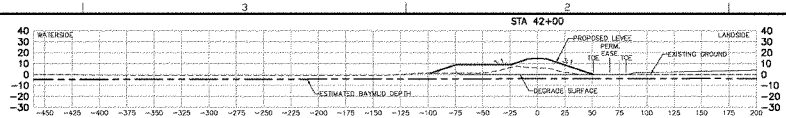
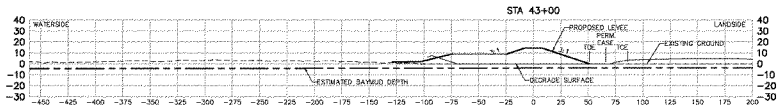
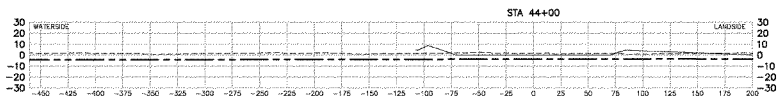
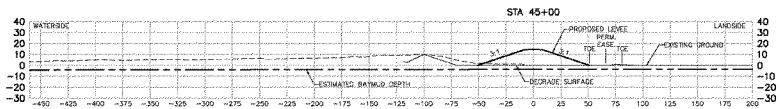
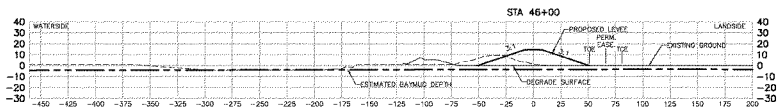
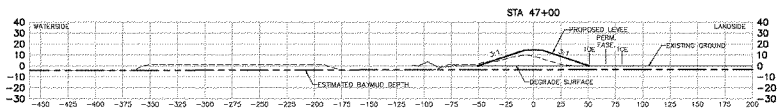












US Army Corps of Engineers
San Francisco District

Sec	Revision	Date	Description

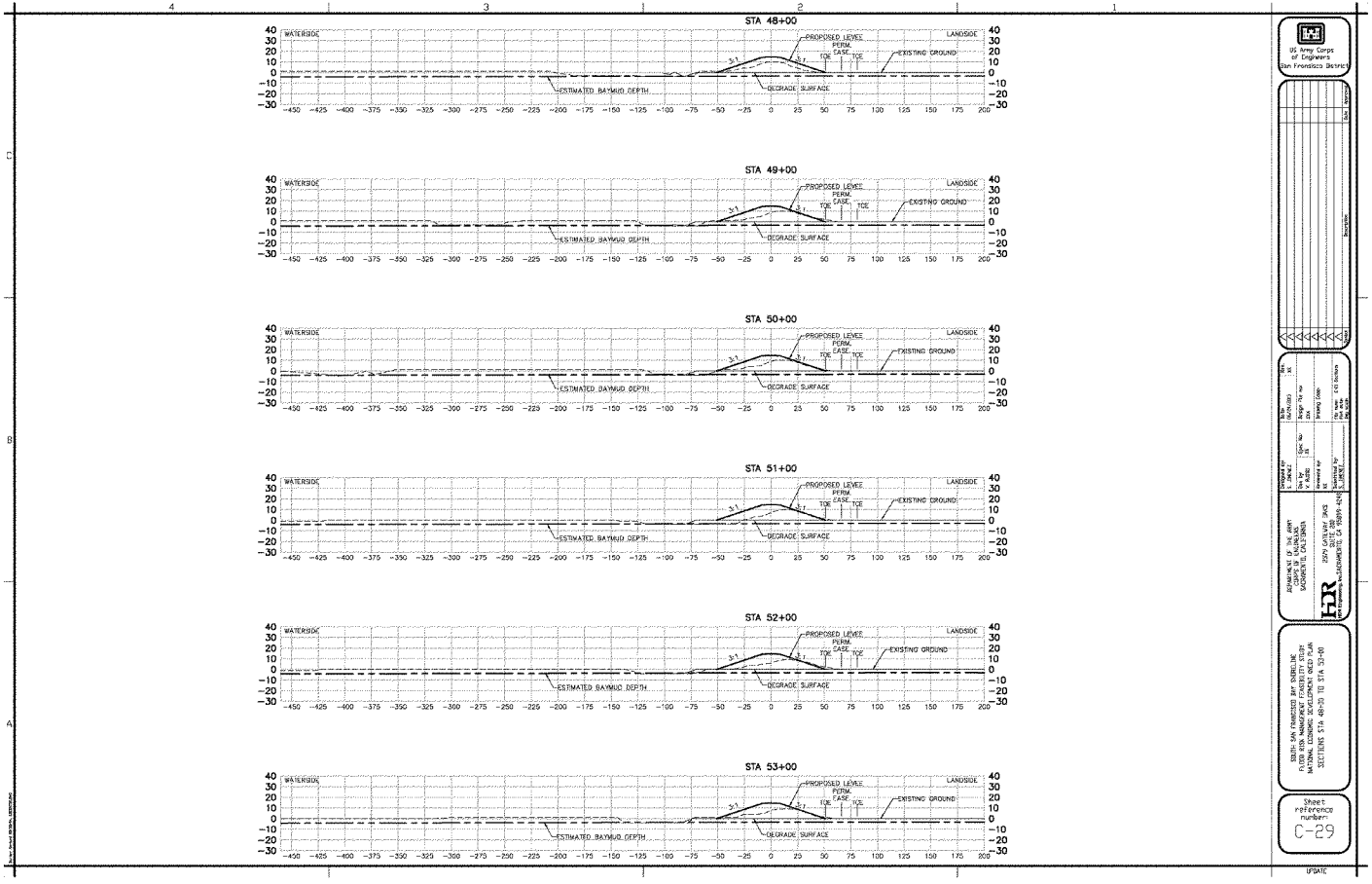
Date: 06/09/2023
Design file no: 301
Sheet No: 31
Drawing type: Plan
Drawing No: E1-C-Section
Designed by: STEPHANIE Z.
Drawn by: SAM
Checked by: M.
Approved by: M.
File name: E1-C-Section
File date: 06/09/2023

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4249
HDR Engineering, Inc.

SUISUN-FAIRFIELD BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 42+00 TO STA 47+00

Sheet reference number:
C-28

UPDATE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STA 50+00
STA 51+00
STA 52+00
STA 53+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
PERM.
TOE
CASE
TOE
EXISTING GROUND
3:1
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT ONED PLAN
SECTIONS STA 48+00 TO STA 53+00
Sheet reference number:
C-29
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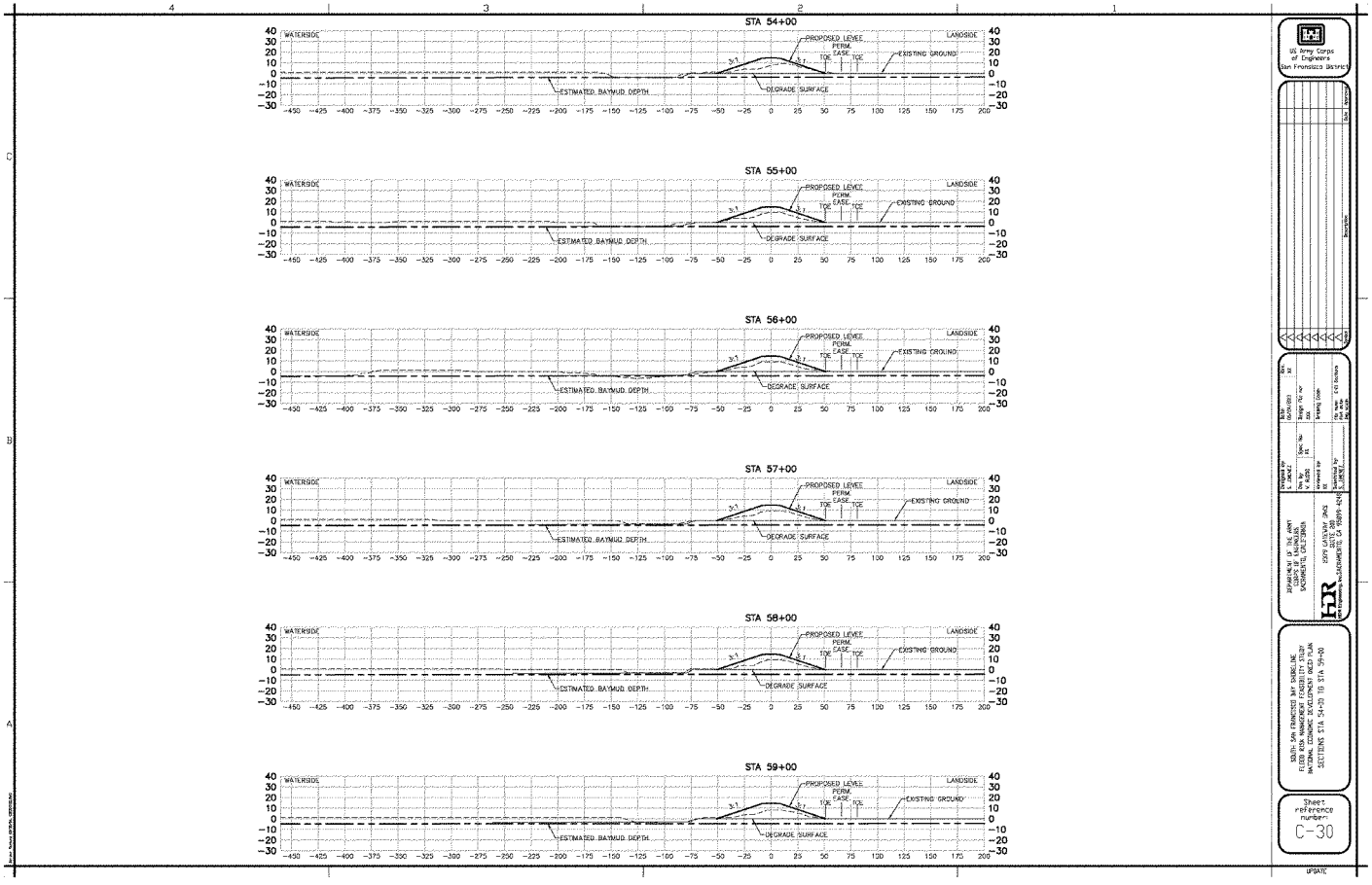
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STA 56+00
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STA 59+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT DIKED PLAN
SECTIONS STA 54+00 TO STA 59+00
Sheet reference number:
C-30
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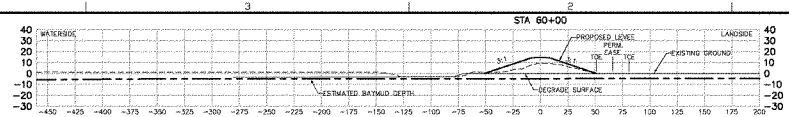

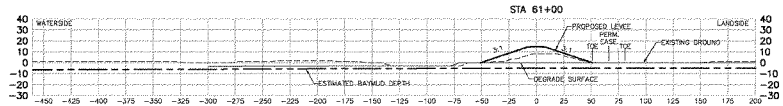

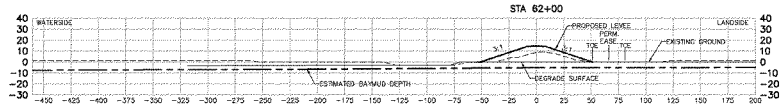

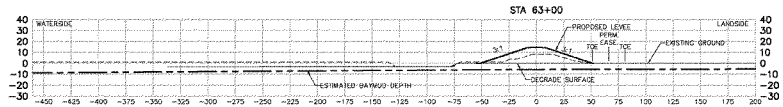

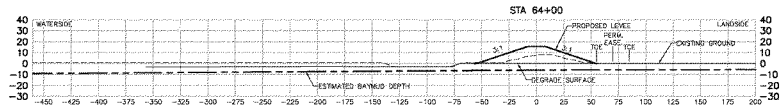

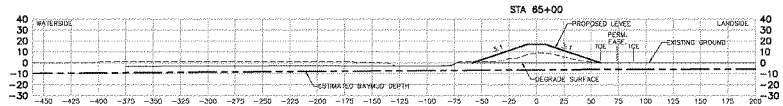

US Army Corps of Engineers
San Francisco District

Mark	Description	Date	Approved

Date: 06/04/2010
Scale: 1in
Approved for Use: Yes
Drawing Number: 1
Sheet No. (#): 1
Drawn by: SL
Checked by: SL
Reviewed by: SL
Approved by: SL
Drawing Name: Sections 60-65
File name: Sections 60-65.dwg

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

HDR
HDR Engineering, Inc. SACRAMENTO, CA 95815-4392
ESRP GATEWAY OPCS
DWR PROJECT NO. 1

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 60+00 TO STA 65+00

Sheet reference number:
C-31

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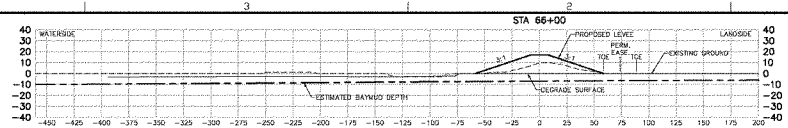

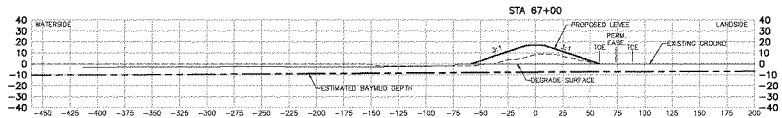

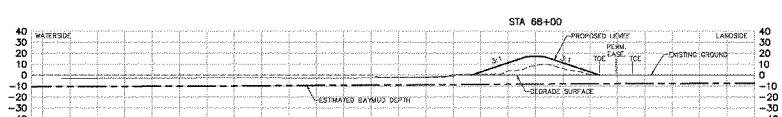

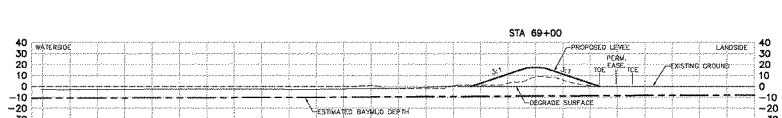

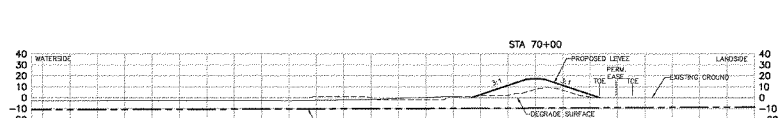

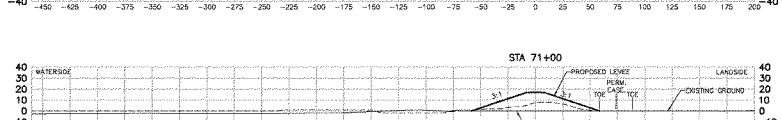

US Army Corps of Engineers
San Francisco District

Sym	Date	Description

Designed by: P. Chandler
Drawn by: D. Ryder
Reviewed by: TL
Submitted by: L. Ferrell
Date: 06/08/2011
Scale: 30'
Design file no: 1
Survey date:
Plot date: 6/8/2011
File name: 1125.dgn

SACRAMENTO CITY, INC. AGENCY
SACRAMENTO, CALIFORNIA
1329 GATEWAY WAY
SACRAMENTO, CA 95833-4245
HDR Engineering, Inc.

SACRAMENTO RIVER BASINS INC
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 66+00 TO STA 71+00

Sheet reference number:
C-32

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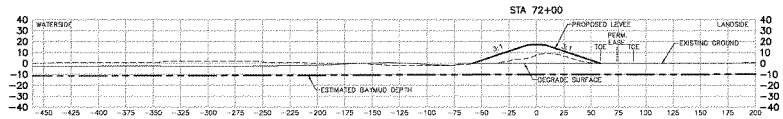

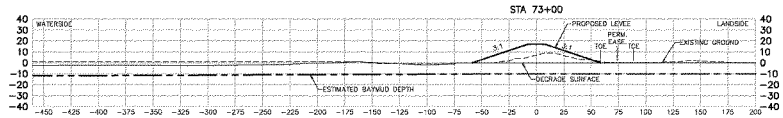

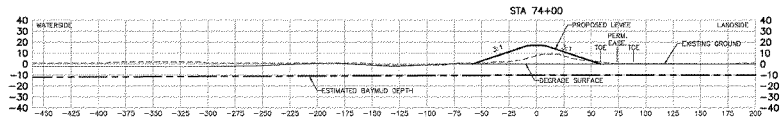

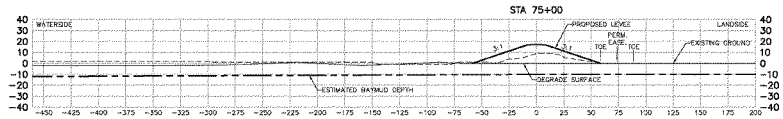

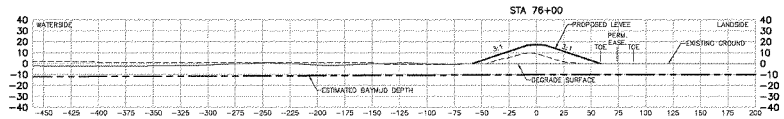

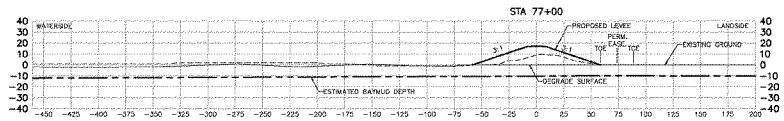

US Army Corps of Engineers San Francisco District

Sheet reference number: C-33

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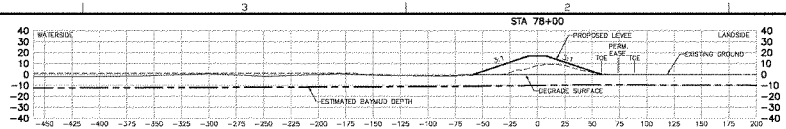

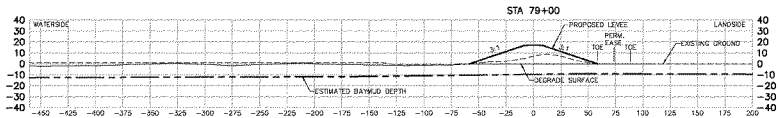

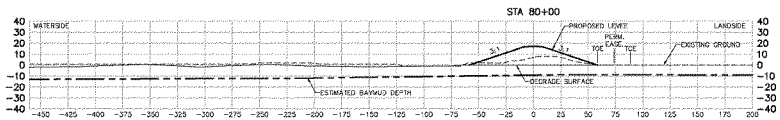

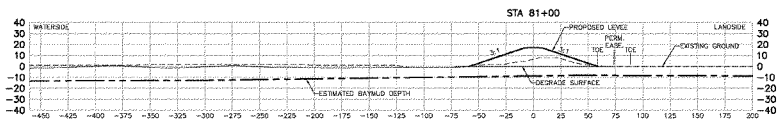

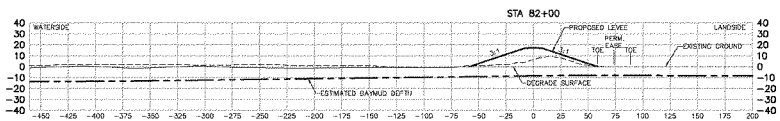

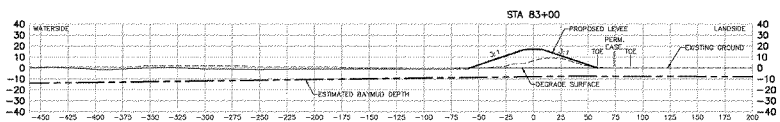

US Army Corps of Engineers
San Francisco District

Sym	Date	Description

Drawn by: Burton Ibsen
No. 50
Design file no: 50
Survey Code:
Checked by: DL
Date: 10-14-03
Reviewed by: DL
Date: 10-14-03
Approved by: DL
Date: 10-14-03
Scale: 1" = 10' H, 1" = 10' V
Dwg. No.: 50
Sheet No.: 34
Sheet Size: 24" x 36"
File name: 50-34.dwg
Plot date: 10-14-03

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR Inc., Engineers-Architects-Planners
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4245

SEWER, SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 78+00 TO STA 83+00

Sheet reference number:
C-34

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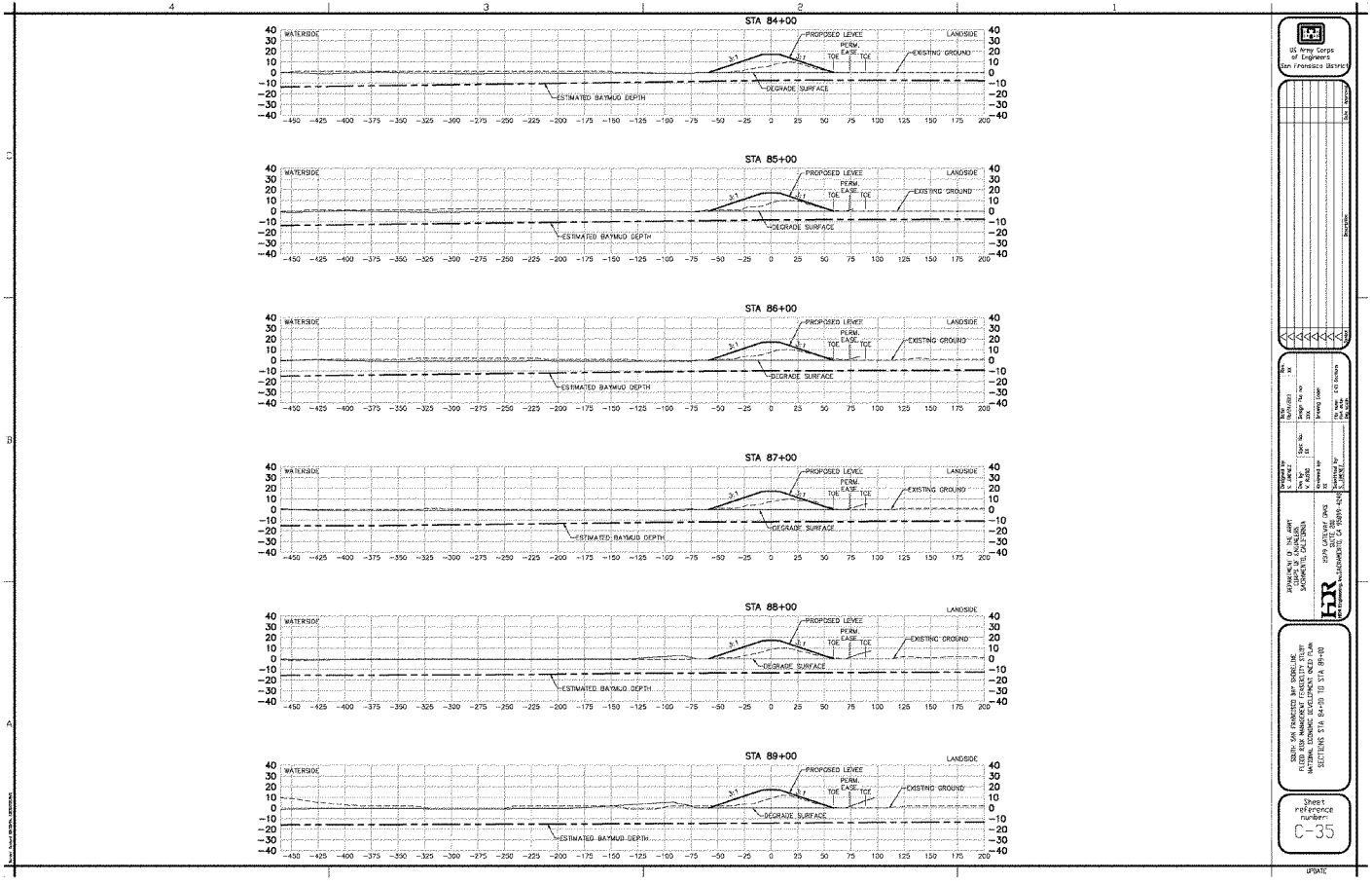
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STA 88+00
STA 89+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
PERM. EASE
TOE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN SECTIONS STA 84+00 TO STA 89+00
Sheet reference number:
C-35
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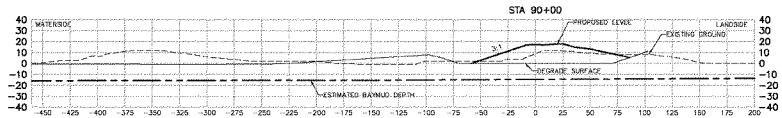
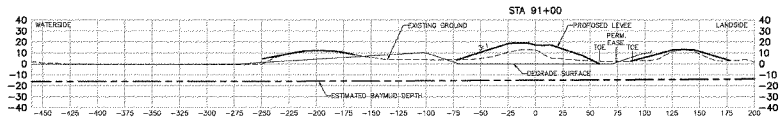
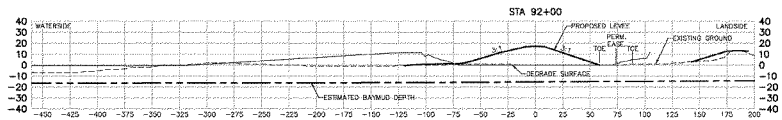
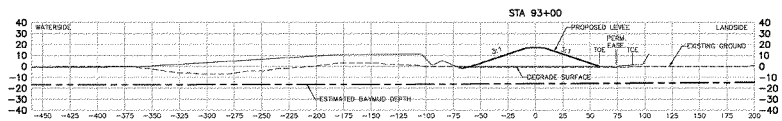
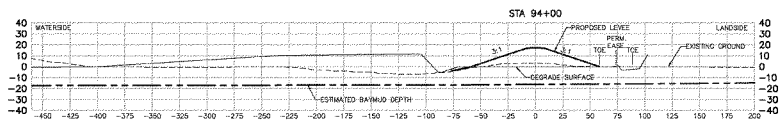
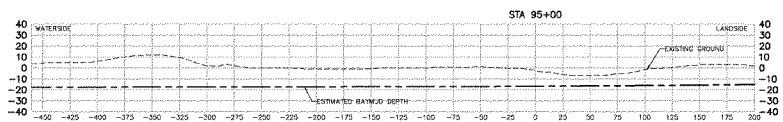










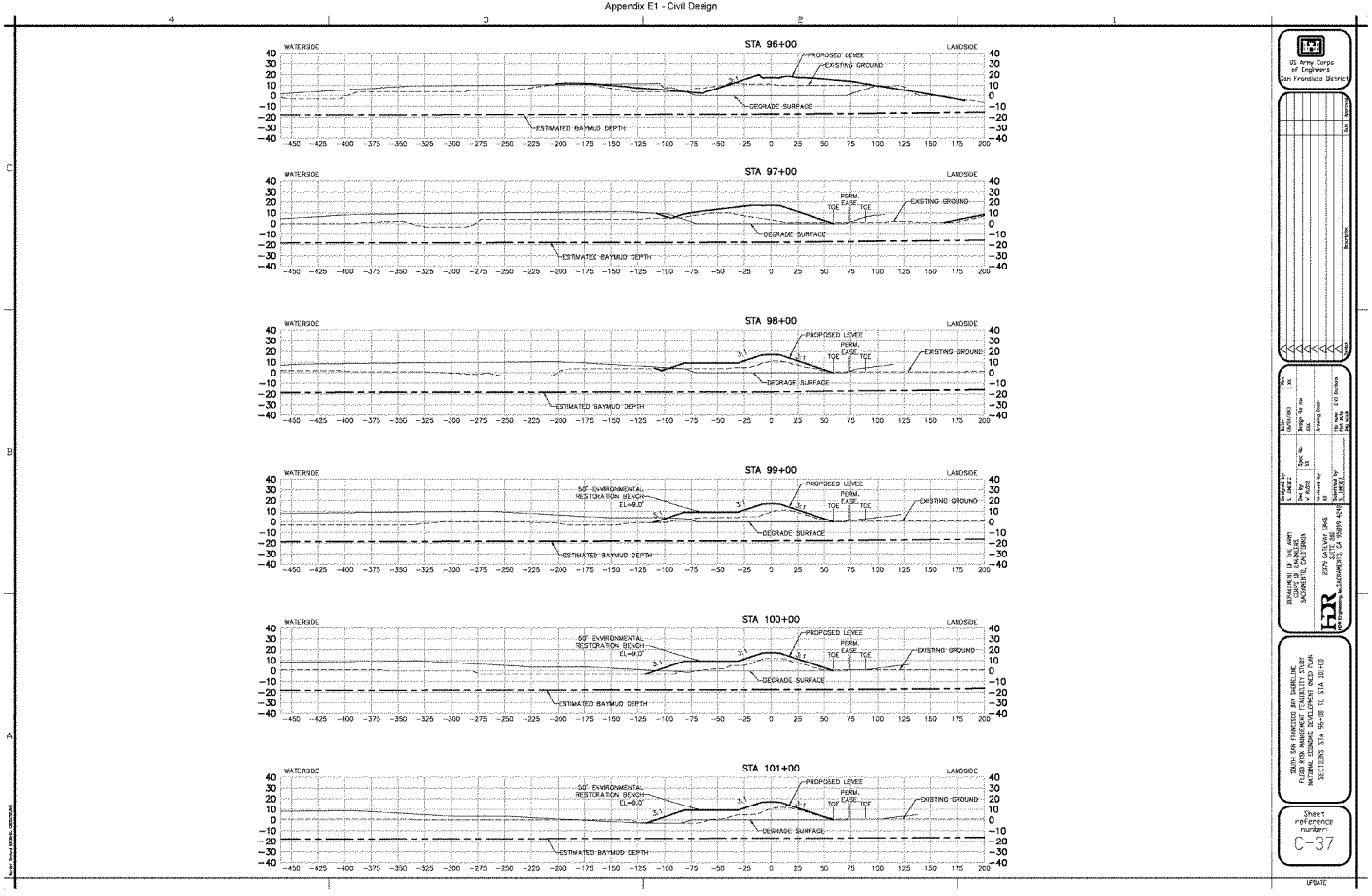


US Army Corps of Engineers
San Francisco District

Date	Description

Sheet reference number
C-36

UPDATE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STA 97+00
STA 98+00
STA 99+00
STA 100+00
STA 101+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
PERM. EASE
TOE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
EDEN GATEWAY GMS
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN
SECTIONS STA 96+00 TO STA 101+00
Sheet reference number:
C-37
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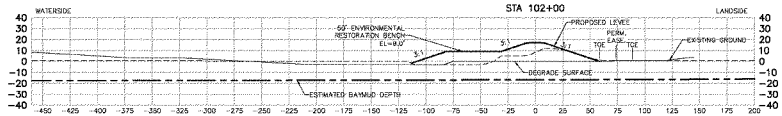
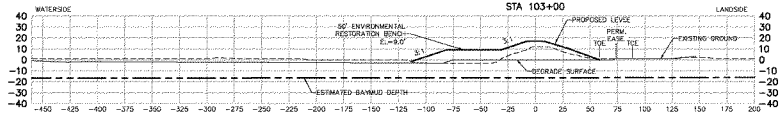
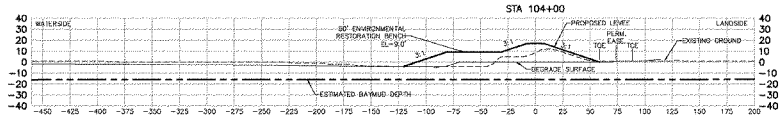
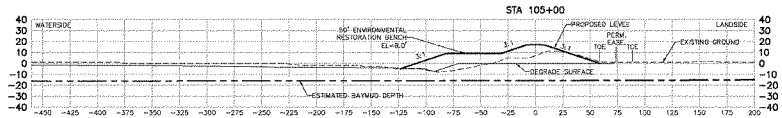
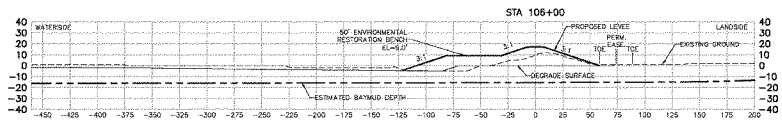
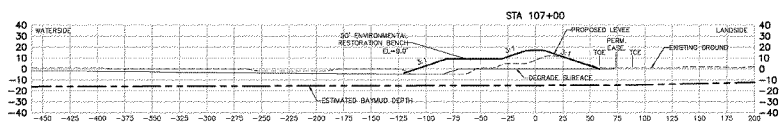












US Army Corps of Engineers
San Francisco District

Sym	Description	Date	Approved

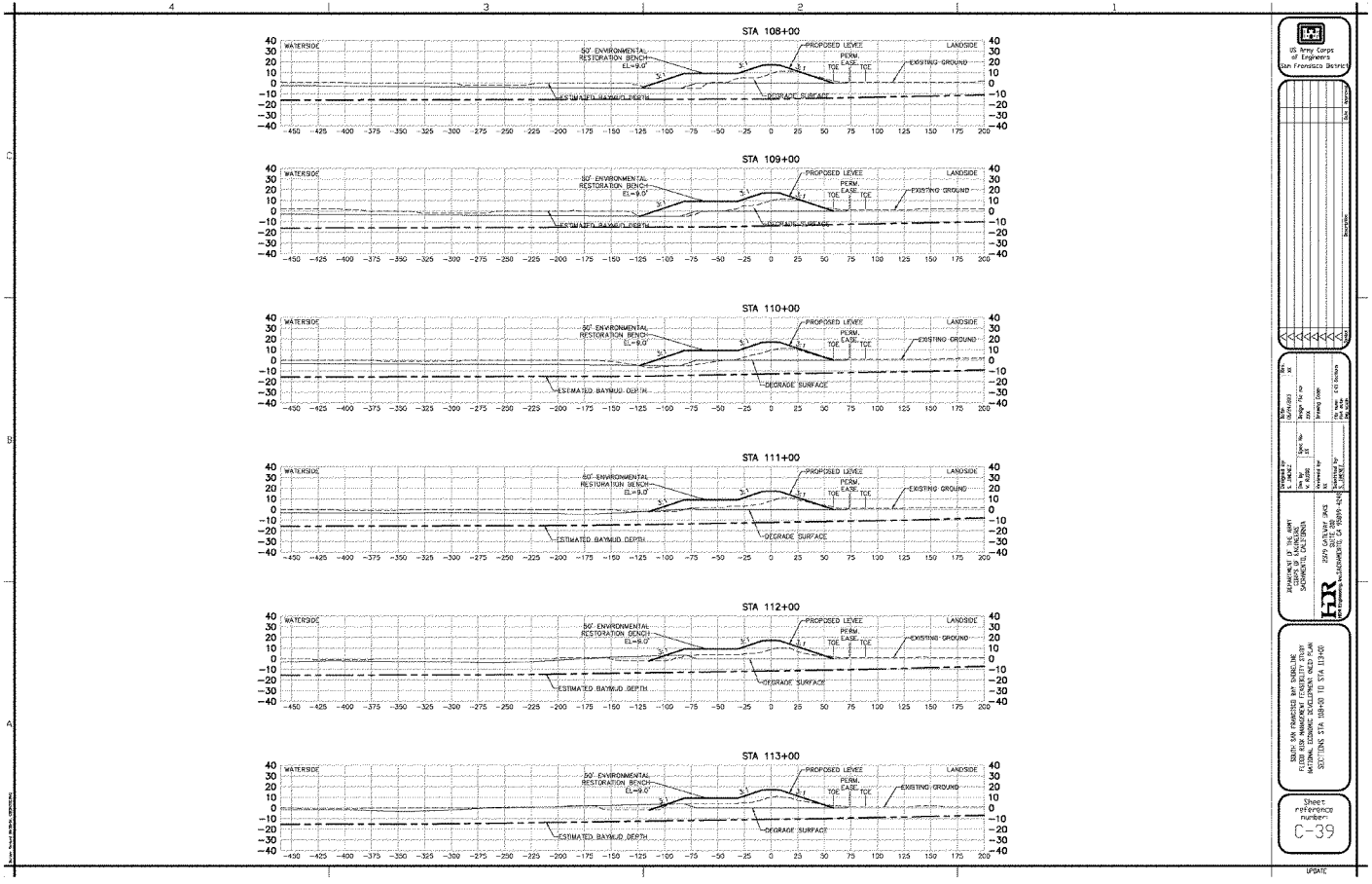
Designed for: STANTEC
Date: 06/04/2013
Dwn by: Chk by: Appd by: Scale: NTS
Spec. No.: Design file no: Drawing type:
Drawing No.: C-38
File name: E10 Sections
Sheet No.: 38

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
HDR Engineering, Inc. CALIFORNIA
8970 GATEWAY SKY
SACRAMENTO, CA 95826-4245

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NAVIGATION ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 102+00 TO STA 107+00

Sheet reference number
C-38

UPDATE


STA 108+00
STA 109+00
STA 110+00
STA 111+00
STA 112+00
STA 113+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
2509 CATEWAY DRIVE SUITE 200 SACRAMENTO, CA 95815-6245
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN
SECTIONS STA 108+00 TO STA 113+00
Sheet reference number:
C-39
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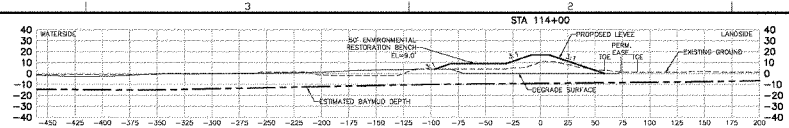

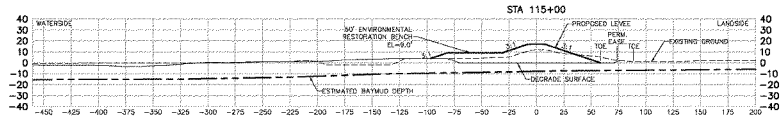

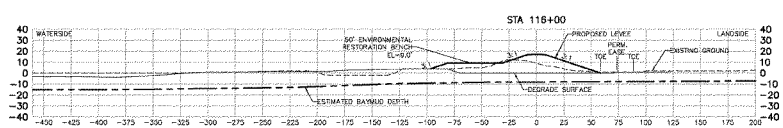

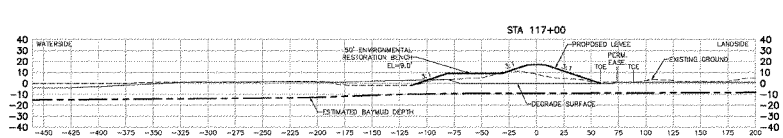

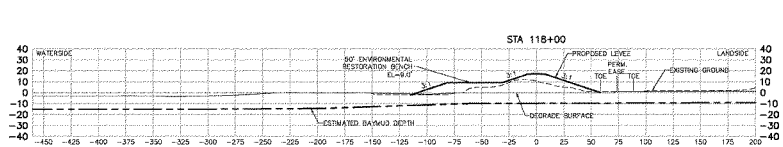

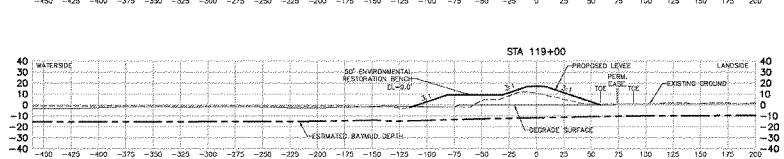

US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

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Drawing type: 02
Spec. No: 01
Drawing Code:
Drawing by: 02
Checked by: 02
Approved by: 02
Drawing No: E-01 Series
File name:
File date:
Sheet size: 24" x 36"

JOINT VENTURE OF THE GANT CORPORATION AND SACRAMENTO ENGINEERS
HDR Engineering, Inc. SACRAMENTO, CA 95815-4405
1320 DATSON DRIVE
TEL: (916) 922-1022 FAX: (916) 922-1037

DELTA-SPA ENHANCED 3KF INDIRECT LINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NAUTICAL COORDINATE DEVELOPMENT (NCD) PLAN
SECTIONS STA. 114+00 TO STA. 119+00

Sheet reference number:
C-40

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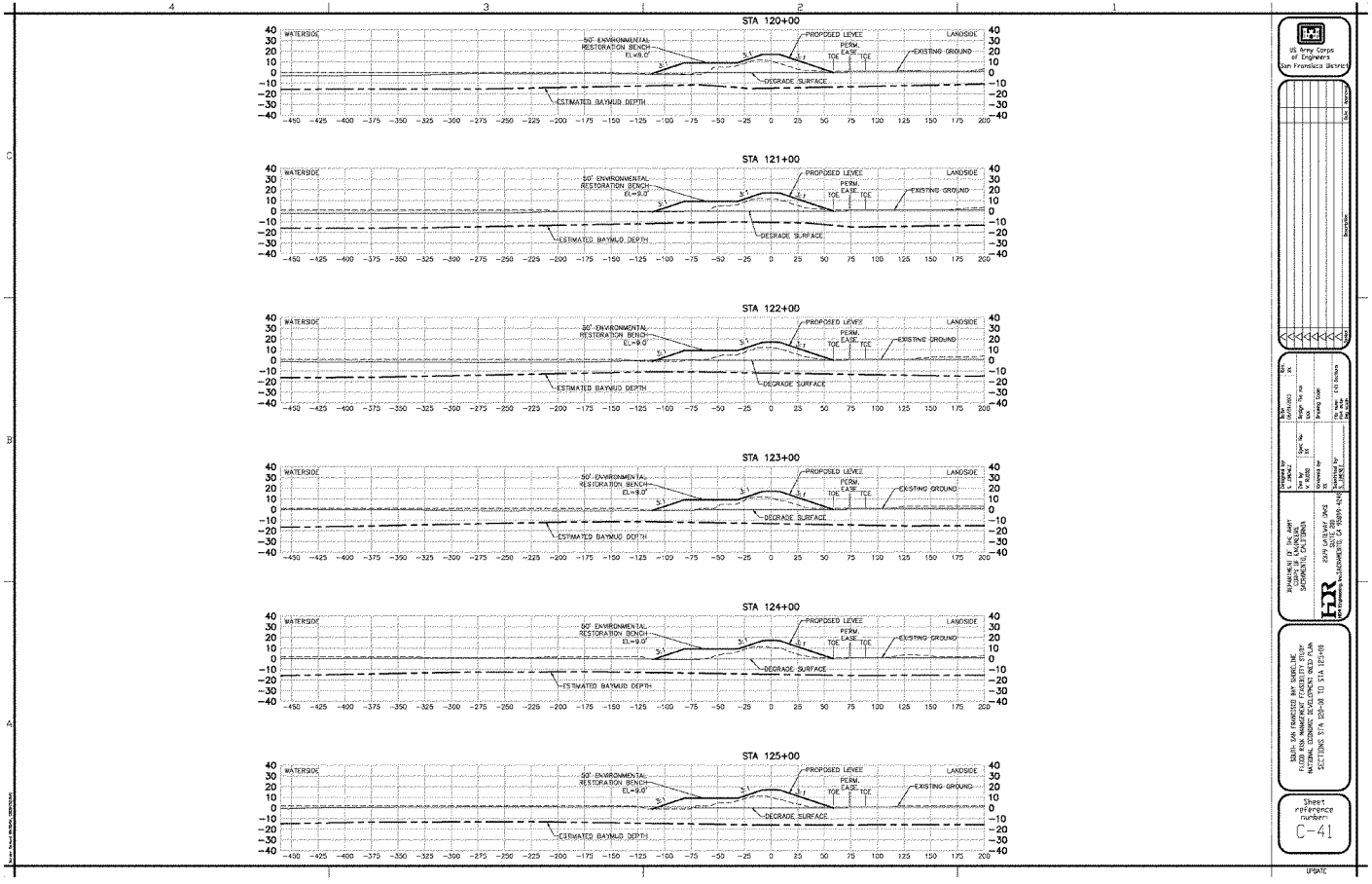
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STA 121+00
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WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT NEED PLAN
SECTIONS STA 120+00 TO STA 125+00
Sheet reference number:
C-41
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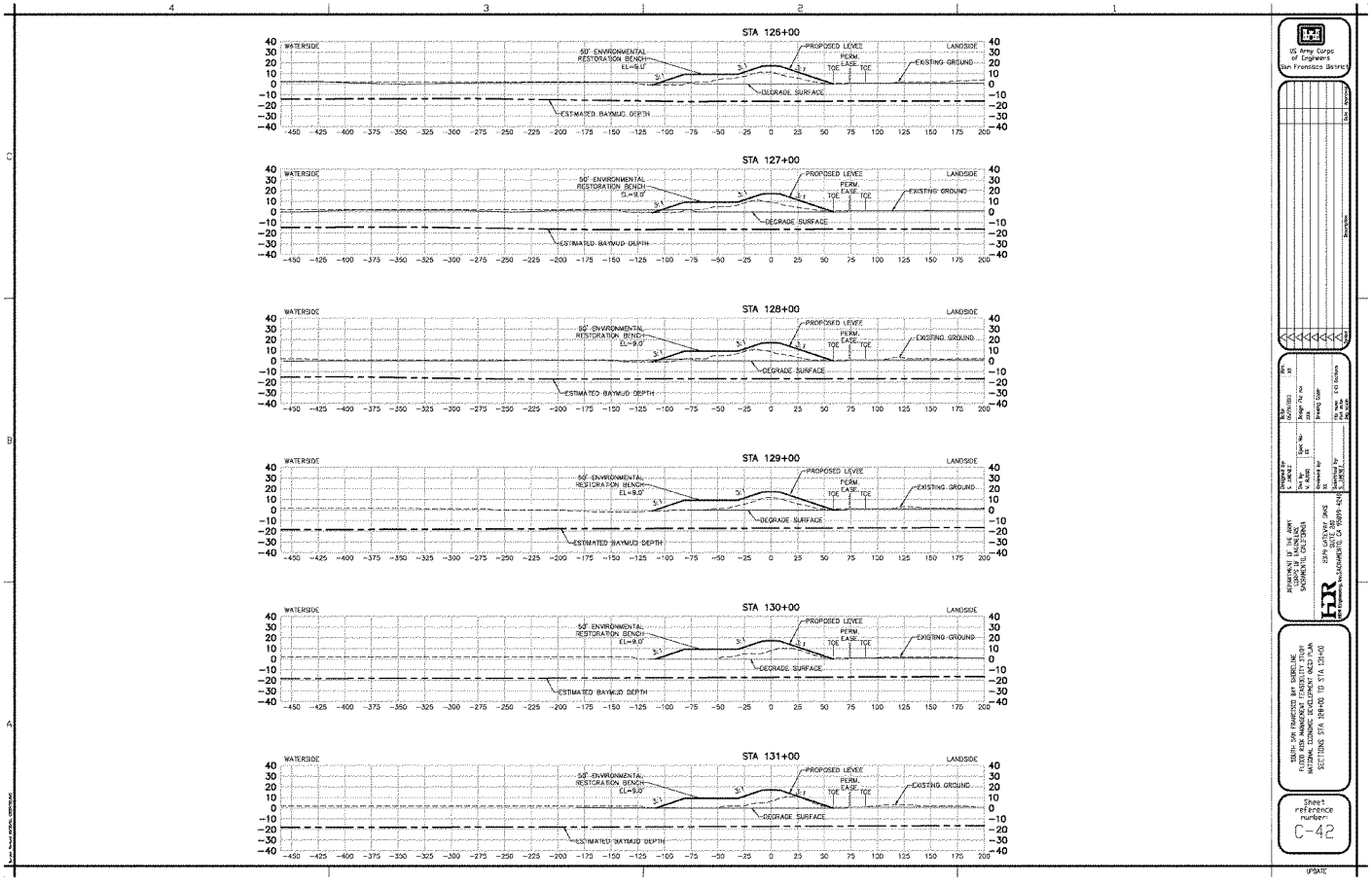
STA 126+00
STA 127+00
STA 128+00
STA 129+00
STA 130+00
STA 131+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT ONED PLAN
SECTIONS STA 126+00 TO STA 131+00
Sheet reference number:
C-42
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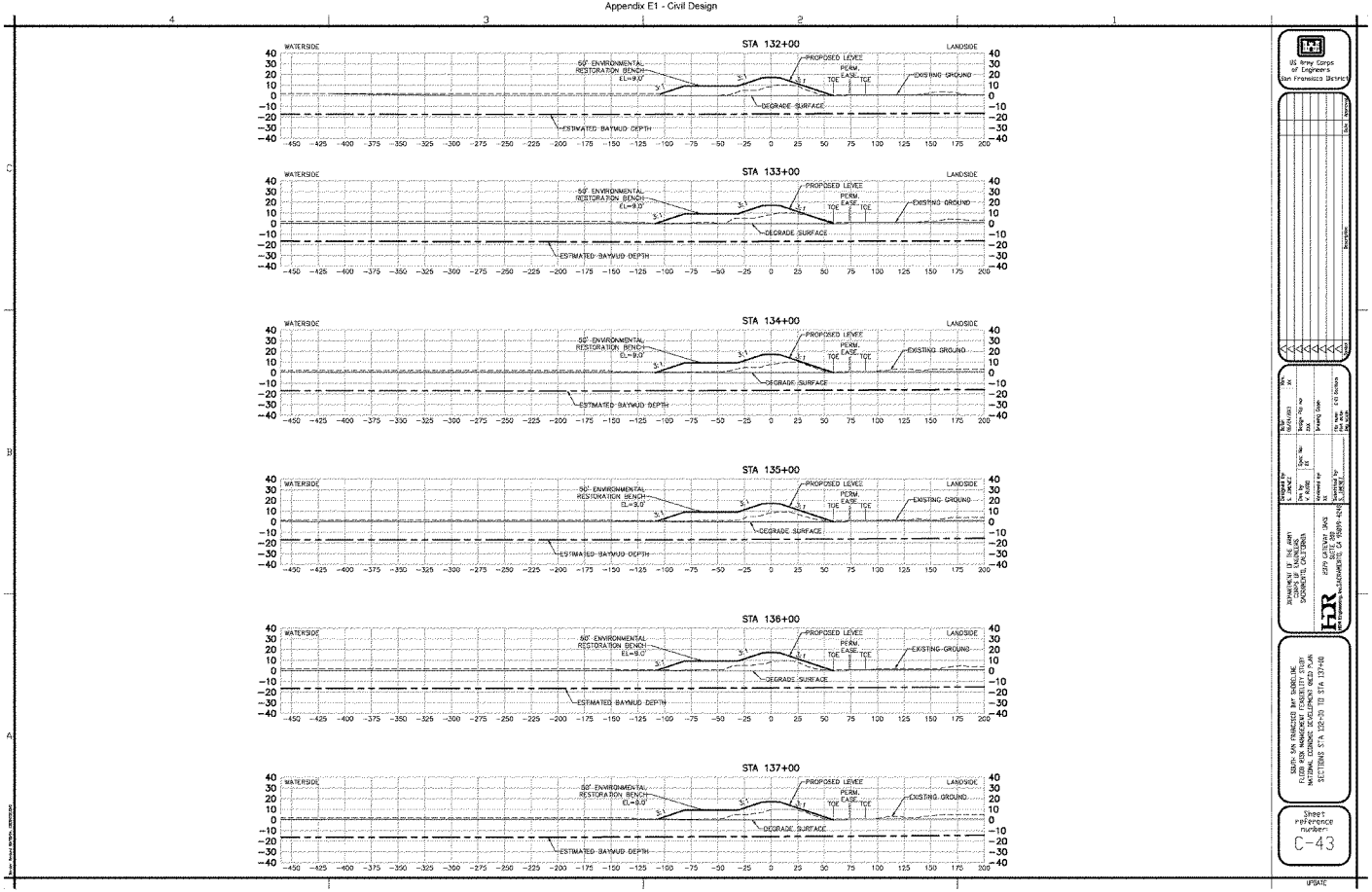
STA 132+00
STA 133+00
STA 134+00
STA 135+00
STA 136+00
STA 137+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT AREA PLAN SECTIONS STA 132+00 TO STA 137+00
Sheet reference number:
C-43
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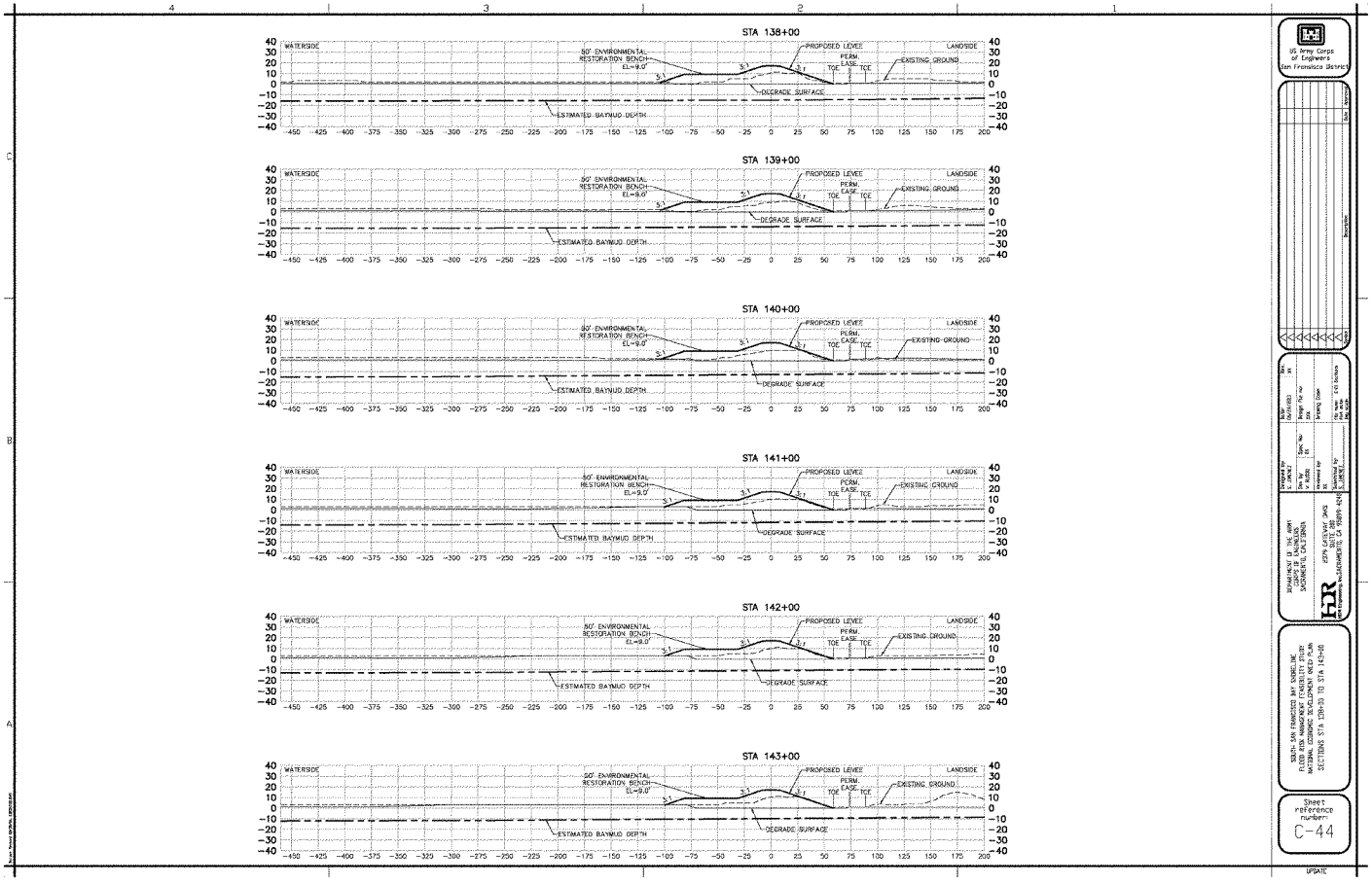
STA 138+00
STA 139+00
STA 140+00
STA 141+00
STA 142+00
STA 143+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD AND MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN
SECTIONS STA 138+00 TO STA 143+00
Sheet reference number:
C-44
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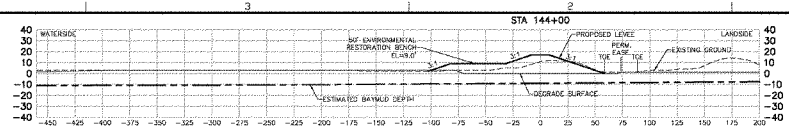
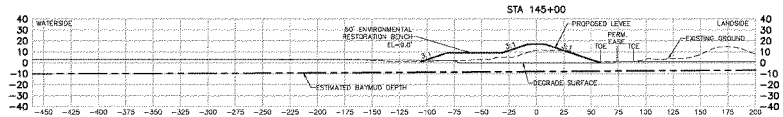
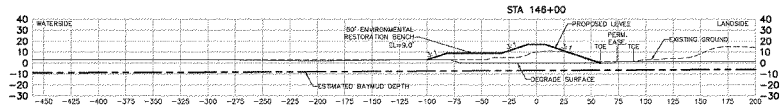
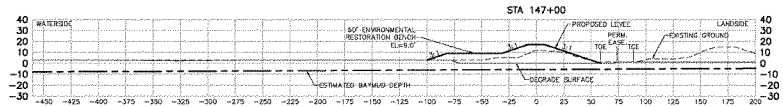
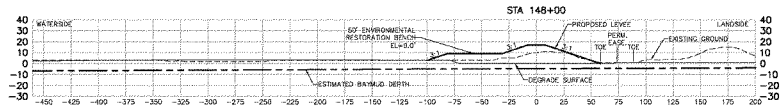
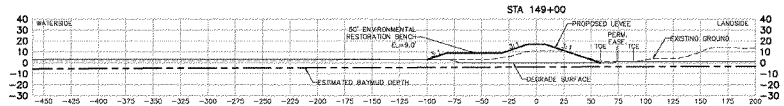












US Army Corps of Engineers
San Francisco District

Mark	Date	Description
A		
B		
C		
D		
E		

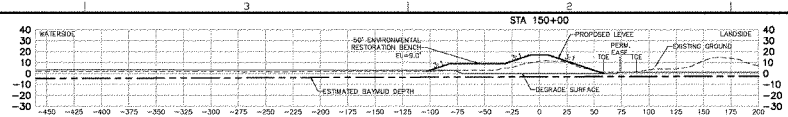
Date: 30-Jan-2013
Scale: 1in
Drawing Name: Bridge Ave no Levee
Drawing Code: Typical Section
Drawn by: SL
Checked by: SL
Approved by: SL
Revision: 0
Revision Date: 30-Jan-2013
File name: C-45.dwg
Plot date: 30-Jan-2013

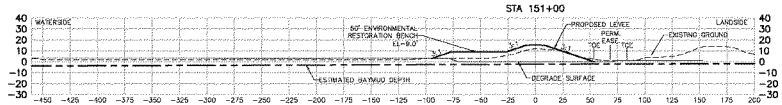
DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT
CORPS OF ENGINEERS
1534 CATEWAY BLVD
MOTT MACDONALD
HDR
HDR Engineering, Inc. SACRAMENTO, CA 95815-4810

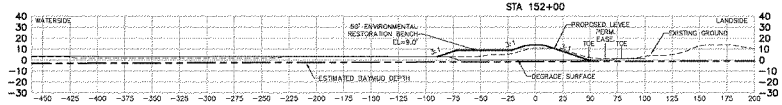
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 144+00 TO STA 149+00

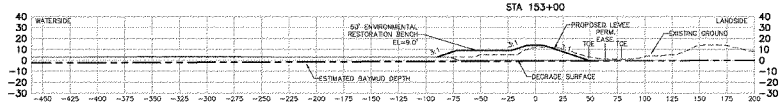
Sheet reference number:
C-45

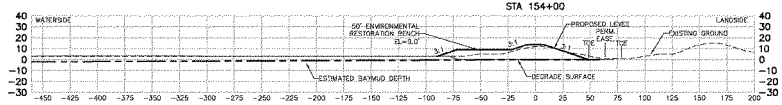
UPDATE

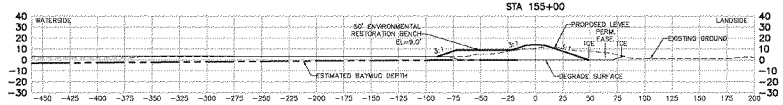












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

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Drawn by: Mark Hess
Date: 06/04/2003
Scale: 1" = 20'
Spec. No.: 01
Design file no.: 01
Reviewed by:
Submitted by:
Drawing name:
Date: 06/04/2003
Scale: 1" = 20'
Sheet: 01
File name: 01-01.dwg
File date: 06/04/2003

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
1325 GATEWAY DRIVE
SACRAMENTO, CA 95815-4825

HDR
HDR Engineering, Inc.

SUISUN, SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NAVIGATION, ECONOMIC DEVELOPMENT AND RECREATION
SECTIONS STA 124+00 TO STA 155+00

Sheet reference number:
C-46

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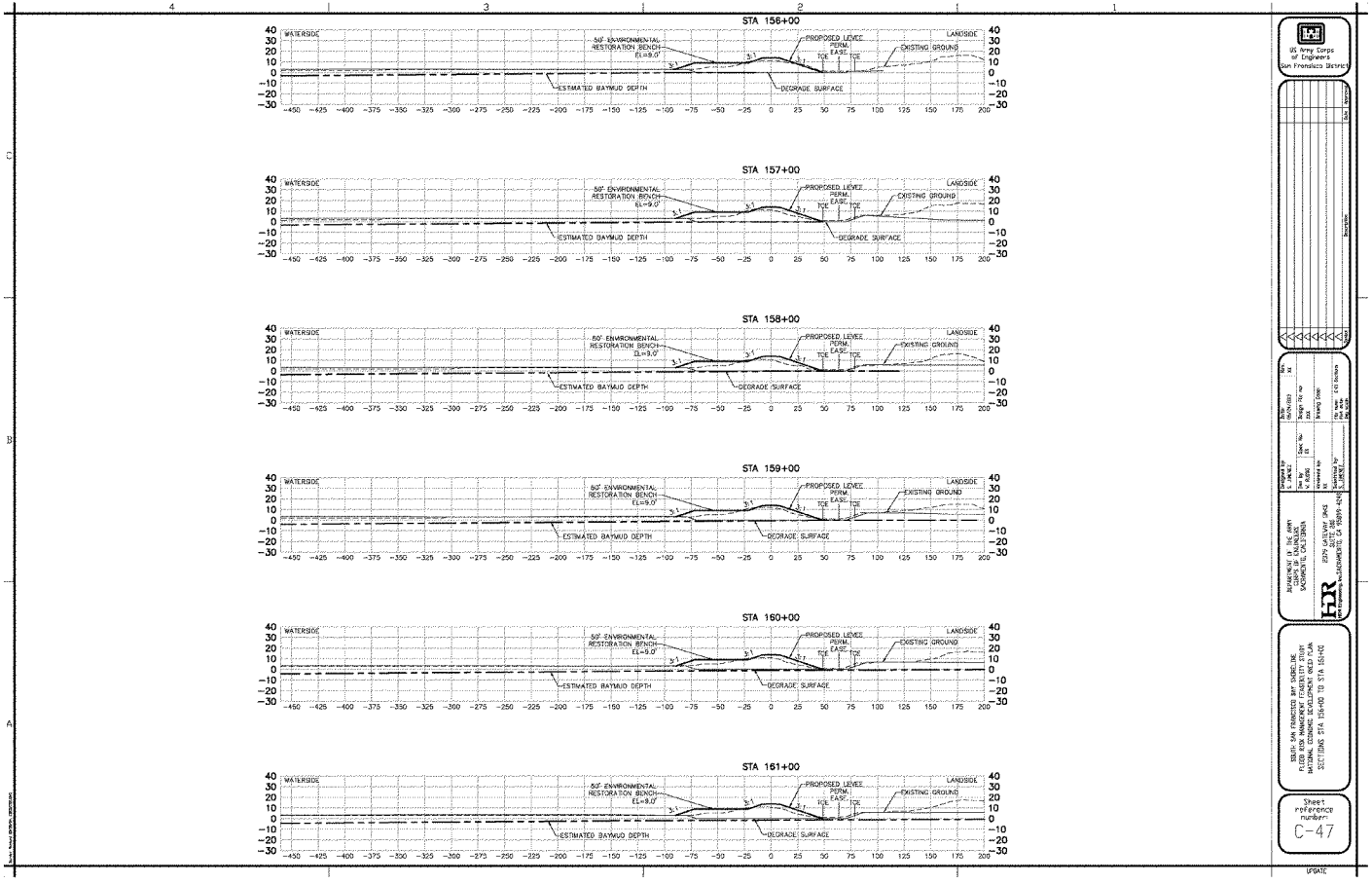
STA 156+00
STA 157+00
STA 158+00
STA 159+00
STA 160+00
STA 161+00
WATERSIDE
LANDSIDE
50' ENVIRONMENTAL RESTORATION BENCH EL=9.0'
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN SECTIONS STA 156+00 TO STA 161+00
Sheet reference number:
C-47
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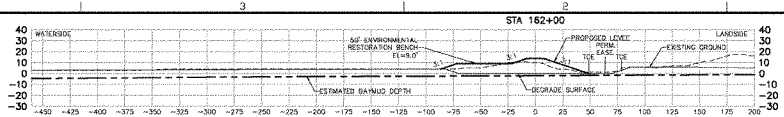

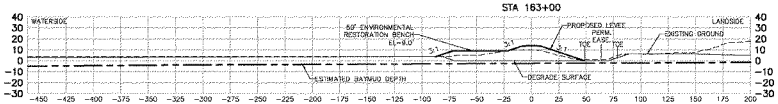

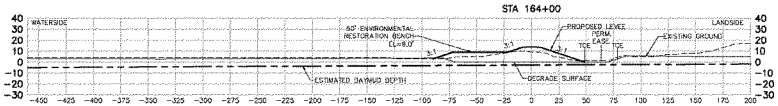

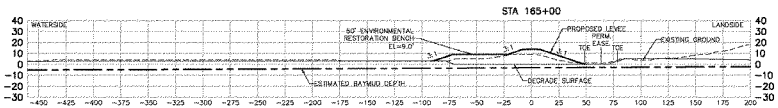

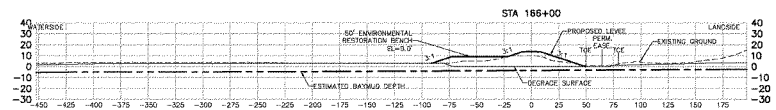

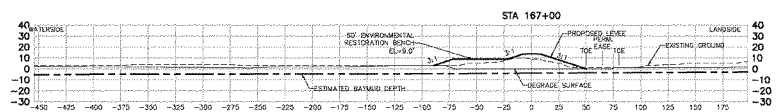

US Army Corps of Engineers
San Francisco District

Mark	Date	Description	By

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Drawn by: Checked by:
Reviewed by: Approved by:
Date: 02/04/2013
Scale: 1:50
Design file no: 01
Drawing name:
Plot date: 2/4/2013
File name: C-48.dwg

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CA 95814-2922

HDR
HDR Engineering, Inc.

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 162+00 TO STA 167+00

Sheet reference number:
C-48

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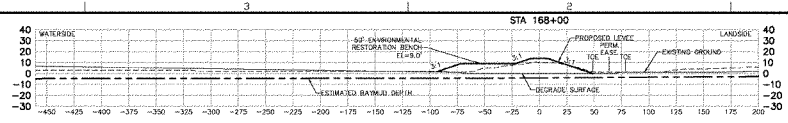

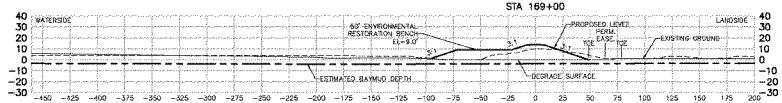

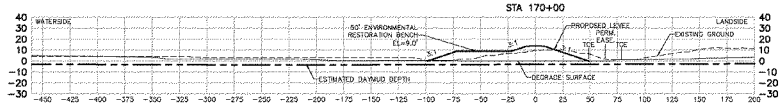

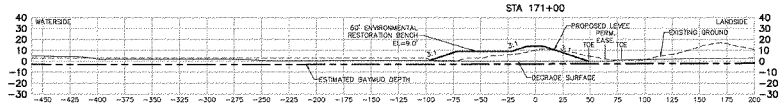

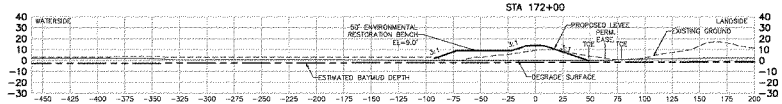

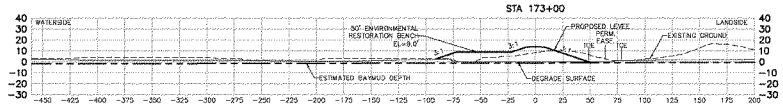

US Army Corps of Engineers San Francisco District

Sheet reference number: C-49

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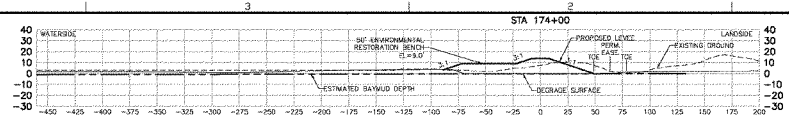

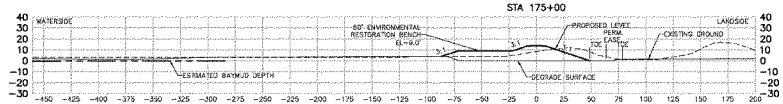

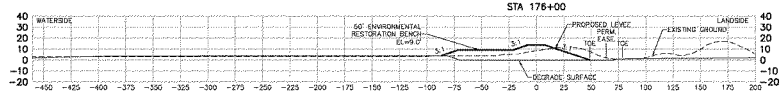

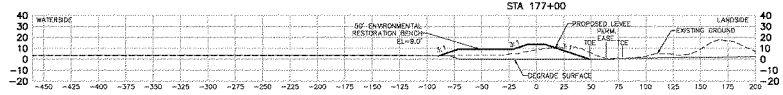

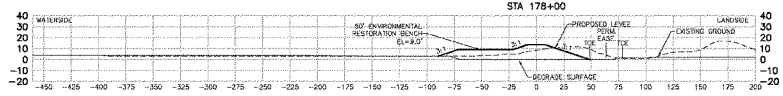

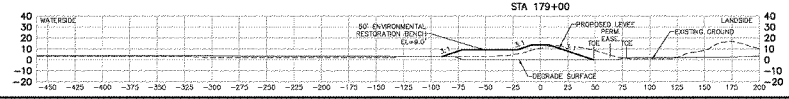

US Army Corps of Engineers
San Francisco District

Sym	Date	Revision	Description

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CA 95814-2922
HDR Engineering, Inc.

Designed by: S. CHANG
Date: 06/09/2010
Drawn by: M. DAVIS
Date: 06/09/2010
Reviewed by: B. SHANG
Date: 06/09/2010
Submitted by: M. LEONE
Date: 06/09/2010
Scale: As noted
Sheet No. 31
Design file no. 31
Drawing name: 31-Sections
File name: 31-Sections
Sheet size: 24x36

CALIFORNIA FRANCISCO BAY INDEX DE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 174+00 TO STA 179+00

Sheet reference number:
C-50

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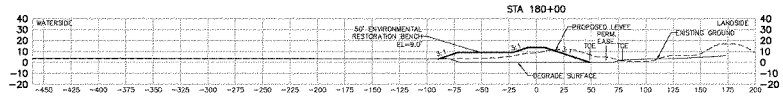
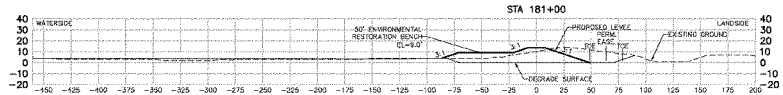
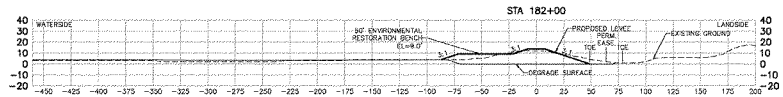
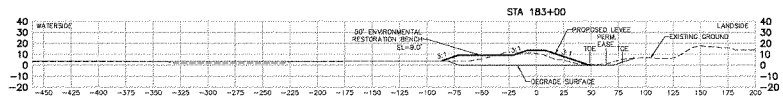
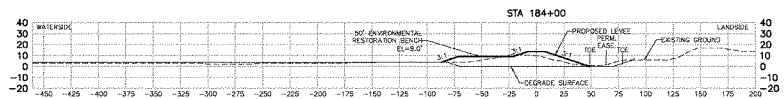
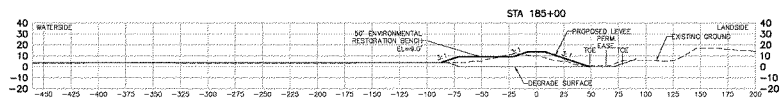












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

HDR Engineering, Inc.
8950 CORDOVA ARCS
SUITE 100
SACRAMENTO CA 95826-4916

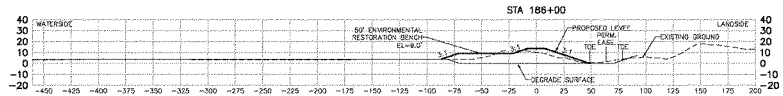
Date Approved (Signature of Chief, Design Branch)
Date Approved (Signature of Chief, Engineering Division)
Date Approved (Signature of Chief, Construction Division)
Date Approved (Signature of Chief, Real Estate Division)
Date Approved (Signature of Chief, Planning Branch)
Date Approved (Signature of Chief, Operations Division)

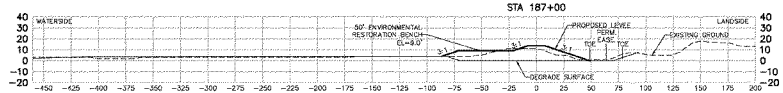
Sheet No. 31
Sheet No. 31
Drawing Number
Drawing Number
Drawing Number
Drawing Number

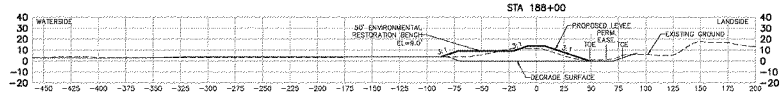
DESIGN FOR CONNECTED BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT PLAN
SECTIONS STA 180+00 TO STA 185+00

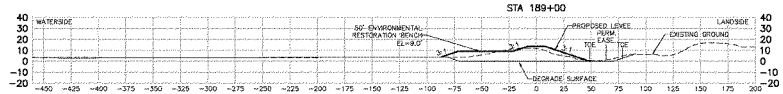
Sheet reference number:
C-51

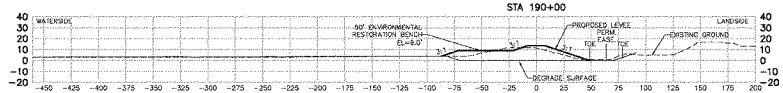
UPDATE

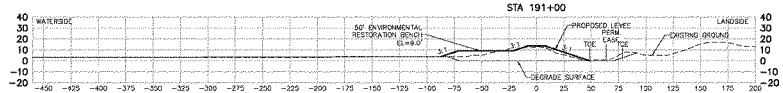












US Army Corps of Engineers
San Francisco District

Sym	Date	Description

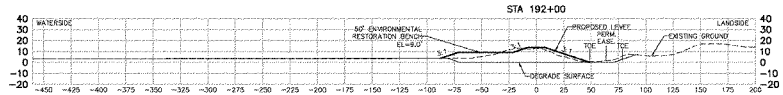
Drawn by: D. CHANG Jr. | Date: 02/01/03 | Sheet No: 30
Des by: Dr. Sup: | Design file no: 1.01
Reviewed by: RL | Survey Date:
Checked by: RL | Plot date: 2/4/03 | File name: 2/4/03 | Plot scale: 1:1

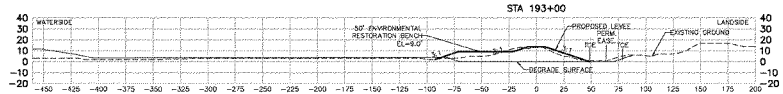
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR Inc. Engineers-Architects-Consultants
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4210

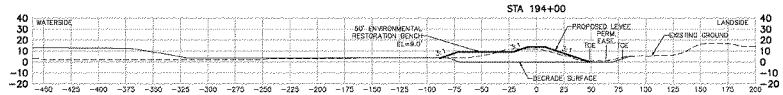
DELTA, SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
SECTIONS STA 186+00 TO STA 191+00

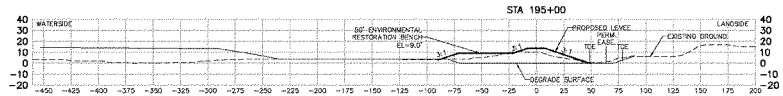
Sheet reference number:
C-52

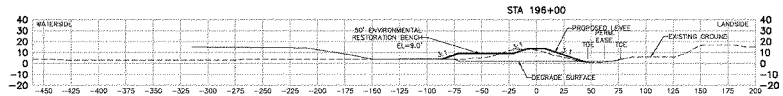
UPDATE

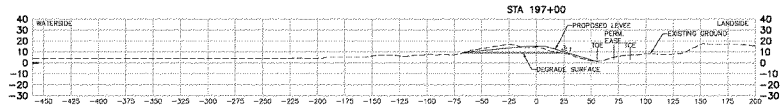












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved
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2			
3			
4			
5			

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Spec no: 01
Drawing Code:
Drawn by: SL
Designed by: SL
Checked by: SL
Approved by: SL
Drawing no: 01
Sheet no: 01
Revision no: 01
Revision date: 06/07/2011
Revision by: SL
Revision: 01
Revision no: 01
Revision date: 06/07/2011
Revision by: SL
Revision: 01

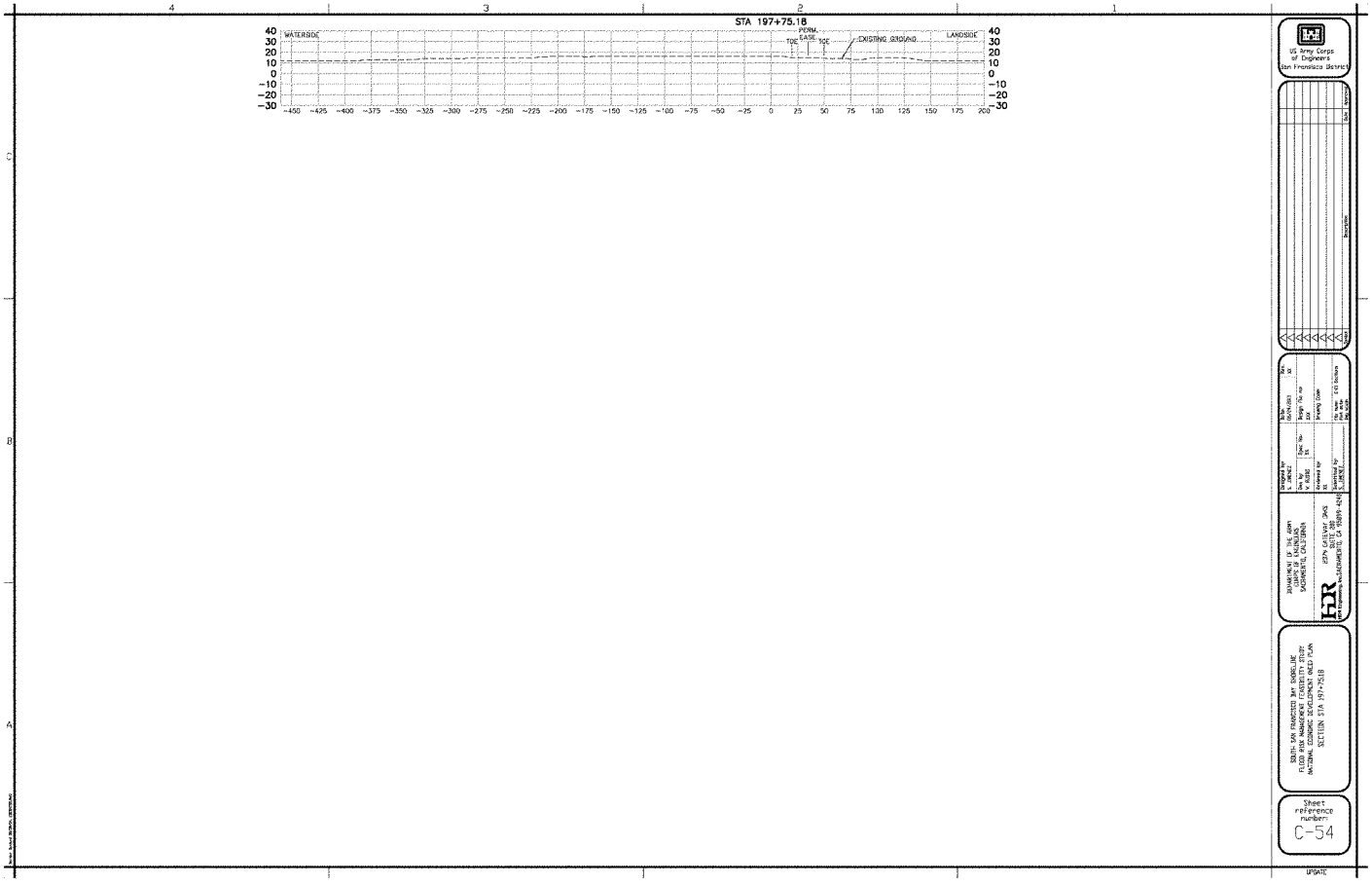
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

HDR
HDR Engineering, Inc.
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO CA 95833-4210

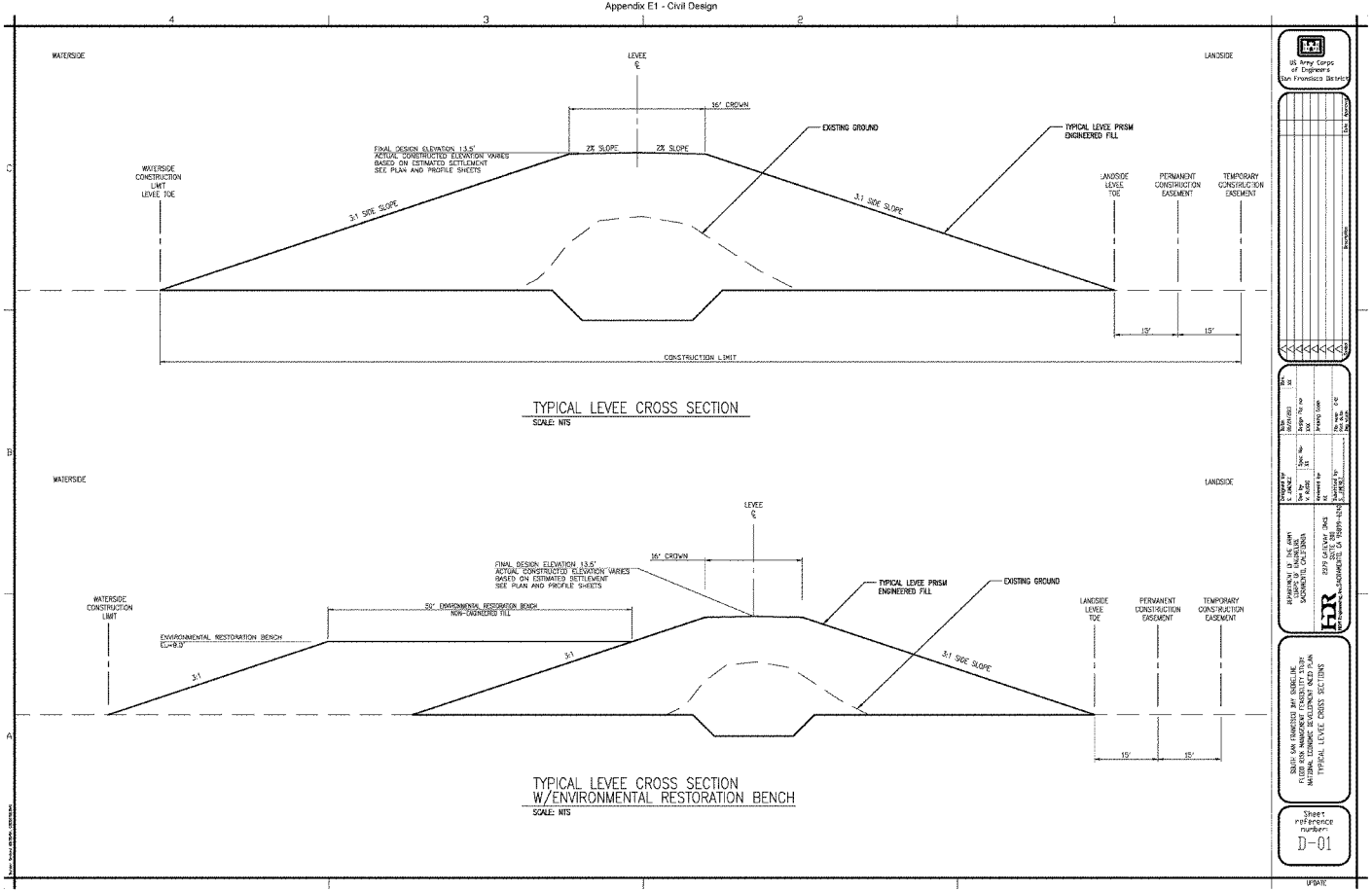
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NAVIGATION COMMON DEVELOPMENT AREA "A-2"
SECTIONS STA 192+00 TO STA 197+00

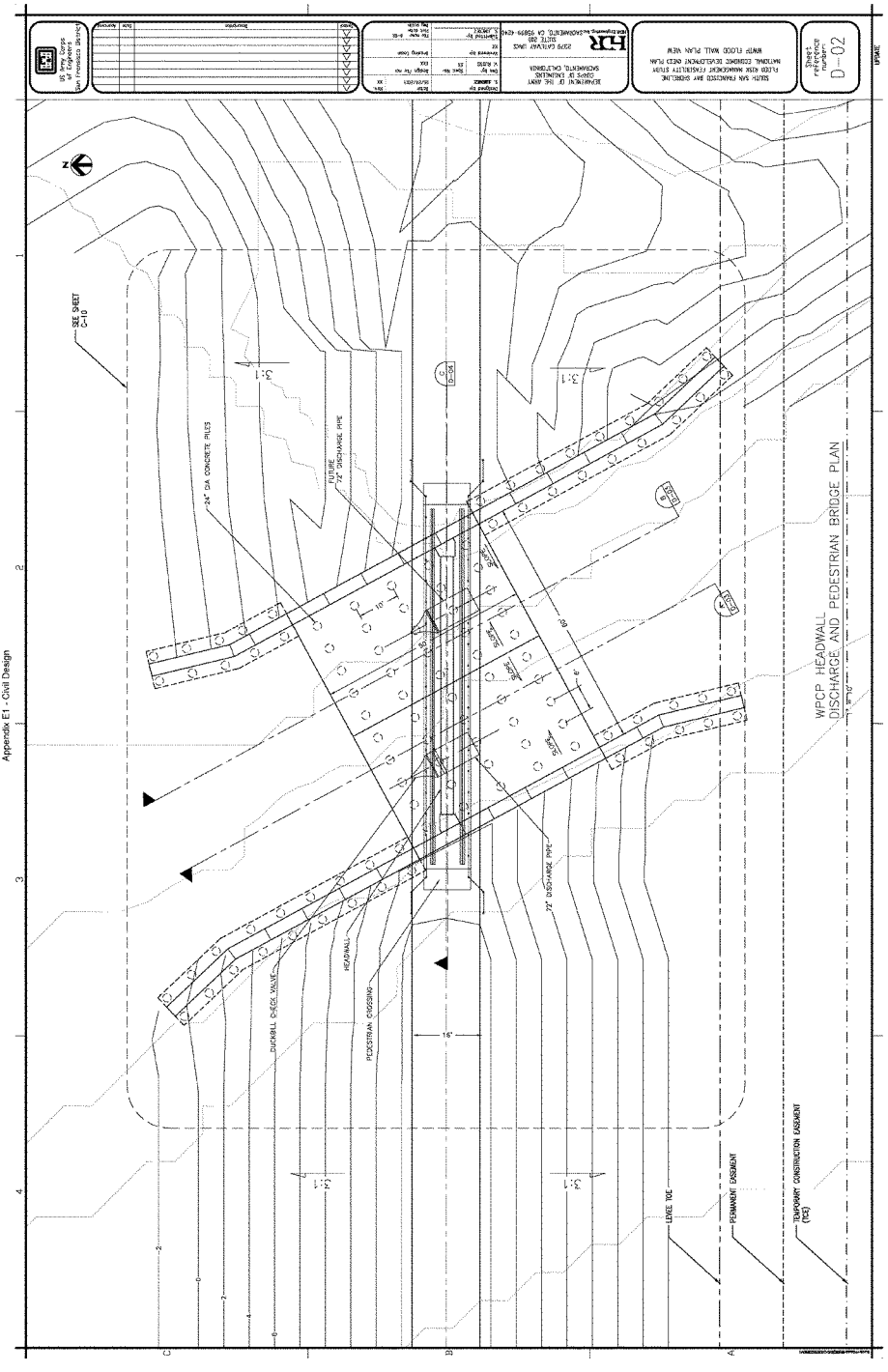
Sheet reference number:
C-53

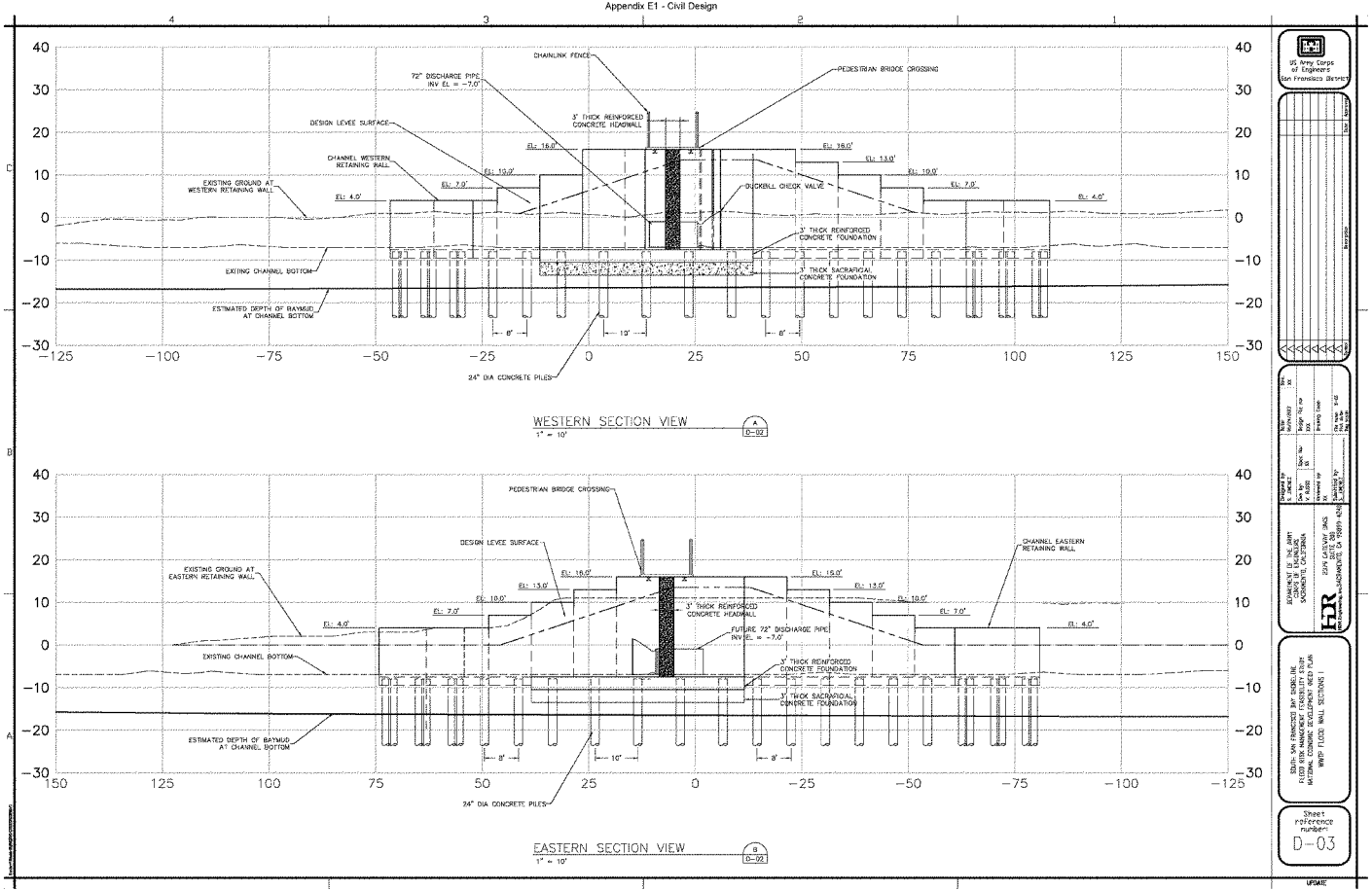
UPDATE


STA 197+75.18
WATERSIDE
PERM. EASE
TOE
TOE
EXISTING GROUND
LANDSIDE
40
30
20
10
0
−10
−20
−30
−450 −425 −400 −375 −350 −325 −300 −275 −250 −225 −200 −175 −150 −125 −100 −75 −50 −25 0 25 50 75 100 125 150 175 200
US Army Corps of Engineers San Francisco District
JOHNSON, LP THE GRAND CHAMBER OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT UNDED PLAN
SECTION STA 197+75.18
Sheet reference number:
C-54
UPDATE

M4
A21
A20
A19
BERM BREACH (TYP)
COYOTE CREEK
A9
DITCH BLOCK (TYP)
A14
A15
A17
A10
LEVEE BREACH (TYP)
A18
PILOT CHANNEL (TYP)
A11
A13
A16
EXISTING RAILROAD
A7
A6
A12
NEW CHICAGO MARSH
SJ/SC WPCP
ALVISO
A8
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT QUEED PLAN IN POND RESTORATION PLAN
Sheet reference number:
C-55
UPDATE


WATERSIDE
LANDSIDE
LEVEE ℄
16' CROWN
FINAL DESIGN ELEVATION 13.5'
ACTUAL CONSTRUCTED ELEVATION VARIES
BASED ON ESTIMATED SETTLEMENT
SEE PLAN AND PROFILE SHEETS
2% SLOPE
2% SLOPE
EXISTING GROUND
TYPICAL LEVEE PRISM
ENGINEERED FILL
WATERSIDE
CONSTRUCTION
LIMIT
LEVEE TOE
3:1 SIDE SLOPE
3:1 SIDE SLOPE
LANDSIDE
LEVEE
TOE
PERMANENT
CONSTRUCTION
EASEMENT
TEMPORARY
CONSTRUCTION
EASEMENT
15'
15'
CONSTRUCTION LIMIT
TYPICAL LEVEE CROSS SECTION
SCALE: NTS
WATERSIDE
LANDSIDE
LEVEE ℄
16' CROWN
FINAL DESIGN ELEVATION 13.5'
ACTUAL CONSTRUCTED ELEVATION VARIES
BASED ON ESTIMATED SETTLEMENT
SEE PLAN AND PROFILE SHEETS
TYPICAL LEVEE PRISM
ENGINEERED FILL
EXISTING GROUND
WATERSIDE
CONSTRUCTION
LIMIT
50' ENVIRONMENTAL RESTORATION BENCH
NON-ENGINEERED FILL
ENVIRONMENTAL RESTORATION BENCH
EL.=8.0'
3:1
3:1
3:1 SIDE SLOPE
LANDSIDE
LEVEE
TOE
PERMANENT
CONSTRUCTION
EASEMENT
TEMPORARY
CONSTRUCTION
EASEMENT
15'
15'
TYPICAL LEVEE CROSS SECTION
W/ENVIRONMENTAL RESTORATION BENCH
SCALE: NTS
US Army Corps
of Engineers
San Francisco District
Date
Description
Designed by
D. CHANG
Date
06/09/2023
Design file no
Drawn by
Date
Reviewed by
Reviewed by
Reviewed by
Date
Plot date
DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT
SACRAMENTO, CALIFORNIA
2379 GATEWAY
SACRAMENTO, CA 95899-4363
HDR
SMUD SAN CONNECTED BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
TYPICAL LEVEE CROSS SECTIONS
Sheet
reference
number:
D-01
UPDATE


US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT ONEED PLAN
WWTP FLOOD WALL PLAN VIEW
Sheet reference number
D-02
UPDATE
SEE SHEET C-10
24" DIA CONCRETE PILES
FUTURE 72" DISCHARGE PIPE
SLOPE
72" DISCHARGE PIPE
HEADWALL
PEDESTRIAN CROSSING
DUCKBILL CHECK VALVE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
WPCP HEADWALL
DISCHARGE AND PEDESTRIAN BRIDGE PLAN
E1-158


CHAINLINK FENCE
72" DISCHARGE PIPE INV EL = -7.0'
PEDESTRIAN BRIDGE CROSSING
3' THICK REINFORCED CONCRETE HEADWALL
DESIGN LEVEE SURFACE
CHANNEL WESTERN RETAINING WALL
EXISTING GROUND AT WESTERN RETAINING WALL
EL: 16.0'
EL: 13.0'
EL: 10.0'
EL: 7.0'
EL: 4.0'
DUCKBILL CHECK VALVE
3' THICK REINFORCED CONCRETE FOUNDATION
3' THICK SACRAFICIAL CONCRETE FOUNDATION
EXITING CHANNEL BOTTOM
ESTIMATED DEPTH OF BAYMUD AT CHANNEL BOTTOM
8'
10'
24" DIA CONCRETE PILES
WESTERN SECTION VIEW
1" = 10'
A
D-02
PEDESTRIAN BRIDGE CROSSING
DESIGN LEVEE SURFACE
CHANNEL EASTERN RETAINING WALL
EXISTING GROUND AT EASTERN RETAINING WALL
3' THICK REINFORCED CONCRETE HEADWALL
FUTURE 72" DISCHARGE PIPE INV EL = -7.0'
EXISTING CHANNEL BOTTOM
ESTIMATED DEPTH OF BAYMUD AT CHANNEL BOTTOM
24" DIA CONCRETE PILES
EASTERN SECTION VIEW
1" = 10'
B
D-02
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN
WWTP FLOOD WALL SECTIONS I
Sheet reference number:
D-03
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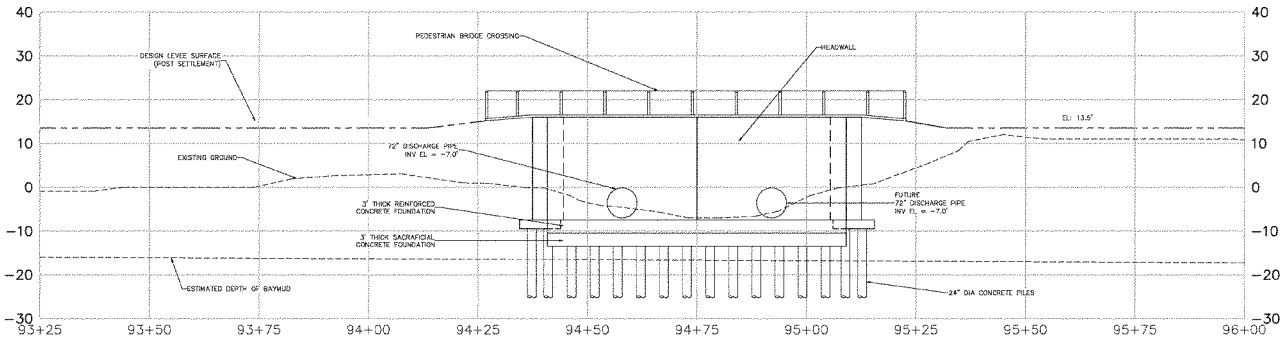

SOUTHERN SECTION VIEW

US Army Corps of Engineers San Francisco District

INVESTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA

2379 GATEWAY OAKS SUITE 200 SACRAMENTO, CA 95833-4245

SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY NATIONAL ECONOMIC DEVELOPMENT NEED PLAN WWTP FLOOD WALL SECTIONS 5

Sheet reference number: D-04

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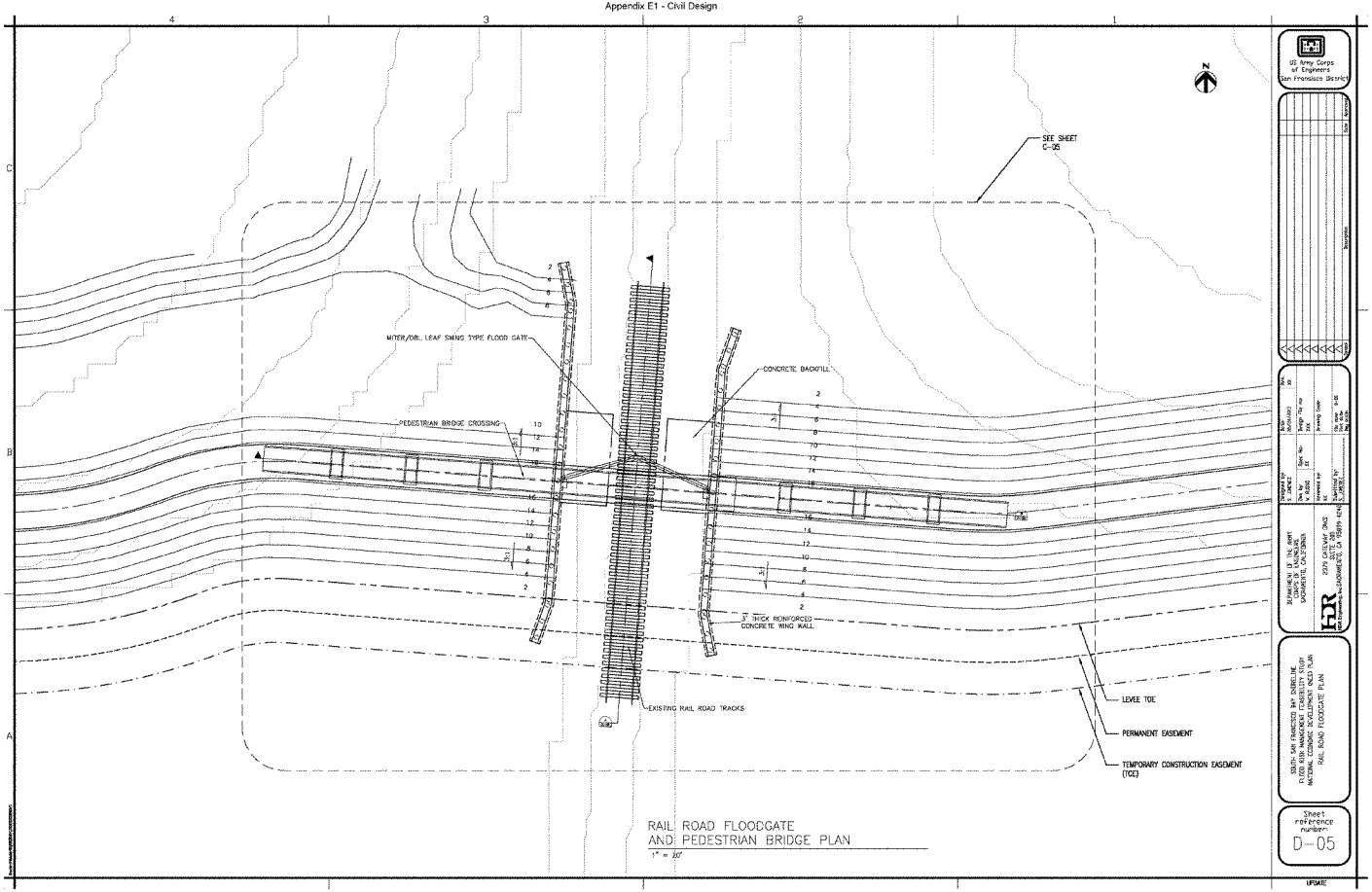
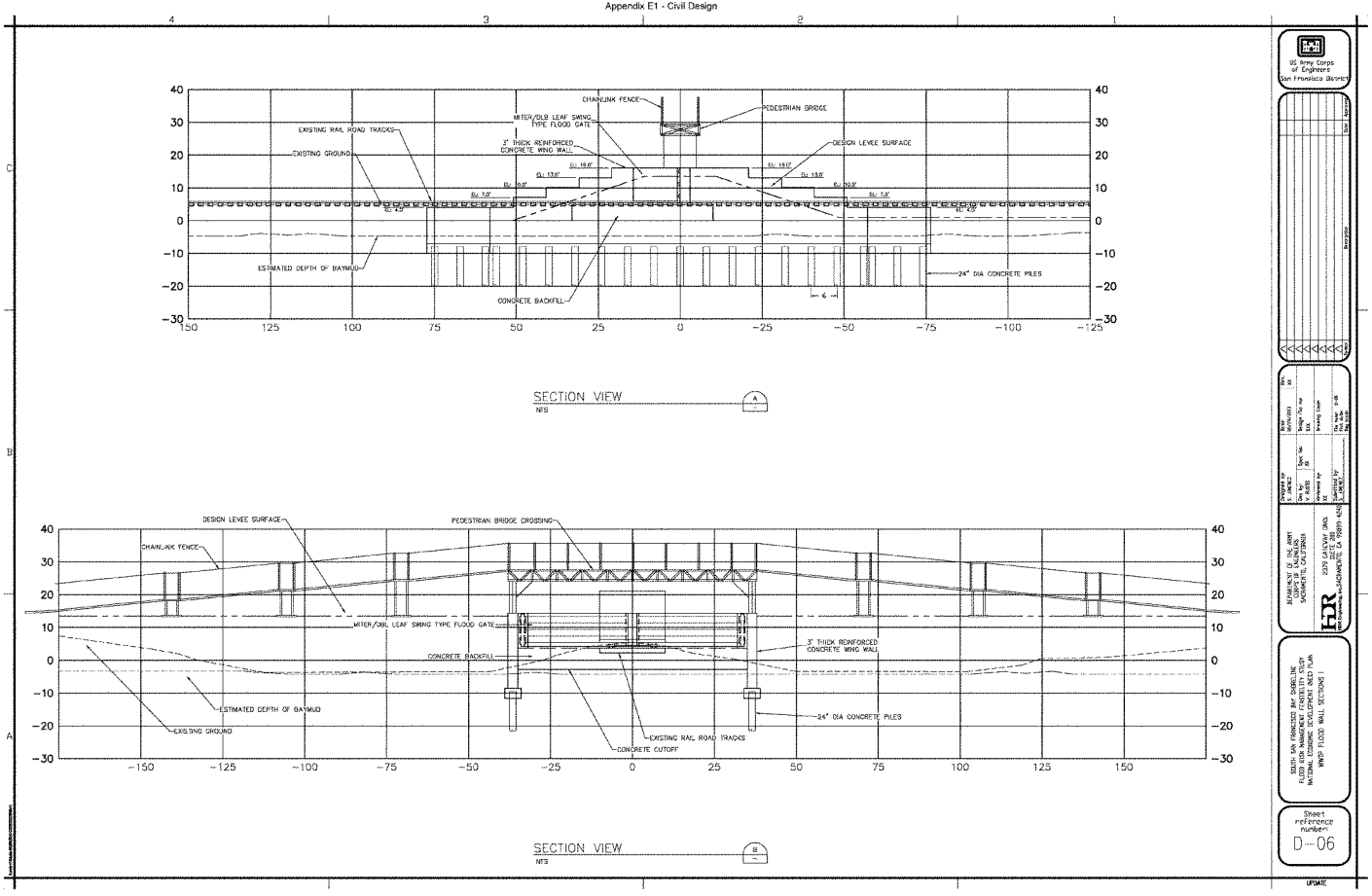

SEE SHEET C-05
MITER/DBL LEAF SWING TYPE FLOOD GATE
CONCRETE BACKFILL
PEDESTRIAN BRIDGE CROSSING
3' THICK REINFORCED CONCRETE WING WALL
EXISTING RAIL ROAD TRACKS
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
RAIL ROAD FLOODGATE AND PEDESTRIAN BRIDGE PLAN
1" = 20'
US Army Corps of Engineers San Francisco District
Sheet reference number: D-05
UPDATE


CHAINLINK FENCE
PEDESTRIAN BRIDGE
MITER/DBL LEAF SWING TYPE FLOOD GATE
EXISTING RAIL ROAD TRACKS
3' THICK REINFORCED CONCRETE WING WALL
DESIGN LEVEE SURFACE
EXISTING GROUND
ESTIMATED DEPTH OF BAYMUD
CONCRETE BACKFILL
24" DIA CONCRETE PILES
SECTION VIEW
NTS
DESIGN LEVEE SURFACE
PEDESTRIAN BRIDGE CROSSING
CHAINLINK FENCE
MITER/DBL LEAF SWING TYPE FLOOD GATE
CONCRETE BACKFILL
3' THICK REINFORCED CONCRETE WING WALL
ESTIMATED DEPTH OF BAYMUD
EXISTING GROUND
24" DIA CONCRETE PILES
EXISTING RAIL ROAD TRACKS
CONCRETE CUTOFF
SECTION VIEW
NTS
US Army Corps of Engineers
San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4245
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN
WINGS FLOOD WALL SECTIONS I
Sheet reference number:
D-06
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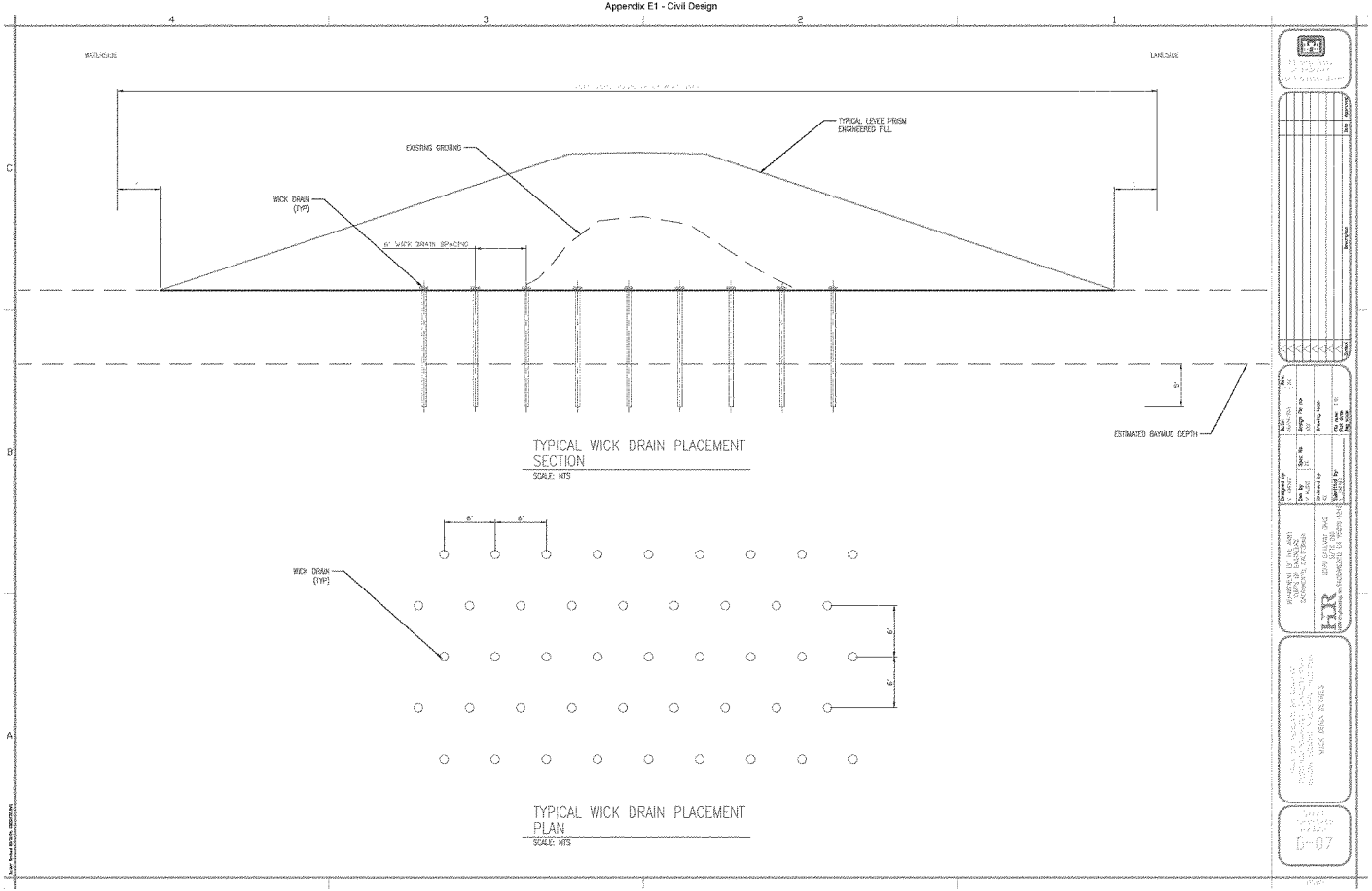

WATERSIDE
LANDSIDE
TYPICAL LEVEE PRISM ENGINEERED FILL
EXISTING GROUND
WICK DRAIN (TYP)
6' WICK DRAIN SPACING
5'
ESTIMATED BAYMUD DEPTH
TYPICAL WICK DRAIN PLACEMENT SECTION
SCALE: NTS
6'
6'
WICK DRAIN (TYP)
6'
6'
TYPICAL WICK DRAIN PLACEMENT PLAN
SCALE: NTS
D-07

Attachment II

LPP Planset

US Army Corps
of Engineers
San Francisco District

SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PREFERRED PLAN

Santa Clara County

California

US Army Corps of Engineers San Francisco District

Sheet reference number: G-01

UPDATE

GENERAL

G-01 COVER SHEET
G-02 INDEX SHEET
G-03 OVERALL SITE PLAN

CIVIL

C-01 PLAN AND PROFILE STA 0+00 TO 10+00
C-02 PLAN AND PROFILE STA 10+00 TO 20+00
C-03 PLAN AND PROFILE STA 20+00 TO 30+00
C-04 PLAN AND PROFILE STA 30+00 TO 40+00
C-05 PLAN AND PROFILE STA 40+00 TO 50+00
C-06 PLAN AND PROFILE STA 50+00 TO 60+00
C-07 PLAN AND PROFILE STA 60+00 TO 70+00
C-08 PLAN AND PROFILE STA 70+00 TO 80+00
C-09 PLAN AND PROFILE STA 80+00 TO 90+00
C-10 PLAN AND PROFILE STA 90+00 TO 100+00
C-11 PLAN AND PROFILE STA 100+00 TO 110+00
C-12 PLAN AND PROFILE STA 110+00 TO 120+00
C-13 PLAN AND PROFILE STA 120+00 TO 130+00
C-14 PLAN AND PROFILE STA 130+00 TO 140+00
C-15 PLAN AND PROFILE STA 140+00 TO 150+00
C-16 PLAN AND PROFILE STA 150+00 TO 160+00
C-17 PLAN AND PROFILE STA 160+00 TO 170+00
C-18 PLAN AND PROFILE STA 170+00 TO 180+00
C-19 PLAN AND PROFILE STA 180+00 TO 190+00
C-20 PLAN AND PROFILE STA 190+00 TO 197+75

C-21 SECTIONS STA 0+00 TO 5+00
C-22 SECTIONS STA 6+00 TO 11+00
C-23 SECTIONS STA 12+00 TO 17+00
C-24 SECTIONS STA 18+00 TO 23+00
C-25 SECTIONS STA 24+00 TO 29+00
C-26 SECTIONS STA 30+00 TO 35+00
C-27 SECTIONS STA 36+00 TO 41+00
C-28 SECTIONS STA 42+00 TO 47+00
C-29 SECTIONS STA 48+00 TO 53+00
C-30 SECTIONS STA 54+00 TO 59+00
C-31 SECTIONS STA 60+00 TO 65+00
C-32 SECTIONS STA 66+00 TO 71+00
C-33 SECTIONS STA 72+00 TO 77+00
C-34 SECTIONS STA 78+00 TO 83+00
C-35 SECTIONS STA 84+00 TO 89+00
C-36 SECTIONS STA 90+00 TO 95+00
C-37 SECTIONS STA 96+00 TO 101+00
C-38 SECTIONS STA 102+00 TO 107+00
C-39 SECTIONS STA 108+00 TO 113+00
C-40 SECTIONS STA 114+00 TO 119+00
C-41 SECTIONS STA 120+00 TO 125+00
C-42 SECTIONS STA 126+00 TO 131+00
C-43 SECTIONS STA 132+00 TO 137+00
C-44 SECTIONS STA 138+00 TO 143+00
C-45 SECTIONS STA 144+00 TO 149+00
C-46 SECTIONS STA 150+00 TO 155+00
C-47 SECTIONS STA 156+00 TO 161+00
C-48 SECTIONS STA 162+00 TO 167+00
C-49 SECTIONS STA 168+00 TO 173+00
C-50 SECTIONS STA 174+00 TO 179+00
C-51 SECTIONS STA 180+00 TO 185+00
C-52 SECTIONS STA 185+00 TO 191+05
C-53 SECTIONS STA 192+00 TO 197+00
C-54 SECTIONS STA 197+75.18

C-55 IN POND WORK

DETAIL

D-01 TYPICAL LEVEE CROSS SECTION
D-02 WWTP DISCHARGE CHANNEL FLOOD WALL 1 - PLAN
D-03 WWTP DISCHARGE CHANNEL FLOOD WALL 2 - SECTIONS 1
D-04 WWTP DISCHARGE CHANNEL FLOOD WALL 3 - SECTIONS 2
D-05 RR CROSSING FLOOD GATE 1 - PLAN
D-06 RR CROSSING FLOOD GATE 2 - SECTIONS 1
D-07 WICK DRAIN DETAILS

SHORELINE PROJECT DATUMS

HORIZONTAL
- CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III

VERTICAL
- NAVD88

US Army Corps of Engineers
San Francisco District

Symbol	Description	Date

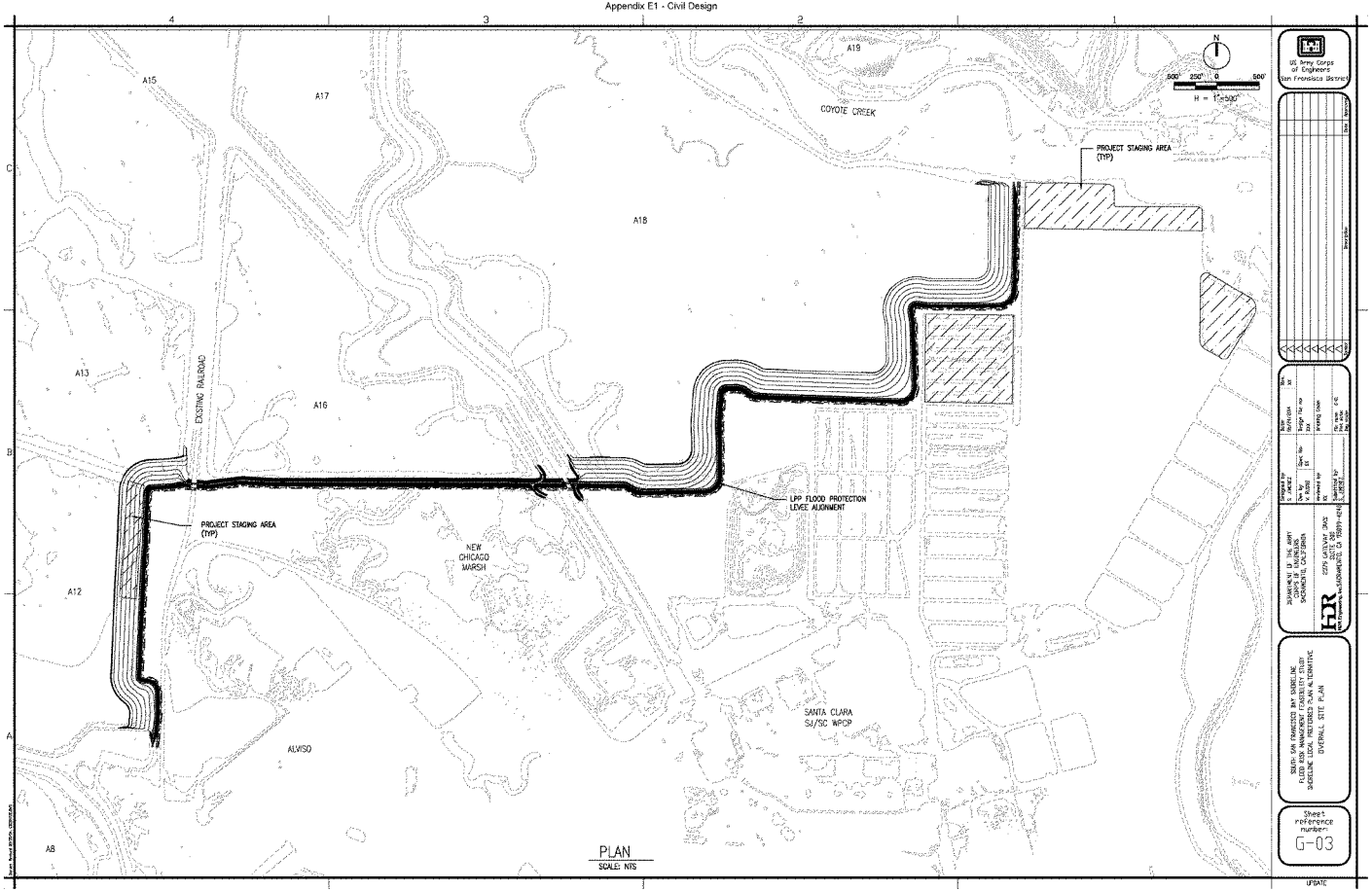
Date: 06/07/2011
Scale: 1" = 40'
Drawn by: Bridge Tech Inc
Reviewed by: Beverly Cohen
Sheet No. 02
Total Sheets: 55
Plot date: 06/07/2011
Plot time: 11:00 AM

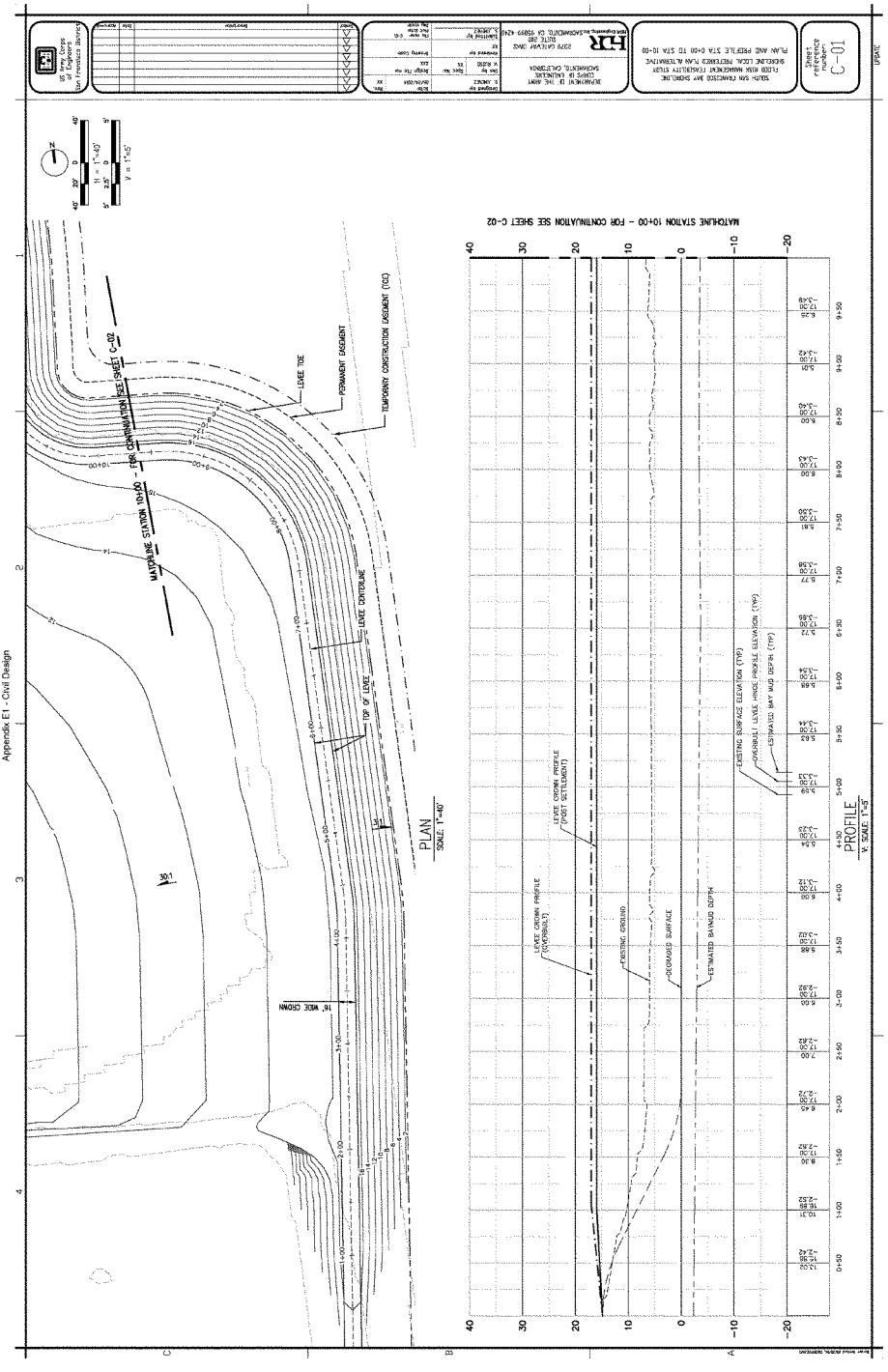
DEPARTMENT OF THE ARMY
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 150
SACRAMENTO, CA 95833-4245
HDR Engineering, Inc.

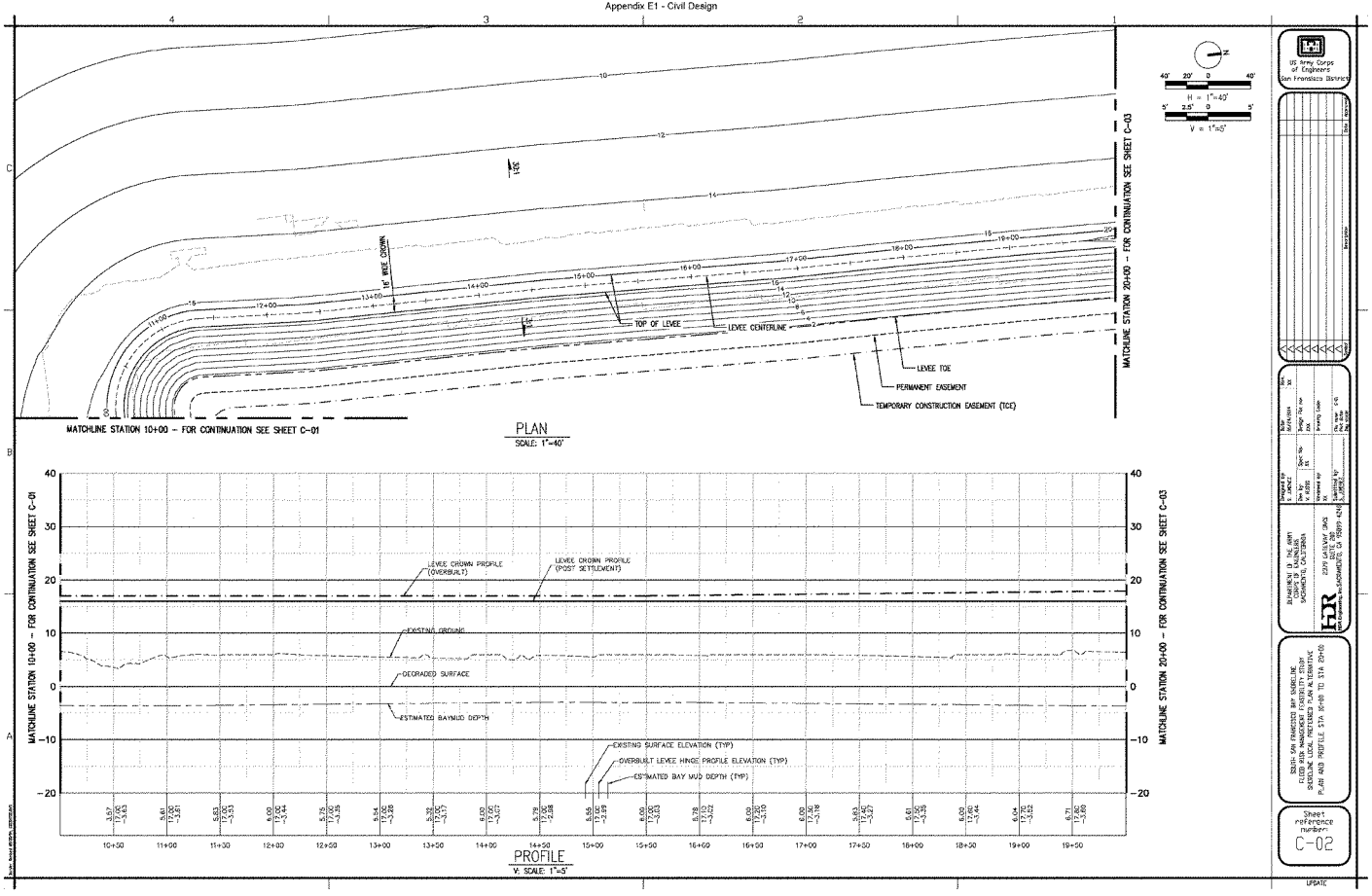
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
INDEX SHEET

Sheet reference number:
G-02

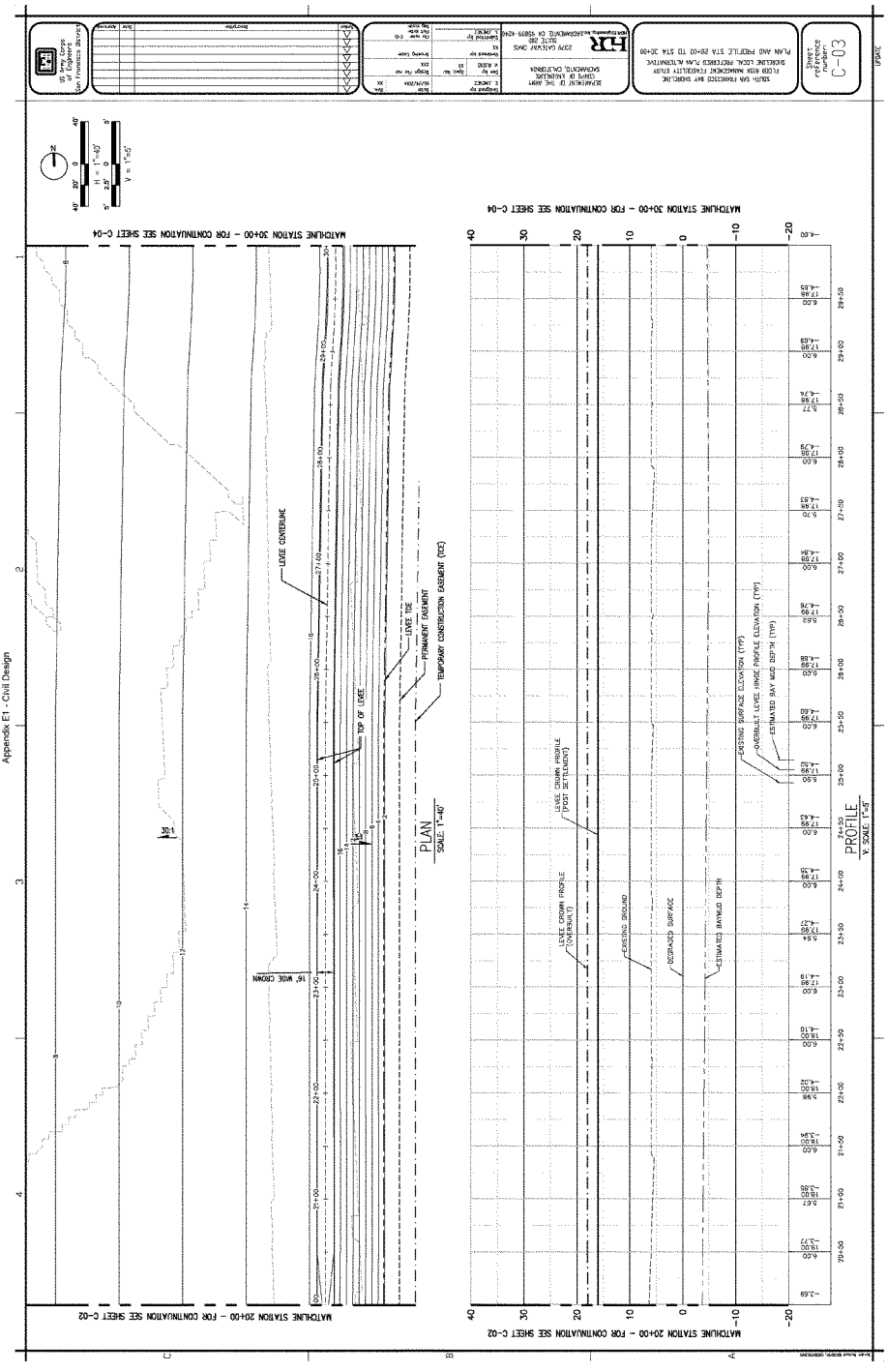
UPDATE


A15
A17
A19
A18
A13
A16
A12
A8
COYOTE CREEK
EXISTING RAILROAD
PROJECT STAGING AREA (TYP)
PROJECT STAGING AREA (TYP)
LPP FLOOD PROTECTION LEVEE ALIGNMENT
NEW CHICAGO MARSH
ALVISO
SANTA CLARA SJ/SC WPCP
N
500' 250' 0 500'
H = 1"=500'
PLAN
SCALE: NTS
US Army Corps of Engineers San Francisco District
Sheet reference number: G-03
UPDATE


US Army Corps of Engineers San Francisco District
HR
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4210
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
PLAN AND PROFILE STA 0+00 TO STA 10+00
Sheet reference number
C-01
UPDATE
MATCHLINE STATION 10+00 - FOR CONTINUATION SEE SHEET C-02
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
TOP OF LEVEE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
E1-170



MATCHLINE STATION 10+00 - FOR CONTINUATION SEE SHEET C-01
MATCHLINE STATION 20+00 - FOR CONTINUATION SEE SHEET C-03
16' WIDE CROWN
TOP OF LEVEE
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
H = 1"=40'
V = 1"=5'
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number
C-02
UPDATE


Appendix E1 - Civil Design
E1-172
MATCHLINE STATION 30+00 - FOR CONTINUATION SEE SHEET C-04
MATCHLINE STATION 20+00 - FOR CONTINUATION SEE SHEET C-02
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
16' WIDE CROWN
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
US Army Corps of Engineers San Francisco District
HR
Sheet reference number: C-03
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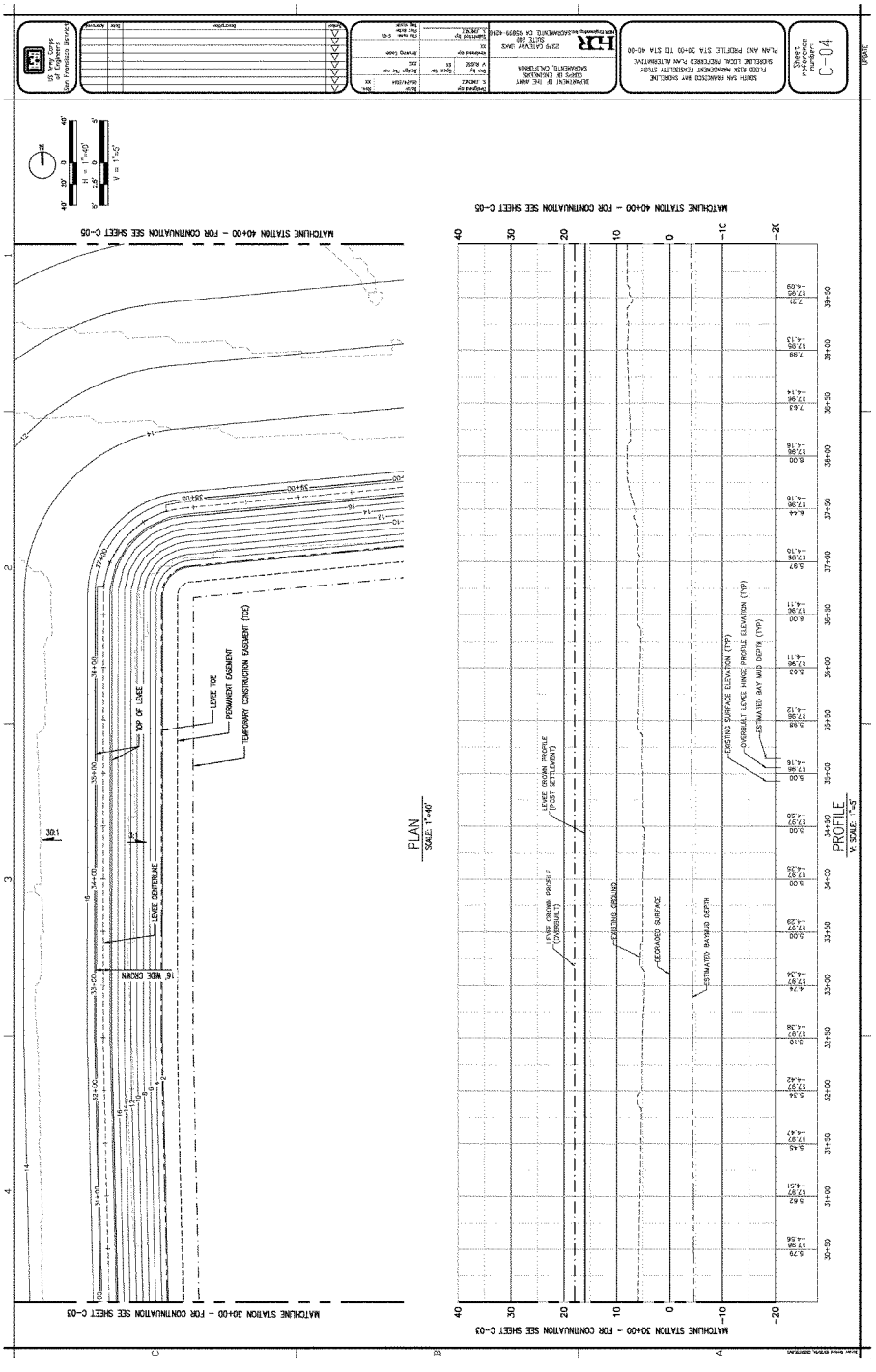
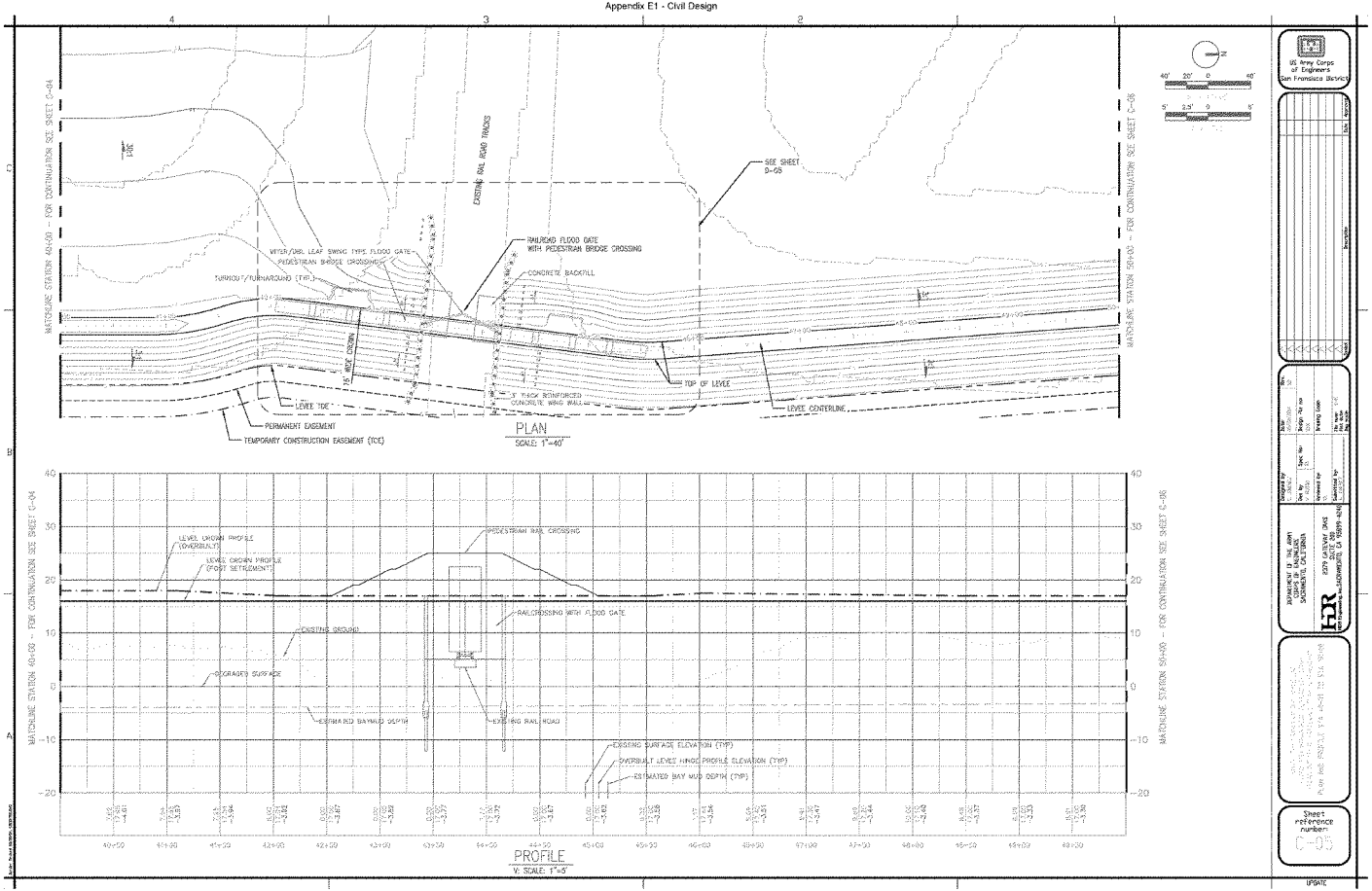
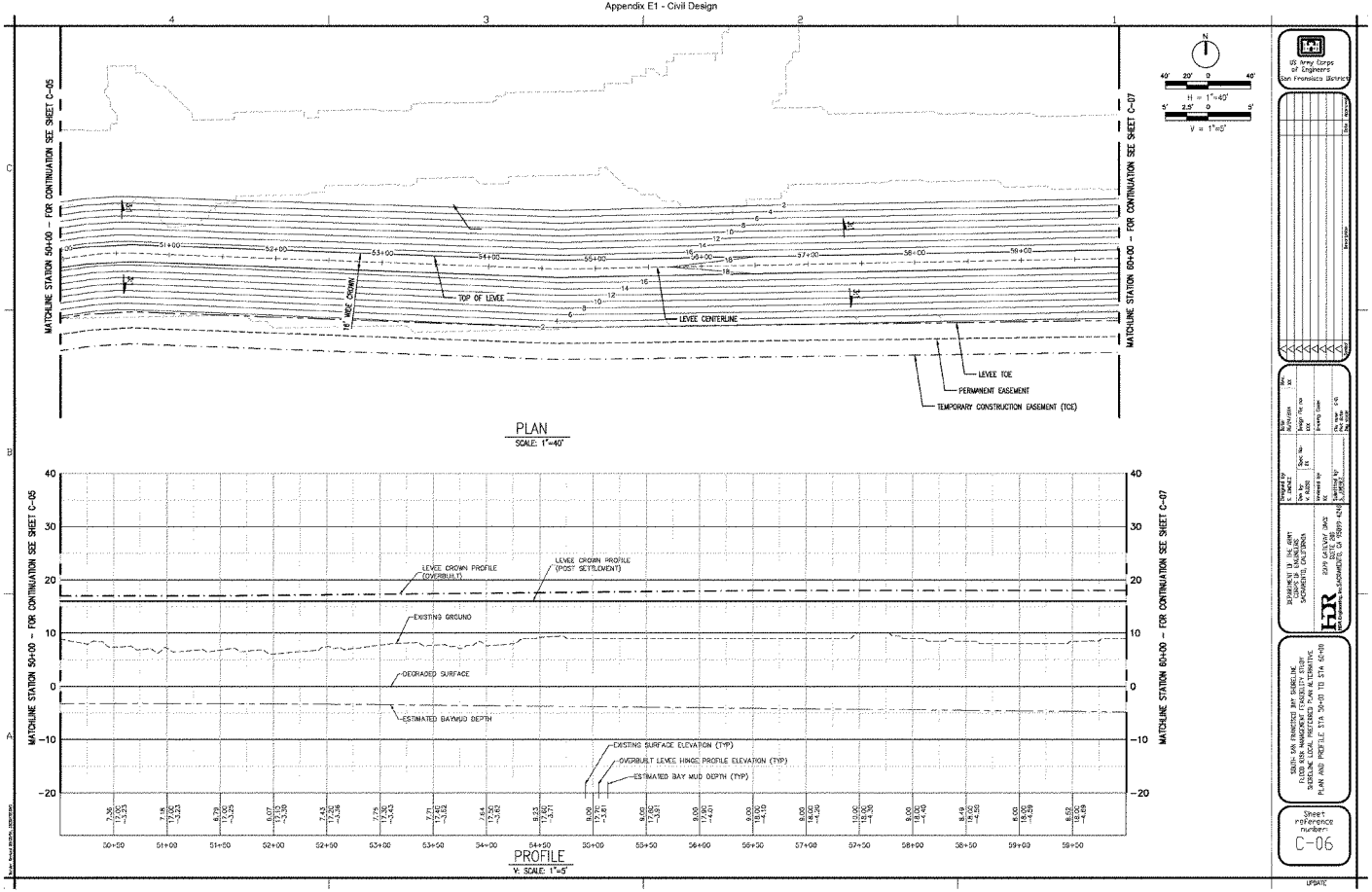
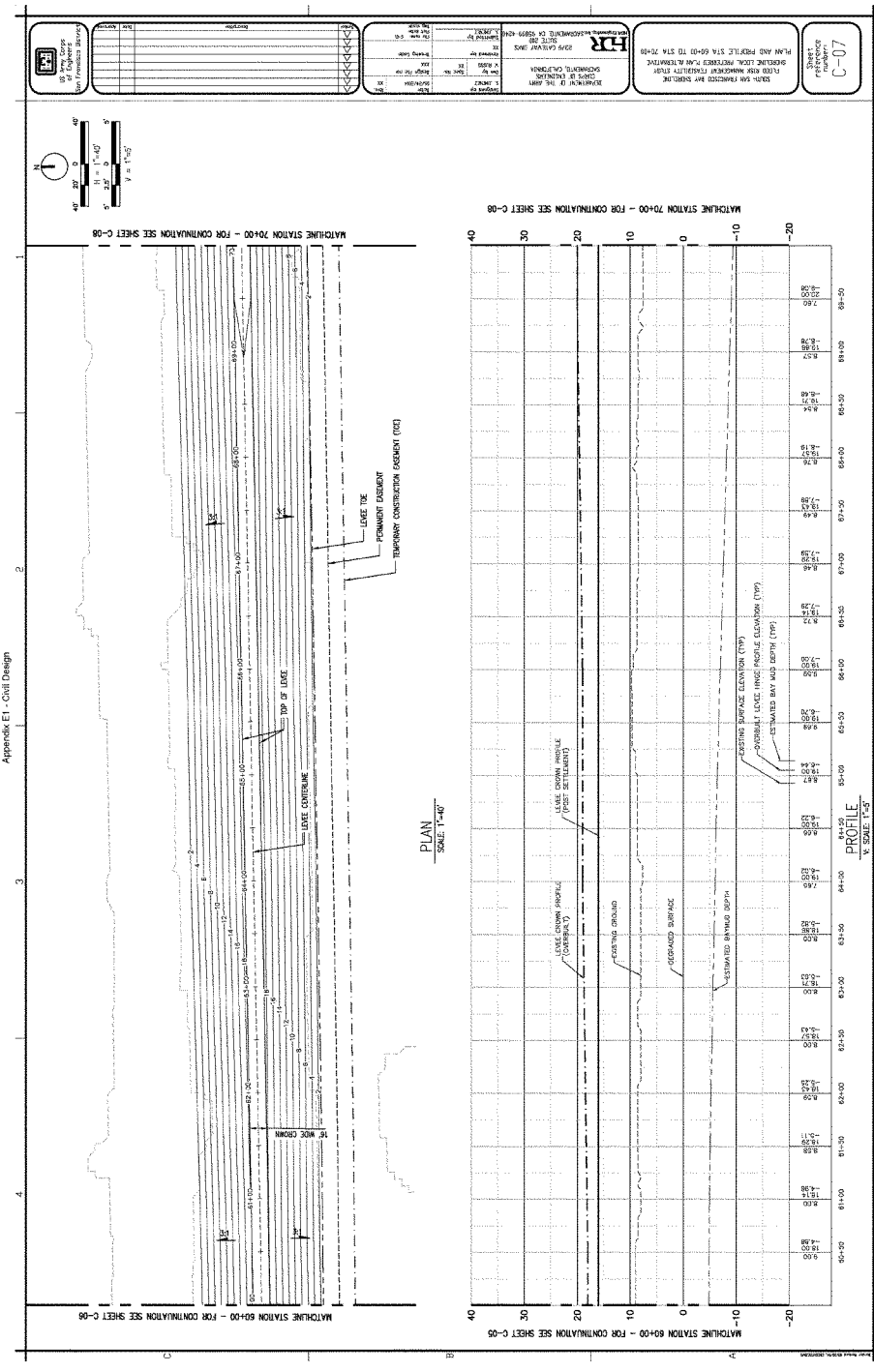
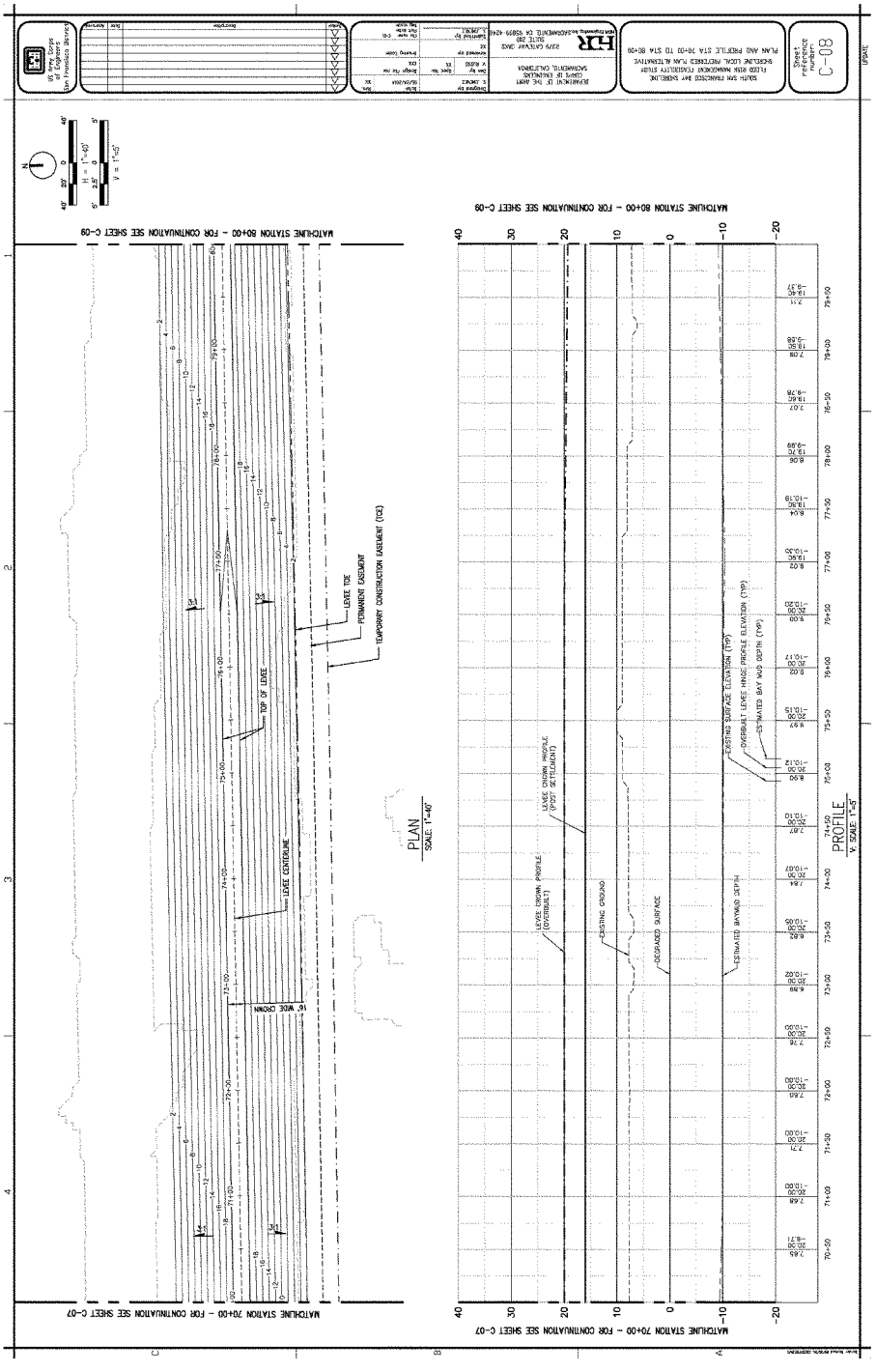
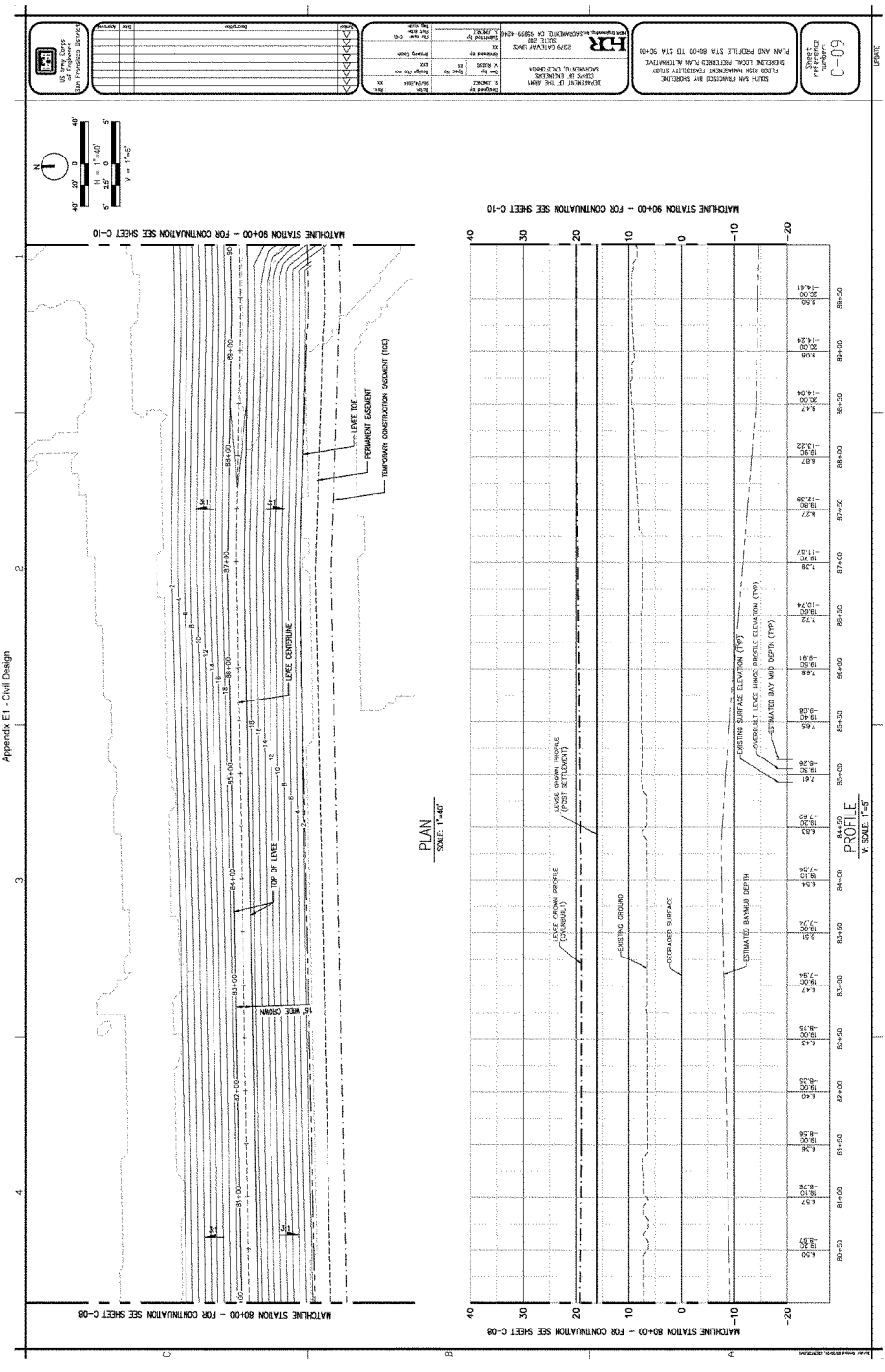

US Army Corps of Engineers
San Francisco District
HR
2329 CALTRAY DAVIS
SUITE 200
SACRAMENTO, CA 95819-4240
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
PLAN AND PROFILE STA 30+00 TO STA 40+00
Sheet reference number
C-04
UPDATE
MATCHLINE STATION 40+00 - FOR CONTINUATION SEE SHEET C-05
MATCHLINE STATION 30+00 - FOR CONTINUATION SEE SHEET C-03
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TOE)
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
Appendix E1 - Civil Design
E1-173

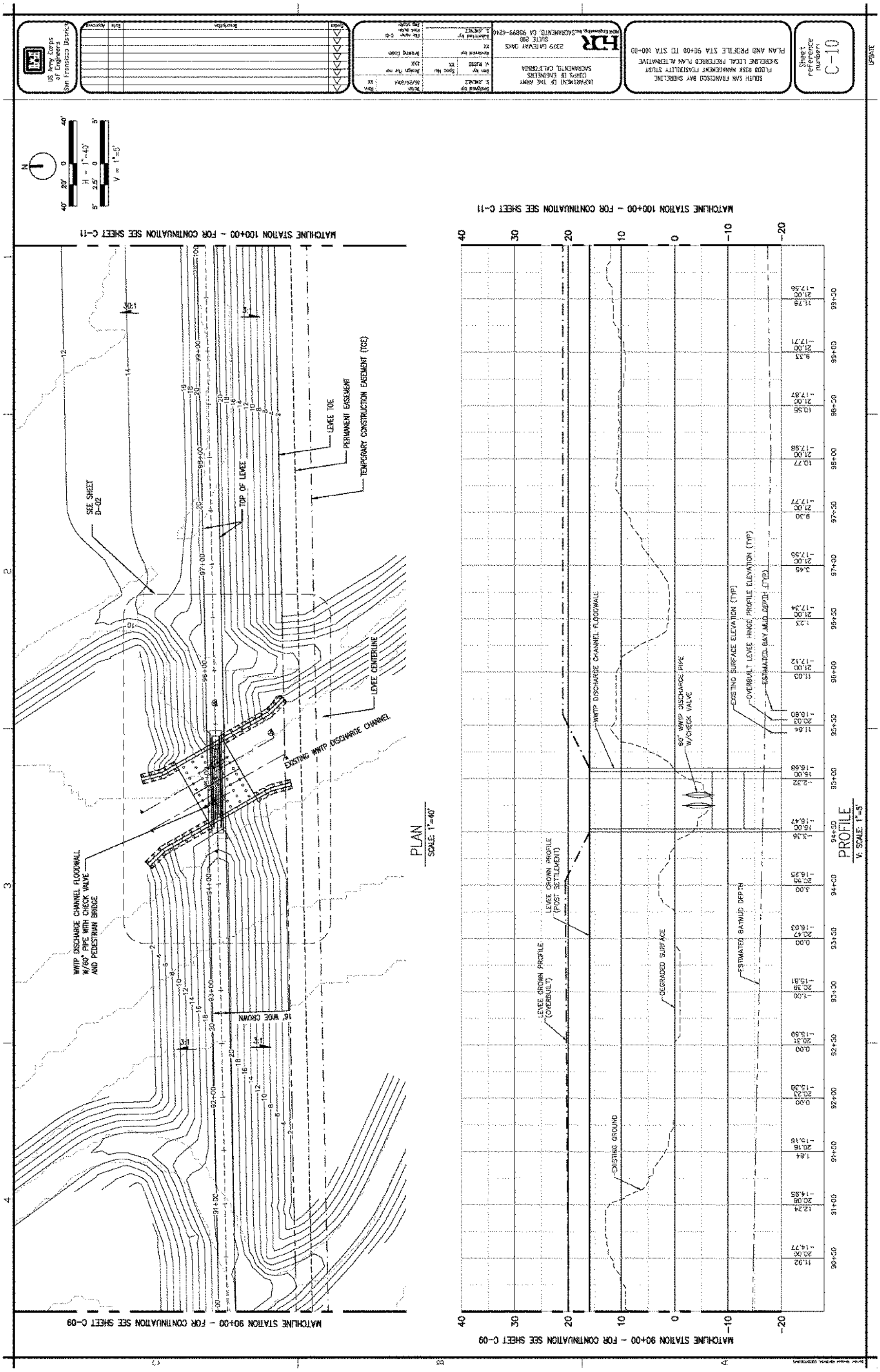

MATCHLINE STATION 40+00 - FOR CONTINUATION SEE SHEET C-04
MATCHLINE STATION 54+00 - FOR CONTINUATION SEE SHEET C-06
SEE SHEET C-05
EXISTING RAIL ROAD TRACKS
RAILROAD FLOOD GATE WITH PEDESTRIAN BRIDGE CROSSING
WITER/DBL LEAF SWING TYPE FLOOD GATE
PEDESTRIAN BRIDGE CROSSING
CONCRETE BACKFILL
TURNOUT/TURNAROUND (TYP)
15' WIDE CROWN
TOP OF LEVEE
8" THICK REINFORCED CONCRETE WING WALL
LEVEE TOE
LEVEE CENTERLINE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
PEDESTRIAN RAIL CROSSING
RAILCROSSING WITH FLOOD GATE
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING RAIL ROAD
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number
C-05
UPDATE

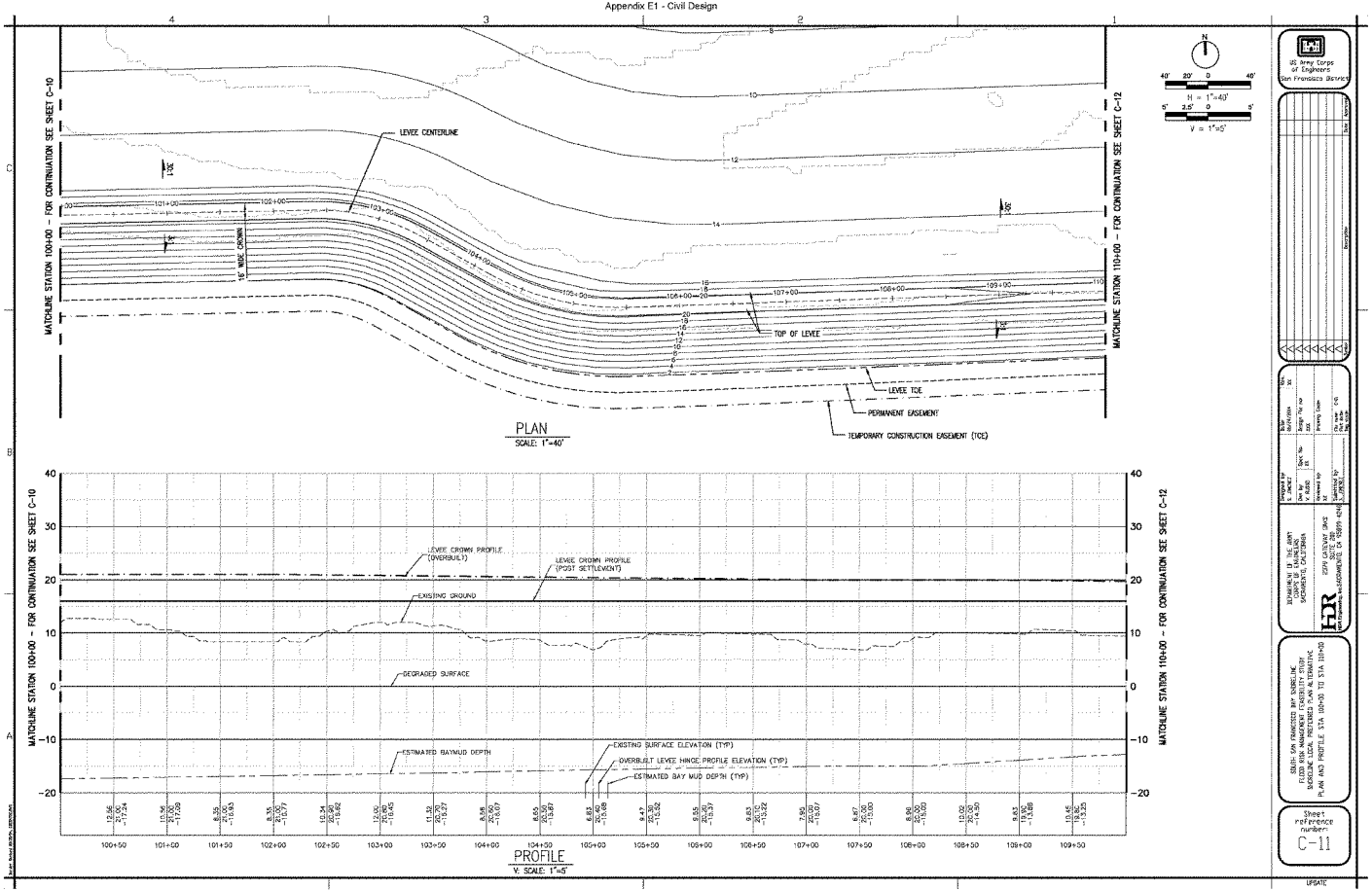

MATCHLINE STATION 50+00 - FOR CONTINUATION SEE SHEET C-05
MATCHLINE STATION 60+00 - FOR CONTINUATION SEE SHEET C-07
TOP OF LEVEE
16' WIDE CROWN
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE CROWN PROFILE (COVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers
San Francisco District
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4245
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
PLAN AND PROFILE STA. 50+00 TO STA. 60+00
Sheet reference number:
C-06
UPDATE

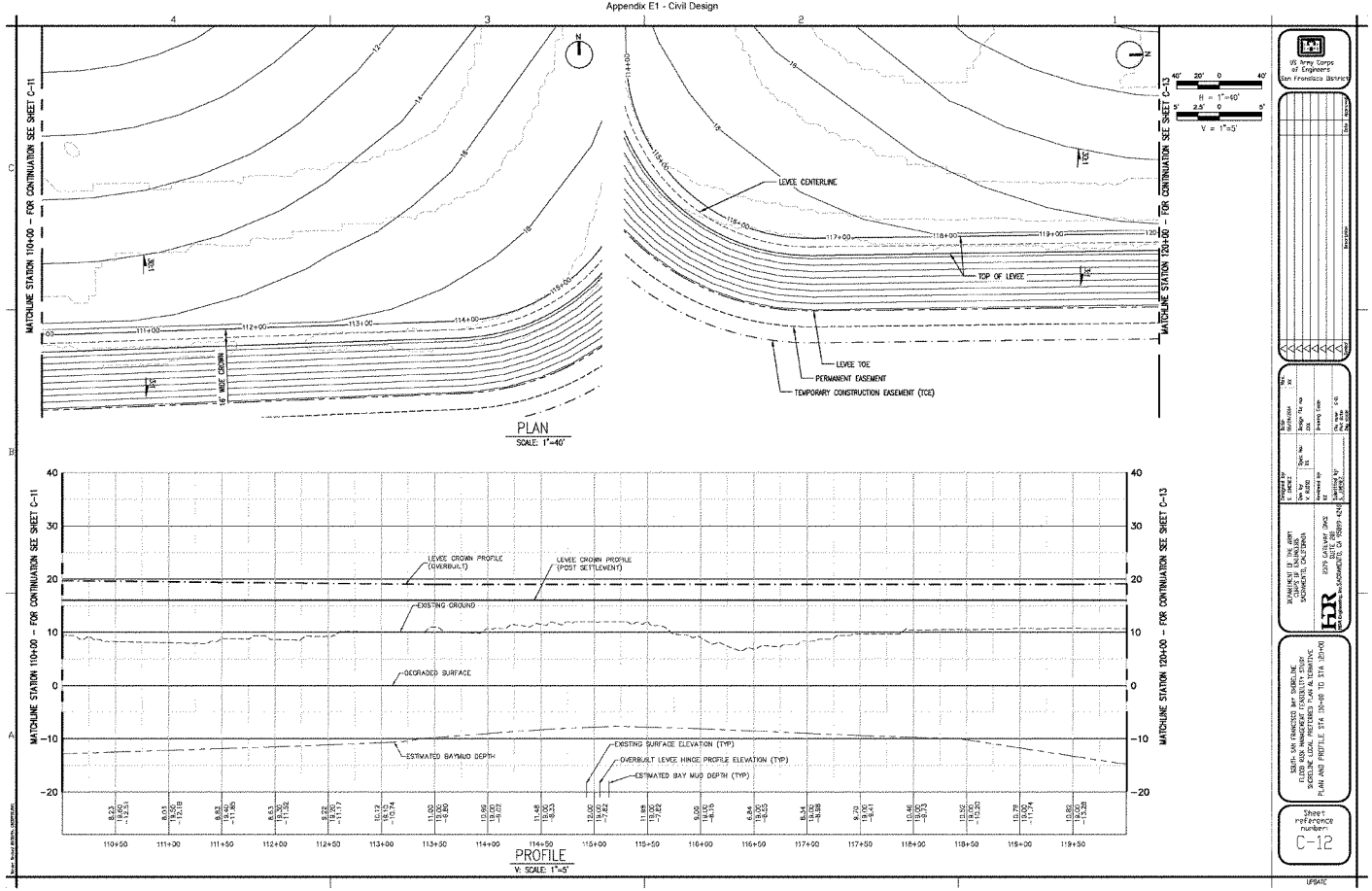

Appendix E1 - Civil Design
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
PLAN AND PROFILE STA 60+00 TO STA 70+00
Sheet reference number
C-07
UPDATE
HR
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO CA 95833-4240
MATCHLINE STATION 70+00 - FOR CONTINUATION SEE SHEET C-08
MATCHLINE STATION 60+00 - FOR CONTINUATION SEE SHEET C-05
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
E1-176

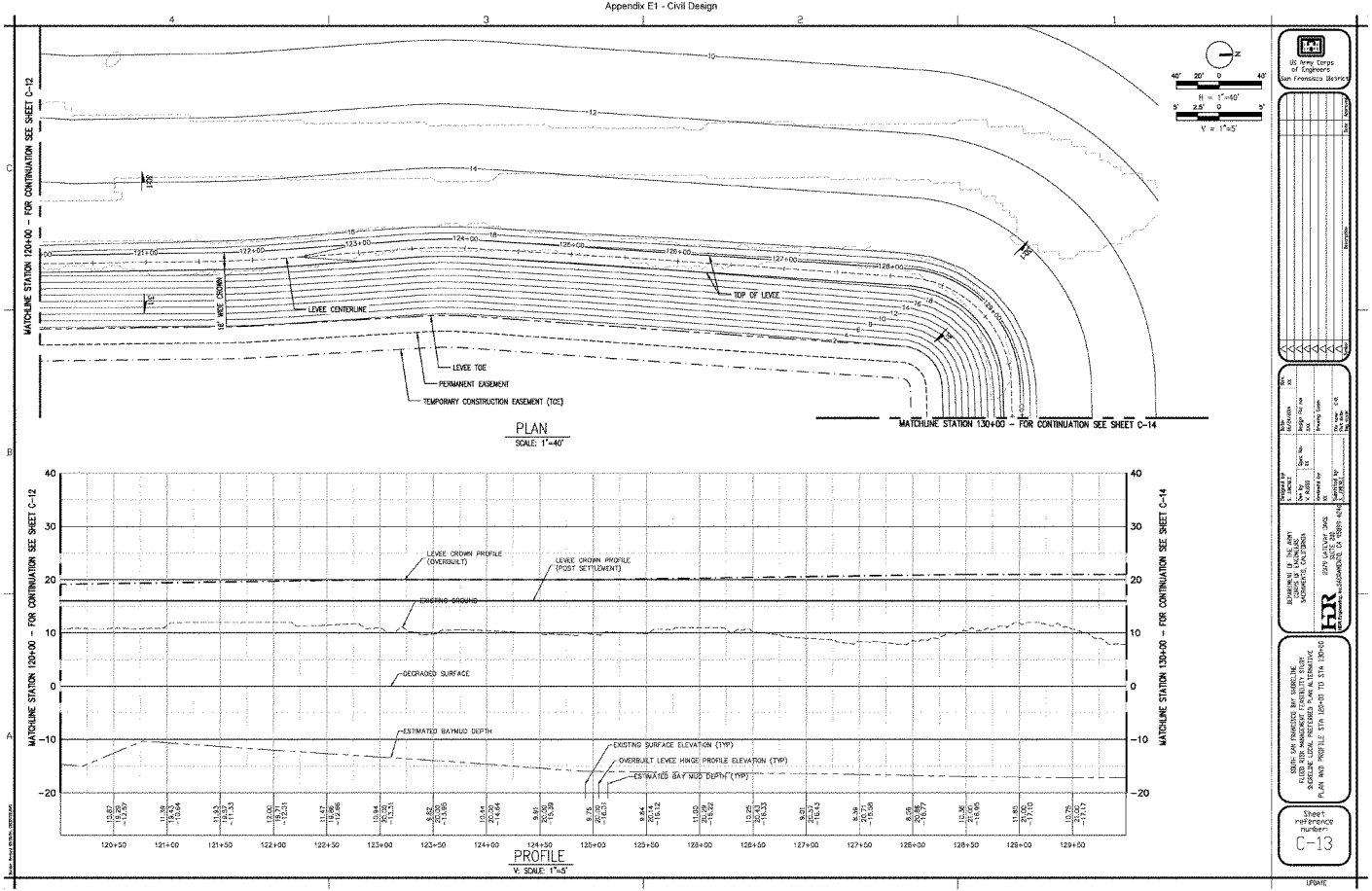

Appendix E1 - Civil Design
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
PLAN AND PROFILE STA 70+00 TO STA 80+00
Sheet reference number
C-08
UPDATE
H = 1"=40'
V = 1"=5'
MATCHLINE STATION 80+00 - FOR CONTINUATION SEE SHEET C-09
MATCHLINE STATION 70+00 - FOR CONTINUATION SEE SHEET C-07
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (OVERBUILT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYWIND DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
E1-177

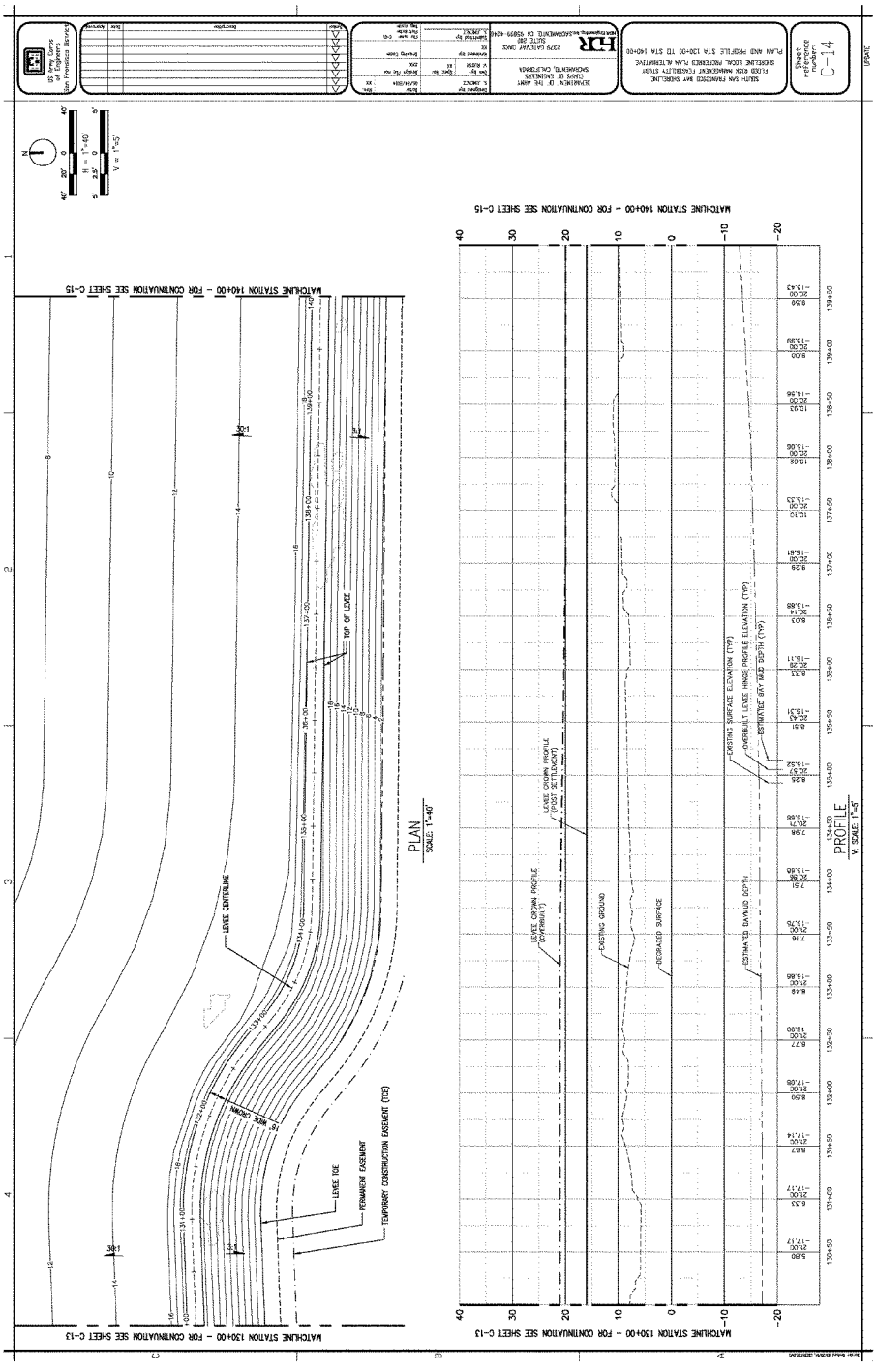

US Army Corps of Engineers San Francisco District
HR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
PLAN AND PROFILE STA 80+00 TO STA 90+00
Sheet reference number
C-09
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
TOP OF LEVEE
15' WIDE CROWN
MATCHLINE STATION 90+00 - FOR CONTINUATION SEE SHEET C-10
MATCHLINE STATION 80+00 - FOR CONTINUATION SEE SHEET C-08
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE CROWN PROFILE (POST SETTLEMENT)
LEVEE CROWN PROFILE (CONTINUAL 1)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
Appendix E1 - Civil Design
E1-178


US Army Corps of Engineers
San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
PLAN AND PROFILE STA 90+00 TO STA 100+00
C-10
MATCHLINE STATION 100+00 - FOR CONTINUATION SEE SHEET C-11
MATCHLINE STATION 90+00 - FOR CONTINUATION SEE SHEET C-09
H = 1"=40'
V = 1"=5'
SEE SHEET D-02
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
EXISTING WWTP DISCHARGE CHANNEL
WWTP DISCHARGE CHANNEL FLOODWALL W/60" PIPE WITH CHECK VALVE AND PEDESTRIAN BRIDGE
16' WIDE CROWN
PLAN
SCALE: 1"=40'
PROFILE
V. SCALE 1"=5'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
WWTP DISCHARGE CHANNEL FLOODWALL
60" WWTP DISCHARGE PIPE W/CHECK VALVE
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
ESTIMATED BAYMUD DEPTH
DEGRADED SURFACE
EXISTING GROUND

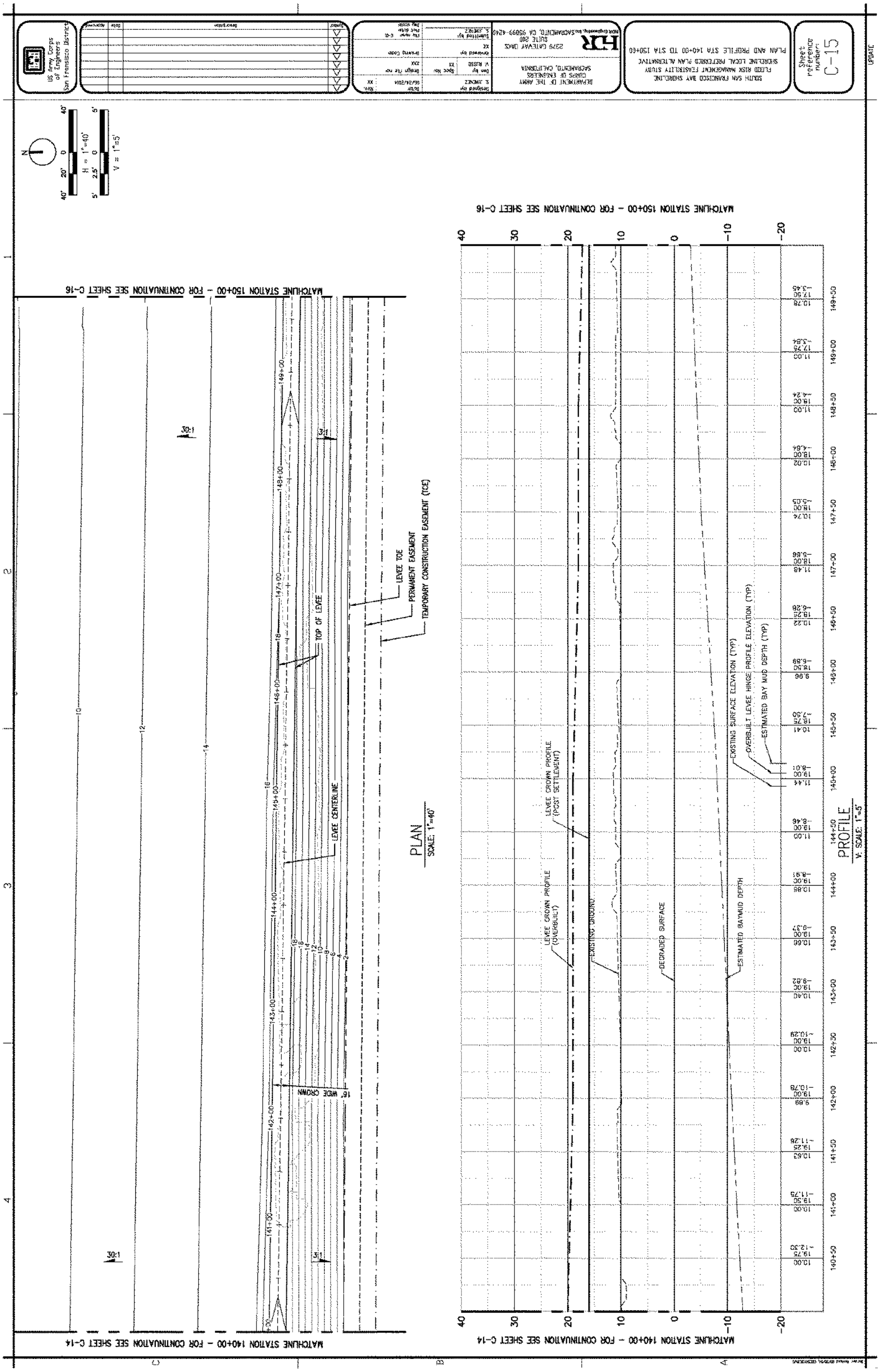

MATCHLINE STATION 100+00 - FOR CONTINUATION SEE SHEET C-10
MATCHLINE STATION 110+00 - FOR CONTINUATION SEE SHEET C-12
LEVEE CENTERLINE
16' WIDE CROWN
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE PLAN AND PROFILE STA 100+00 TO STA 110+00
Sheet reference number:
C-11
UPDATE

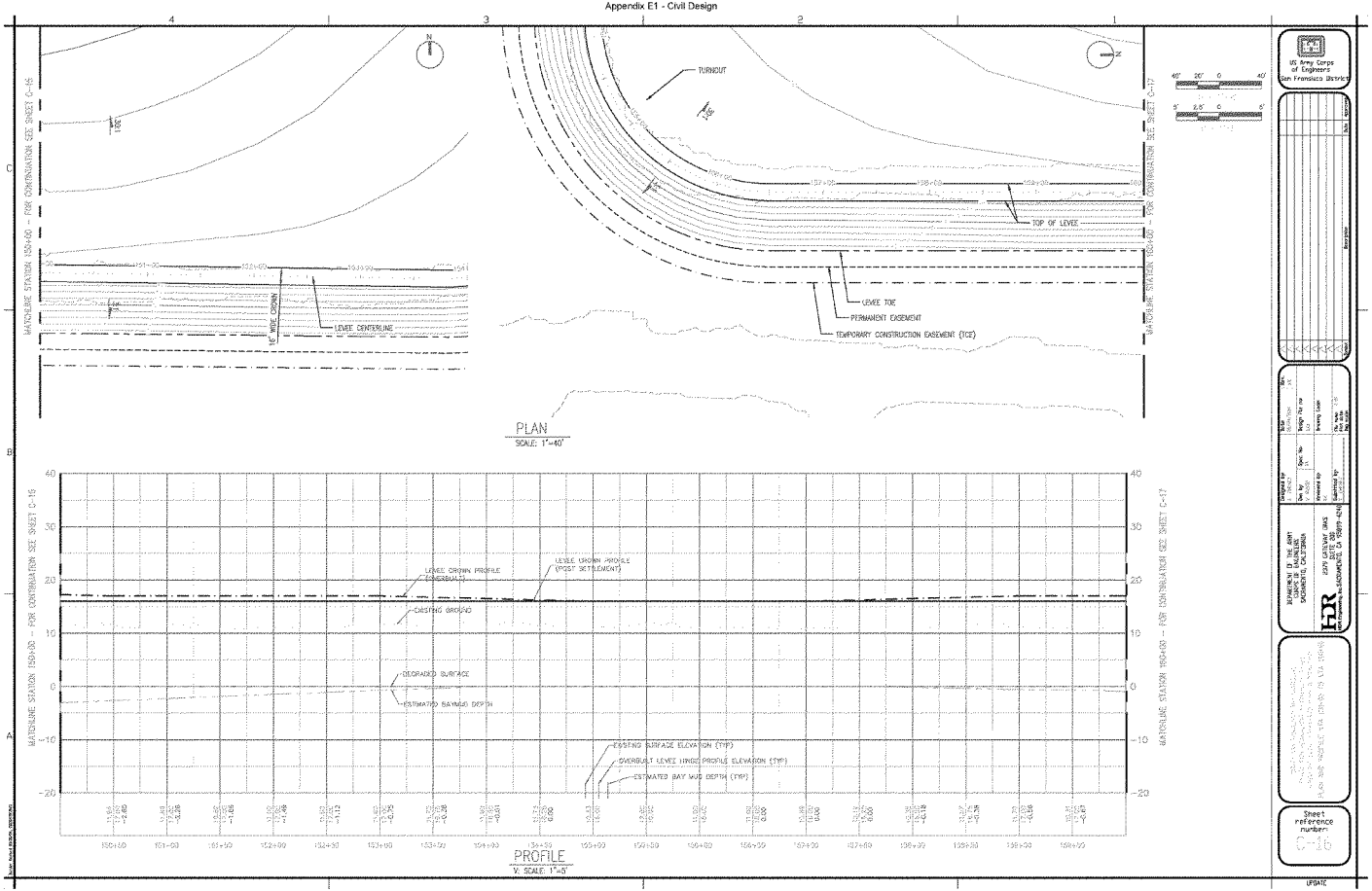

MATCHLINE STATION 110+00 - FOR CONTINUATION SEE SHEET C-11
MATCHLINE STATION 120+00 - FOR CONTINUATION SEE SHEET C-13
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
16' WIDE CROWN
H = 1"=40'
V = 1"=5'
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE PLAN AND PROFILE STA 100+00 TO STA 120+00
Sheet reference number: C-12
UPDATE

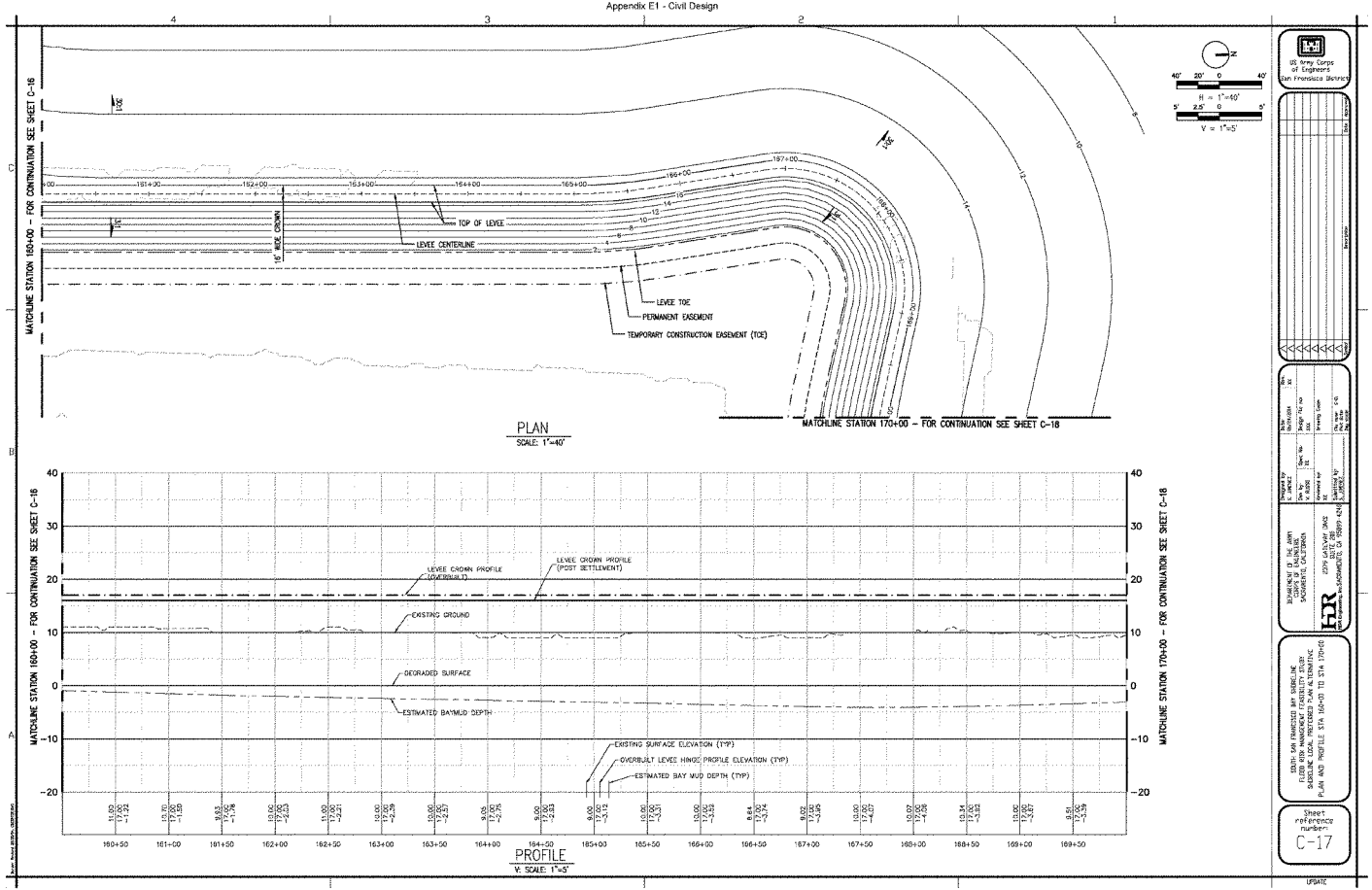

MATCHLINE STATION 120+00 - FOR CONTINUATION SEE SHEET C-12
MATCHLINE STATION 130+00 - FOR CONTINUATION SEE SHEET C-14
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
PLAN AND PROFILE STA 120+00 TO STA 130+00
Sheet reference number: C-13
UPDATE



US Army Corps of Engineers
San Francisco District
HR
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4240
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
PLAN AND PROFILE STA 130+00 TO STA 140+00
Sheet reference number
C-14
UPDATE
MATCHLINE STATION 140+00 - FOR CONTINUATION SEE SHEET C-15
MATCHLINE STATION 130+00 - FOR CONTINUATION SEE SHEET C-13
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED DAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
Appendix E1 - Civil Design
E1-183


SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
PLAN AND PROFILE STA 140+00 TO STA 150+00
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
US Army Corps of Engineers
San Francisco District
HDR
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833
Sheet reference number:
C-15
H = 1"=40'
V = 1"=5'
MATCHLINE STATION 150+00 – FOR CONTINUATION SEE SHEET C-16
MATCHLINE STATION 140+00 – FOR CONTINUATION SEE SHEET C-14
PLAN
SCALE: 1"=40'
PROFILE
V: SCALE: 1"=5'
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
30:1
3:1
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)


TURNOUT
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
LEVEE CENTERLINE
16' WIDE CROWN
MATCHLINE STATION 150+00 - FOR CONTINUATION SEE SHEET C-16
MATCHLINE STATION 160+00 - FOR CONTINUATION SEE SHEET C-17
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V. SCALE: 1"=5'
US Army Corps of Engineers
San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
Sheet reference number:
C-16
UPDATE


MATCHLINE STATION 160+00 - FOR CONTINUATION SEE SHEET C-18
MATCHLINE STATION 170+00 - FOR CONTINUATION SEE SHEET C-18
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
H = 1"=40'
V = 1"=5'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAY MUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
PLAN AND PROFILE STA 160+00 TO STA 170+00
Sheet reference number: C-17
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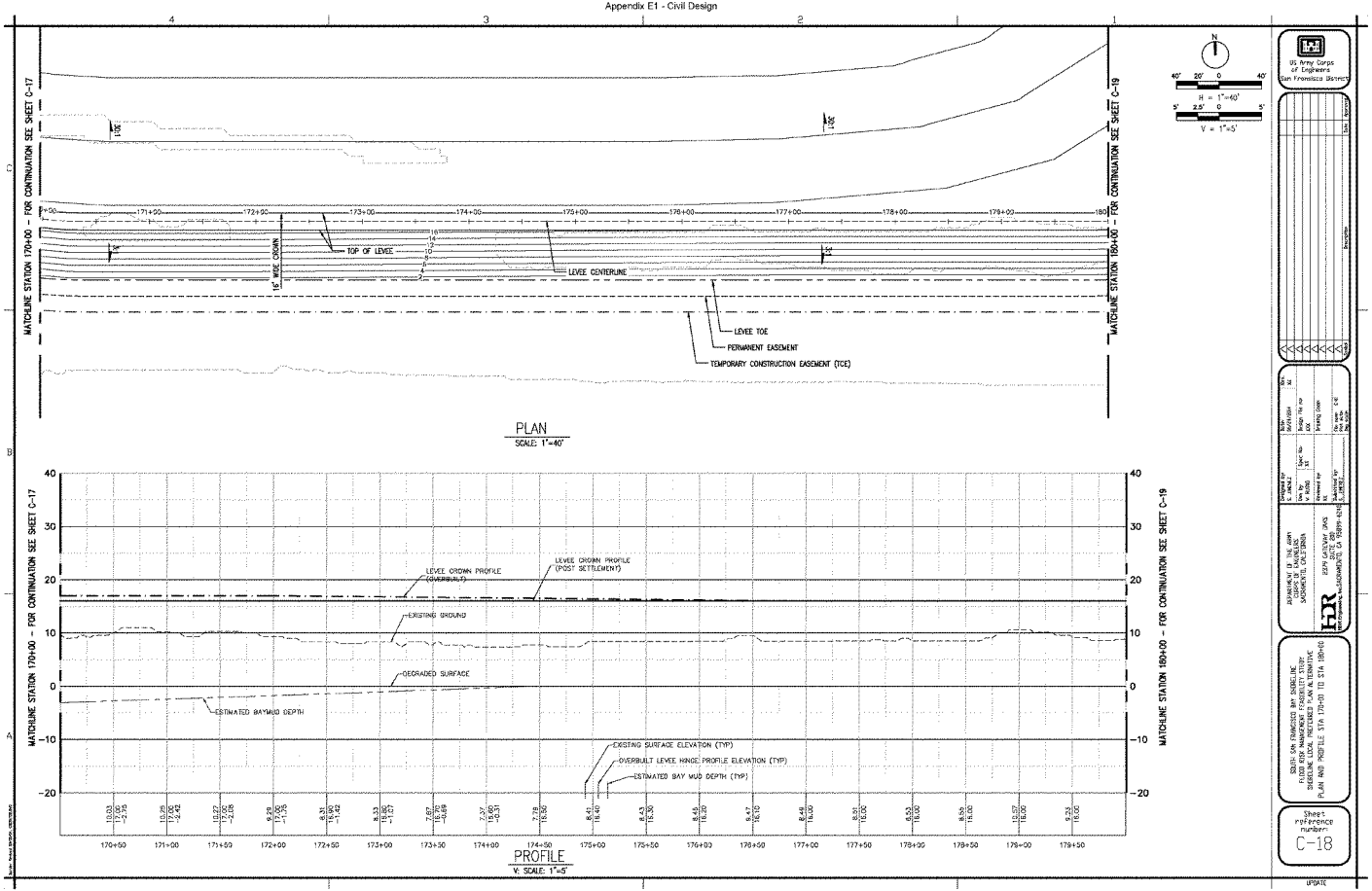
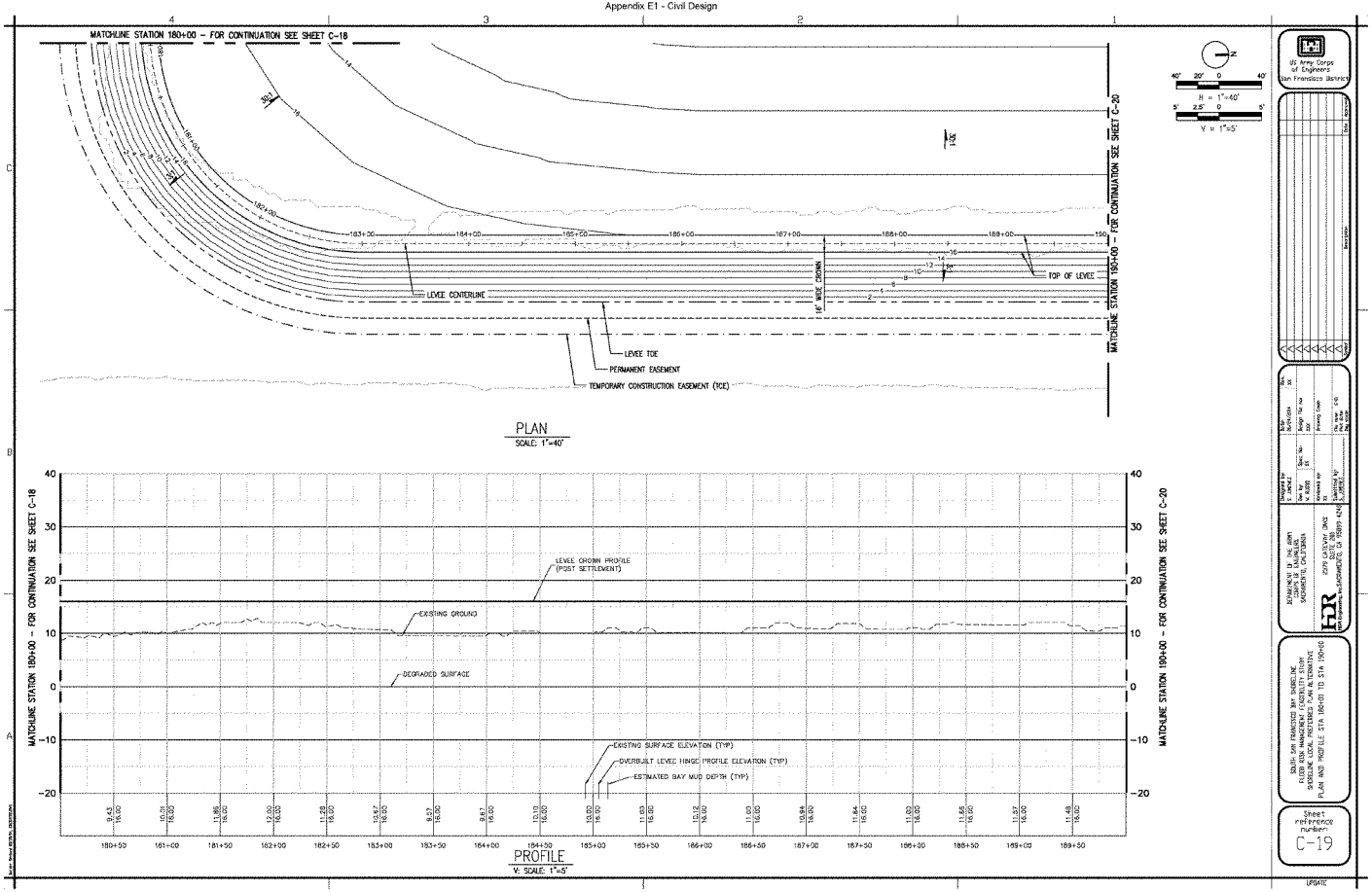
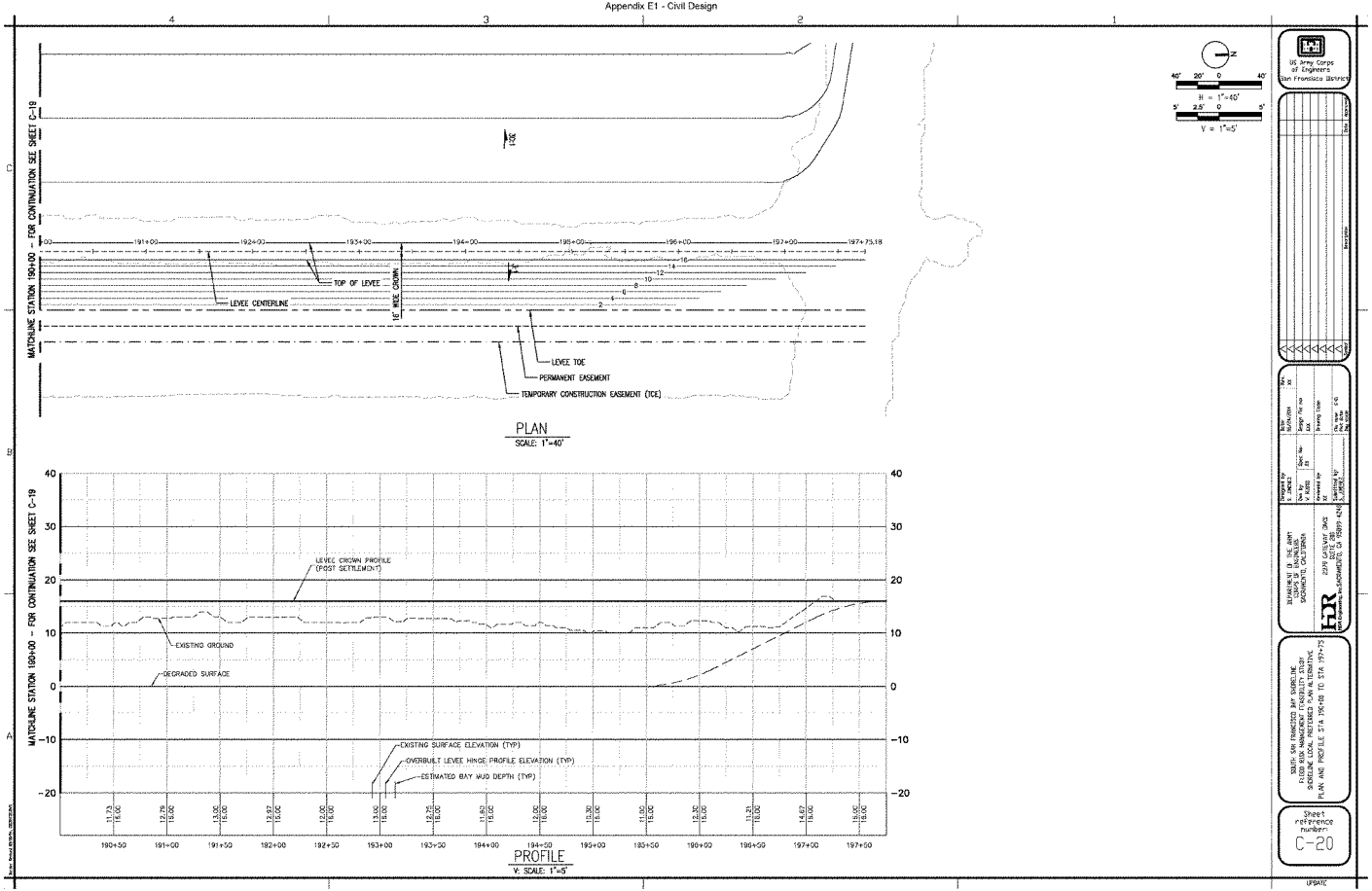

MATCHLINE STATION 170+00 - FOR CONTINUATION SEE SHEET C-17
MATCHLINE STATION 180+00 - FOR CONTINUATION SEE SHEET C-19
TOP OF LEVEE
16' WIDE CROWN
LEVEE CENTERLINE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (OVERBUILT)
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
ESTIMATED BAYMUD DEPTH
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number
C-18
UPDATE


MATCHLINE STATION 180+00 - FOR CONTINUATION SEE SHEET C-18
MATCHLINE STATION 190+00 - FOR CONTINUATION SEE SHEET C-20
LEVEE CENTERLINE
TOP OF LEVEE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
16' WIDE CROWN
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
Sheet reference number: C-19


MATCHLINE STATION 190+00 - FOR CONTINUATION SEE SHEET C-19
TOP OF LEVEE
LEVEE CENTERLINE
16' WIDE CROWN
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
PLAN
SCALE: 1"=40'
LEVEE CROWN PROFILE (POST SETTLEMENT)
EXISTING GROUND
DEGRADED SURFACE
EXISTING SURFACE ELEVATION (TYP)
OVERBUILT LEVEE HINGE PROFILE ELEVATION (TYP)
ESTIMATED BAY MUD DEPTH (TYP)
PROFILE
V: SCALE: 1"=5'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
PLAN AND PROFILE STA 190+00 TO STA 197+75
Sheet reference number:
C-20
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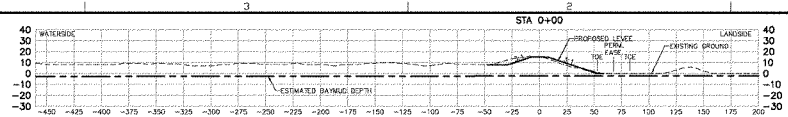
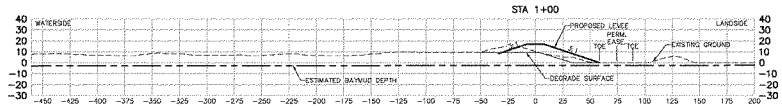
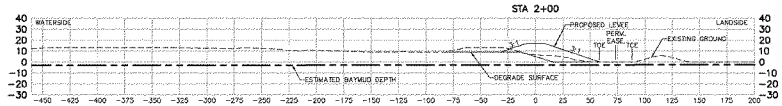
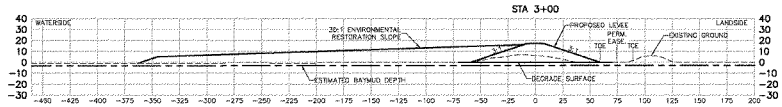
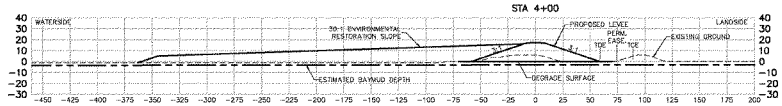
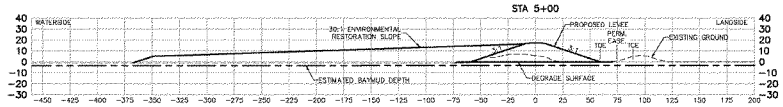












US Army Corps of Engineers
San Francisco District

Date | Description

Designed by: Jeffrey Dorman
Drawn by: Bryan Hu-Jue
Checked by: Sherry Owen
Sheet No. 21
Date: 10/2010
Scale: 1" = 20'
Revisions: File name: E1-C-21 Revisions
Sheet No.

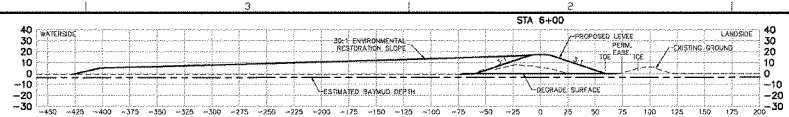
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

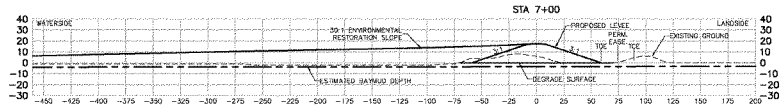
CH2M HILL
CEMP GATEWAY OPCS
1331 GARDEN HIGHWAY
SACRAMENTO, CA 95833-9412

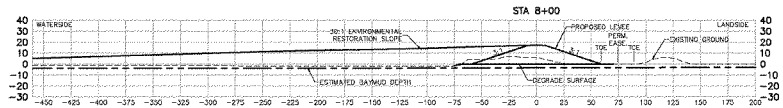
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LEVEE FEATURES PLAN ALTERNATIVE
SECTIONS STA 0+00 TO STA 5+00

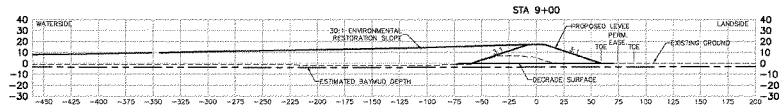
Sheet reference number:
C-21

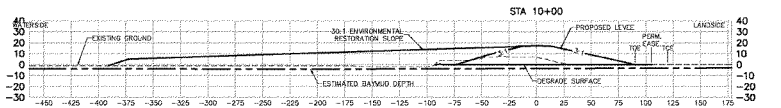
UPDATE

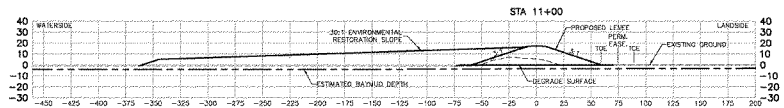












US Army Corps of Engineers
San Francisco District

Sym	Description	Date	Approved

Designed by: J. CHANG, E.
Date: 06/09/2011
Drawn by: J. CHANG
Date: 06/09/2011
Scale: 1:1
Sheet No: 30
Design file no: 30
Drawing name:
Checked by: BL
Approved by: BL
Revision No:
File name: E10 Sections
Plot scale:

DEPARTMENT OF THE ARMY
SACRAMENTO, CALIFORNIA
1325 J STREET
SACRAMENTO, CA 95814-2922
HDR Inc. Engineers-Architects-Planners

SACO, SAN FRANCISCO BAY AREAS, INC
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SACRELOW LEVEE, PROTECTED FLOW ALTERNATIVE
SECTIONS STA 6+00 TO STA 11+00

Sheet reference number:
C-22

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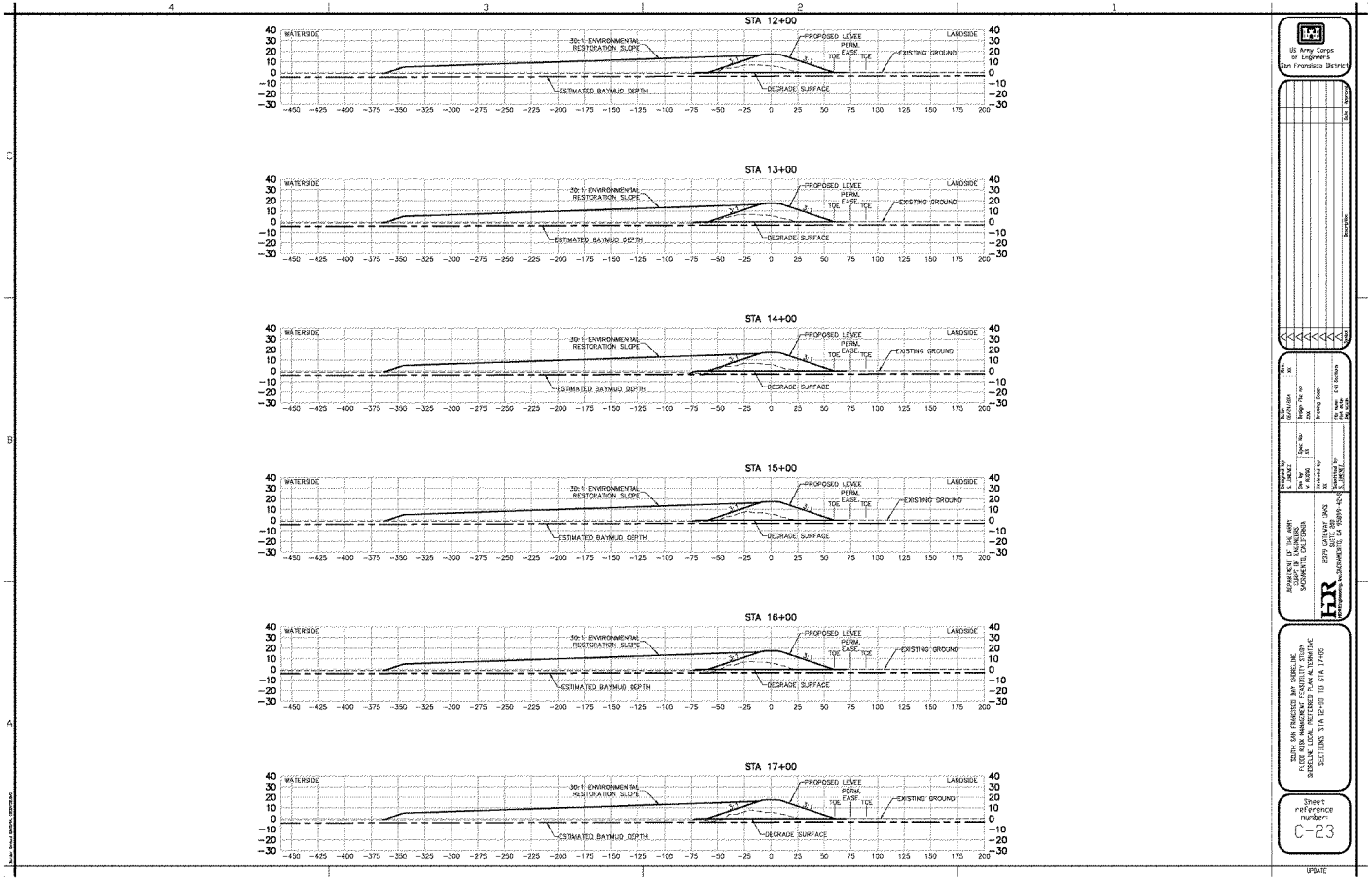
STA 12+00
STA 13+00
STA 14+00
STA 15+00
STA 16+00
STA 17+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT
SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 12+00 TO STA 17+00
Sheet reference number:
C-23
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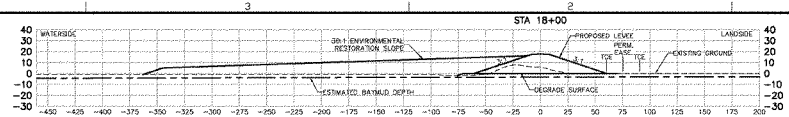

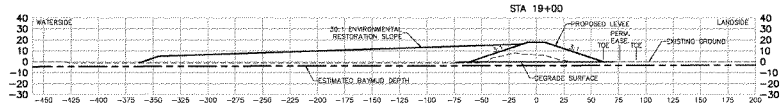

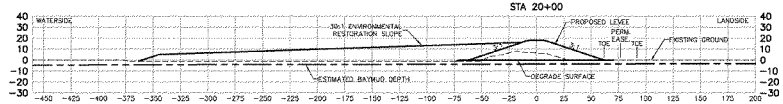

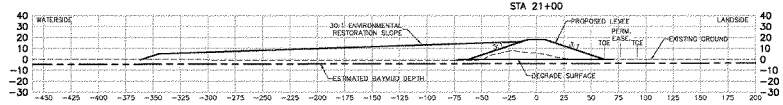

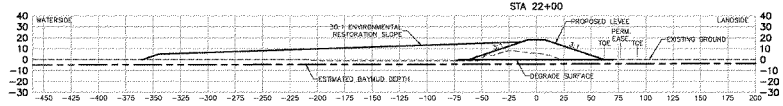

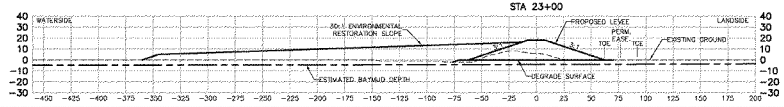

US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

Designed by: D. CHANG, E. Date: 10/2010
Drawn by: BUCKSKIN Scale: NO
Checked by: LEE Spec. No.: Design file no.: 30
Reviewed by: XL Survey Code:
Approved by: S. LEWIS File name: C-24 Date: 10/2010

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
2379 GATEWAY OAKS
SACRAMENTO, CA 95833-4202
HDR Engineering, Inc. SACRAMENTO, CA

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 18+00 TO STA 23+00

Sheet reference number
C-24

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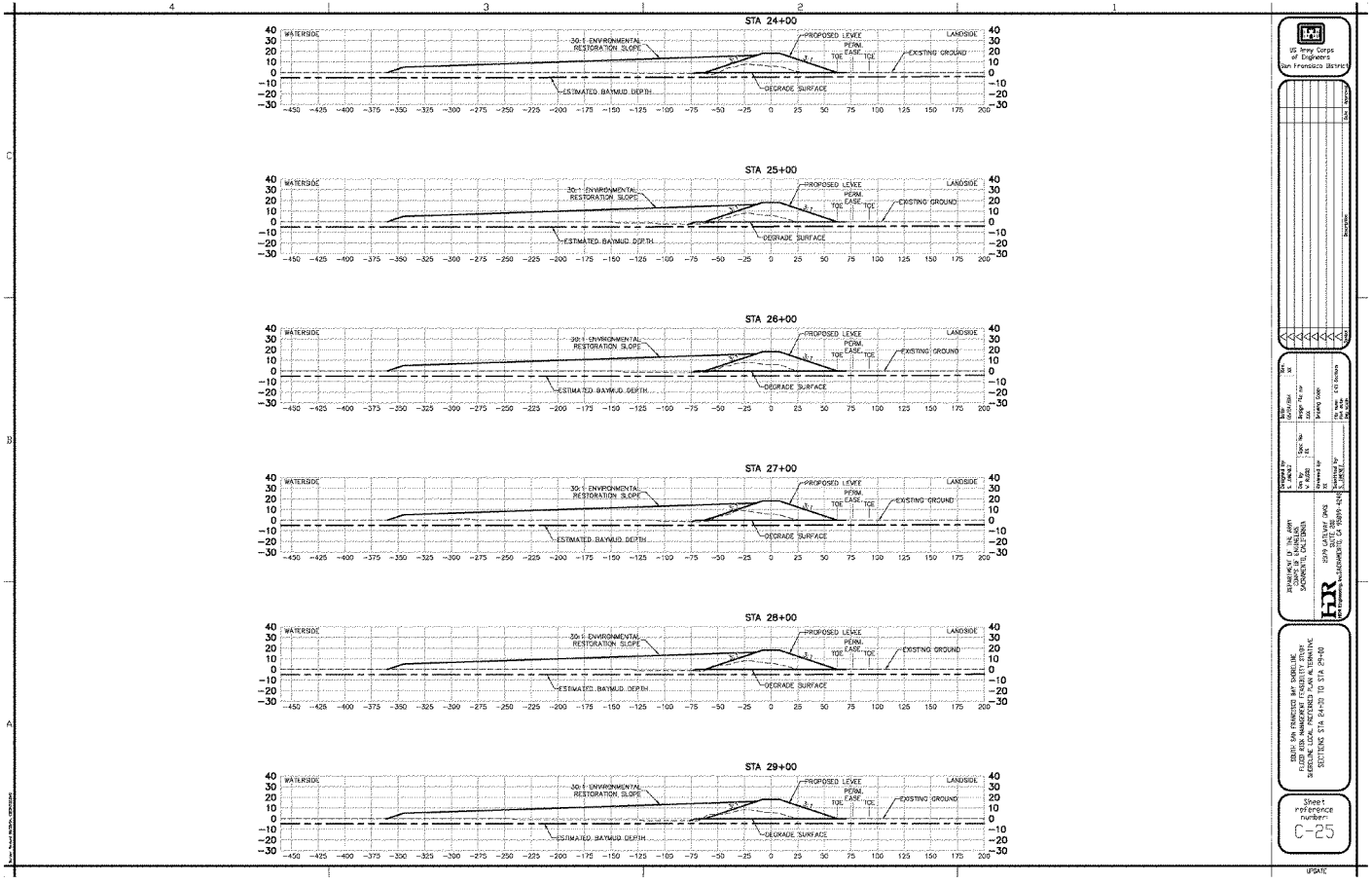
STA 24+00
STA 25+00
STA 26+00
STA 27+00
STA 28+00
STA 29+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 24+00 TO STA 29+00
Sheet reference number:
C-25
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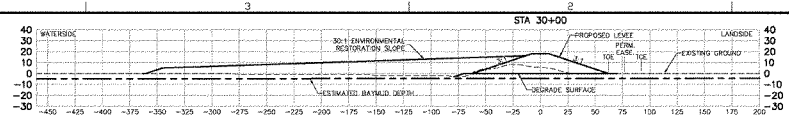

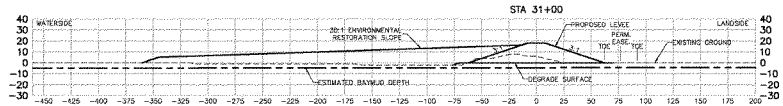

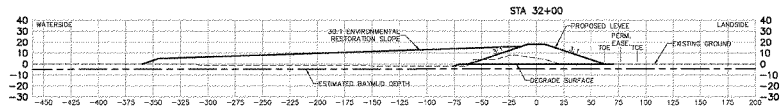

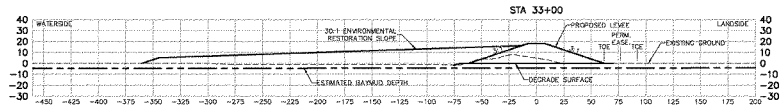

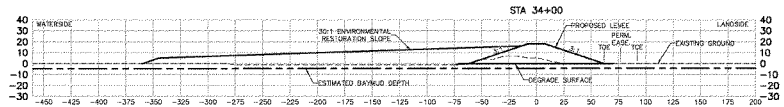

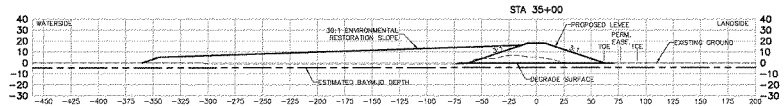

US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

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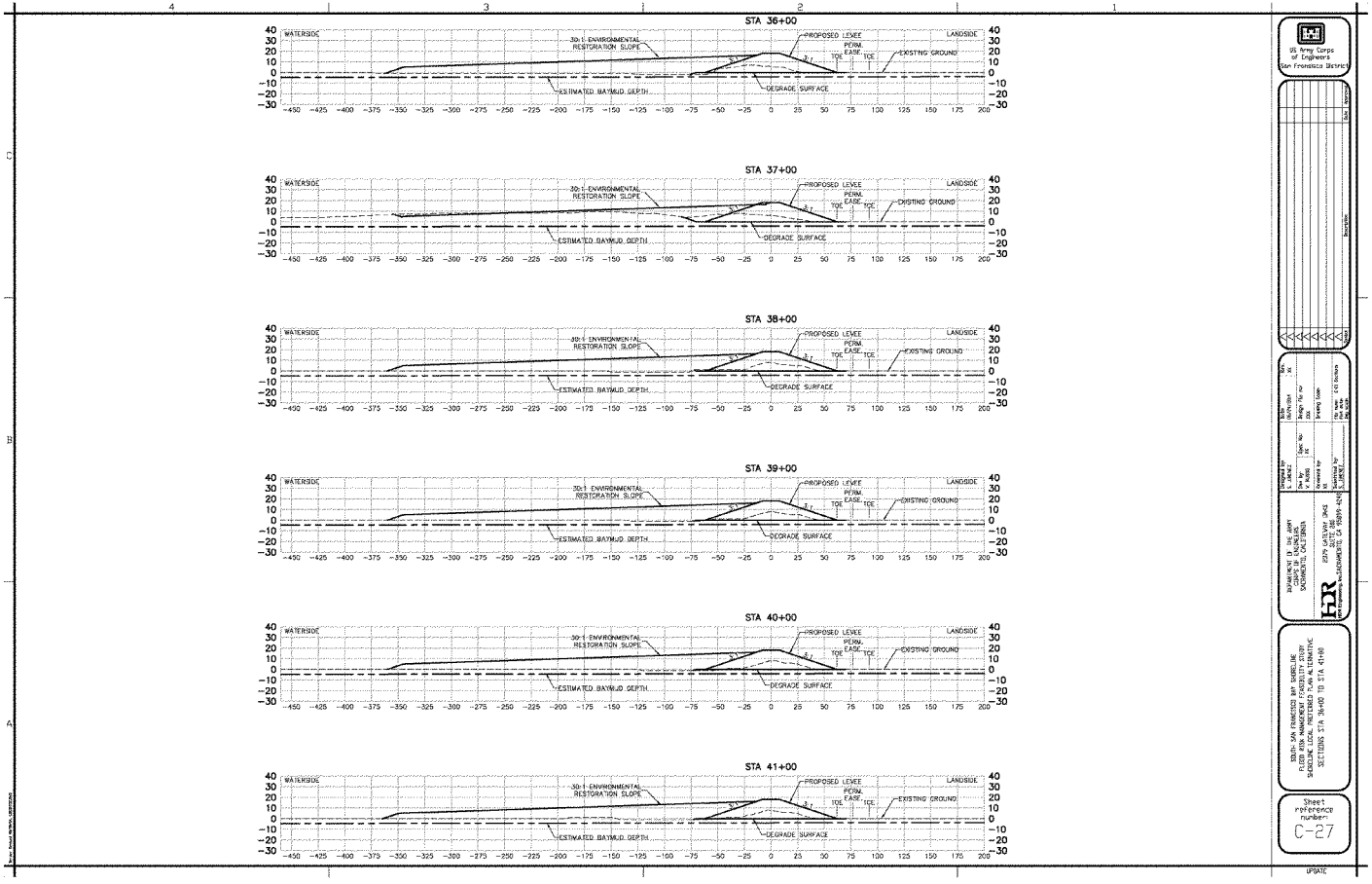
Drawn by: Bob Fitzgerald
Date: 10/2/08
Scale: Design file no.
Spec. No.: N/A
Reviewed by: Jeremy Cohen
Approved by: N/A
Date: 10/2/08
Scale: N/A
File name: 0000-0000-0000.dgn
File no.: E-01 Sections

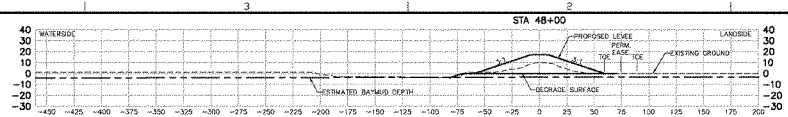
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CA 95814-2922
HDR Engineering, Inc.

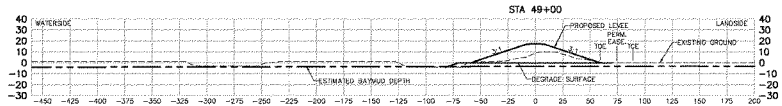
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 30+00 TO STA 35+00

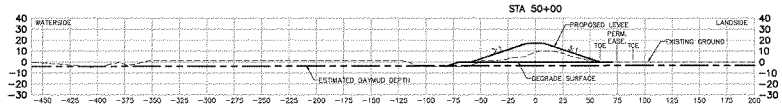
Sheet reference number:
C-26

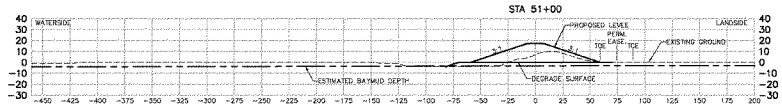
UPDATE

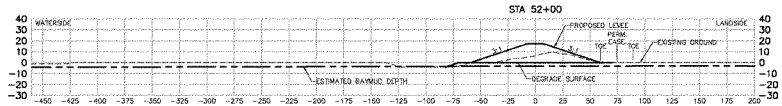

STA 36+00
STA 37+00
STA 38+00
STA 39+00
STA 40+00
STA 41+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
TCE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4245
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 36+00 TO STA 41+00
Sheet reference number:
C-27
UPDATE

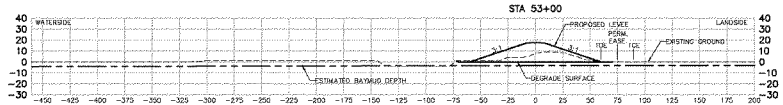












US Army Corps of Engineers
San Francisco District

Mark	Description	Date	Approved

Designed for: CHARLIE
Drawn by: AUSTIN GUSTAVSON
Checked by: BV
Spec. No.: 241
Design file no: 241
Drawing name:
Reviewed by: KE
Reviewed by: BE
Approved by: BV
Date: 2/2/2018
Scale: 1:100
File name: 241-C-29.dwg
File No.: 241-C-29

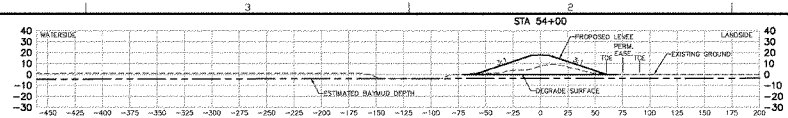
ADVANCEMENT OF SEAL COMMITTEE
SACRAMENTO, SACRAMENTO COUNTY, CALIFORNIA

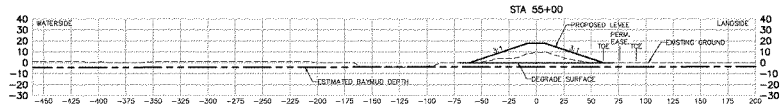
HDR
HDR Engineering, Inc. | SACRAMENTO, CA 95815-4388 | 2379 GATEWAY OAKS DRIVE, SUITE 200

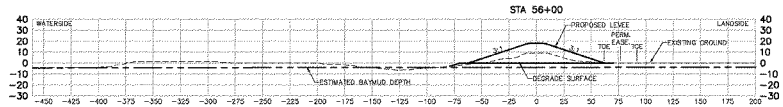
SOUTH SAN CONNECTED BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 48+00 TO STA 53+00

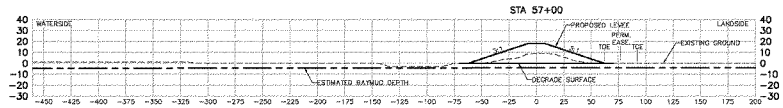
Sheet reference number:
C-29

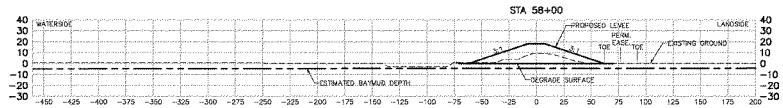
UPDATE

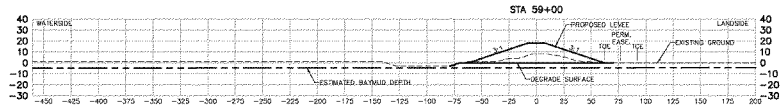












US Army Corps of Engineers
San Francisco District

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

HDR Engineering, Inc.
2509 CANYON DRIVE
SUITE 200
SACRAMENTO, CA 95819-4240

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 54+00 TO STA 59+00

Sheet reference number:
C-30

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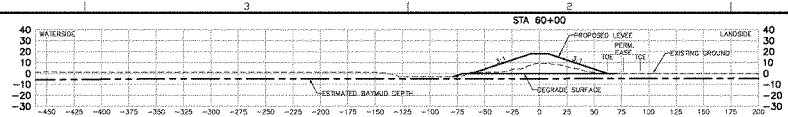

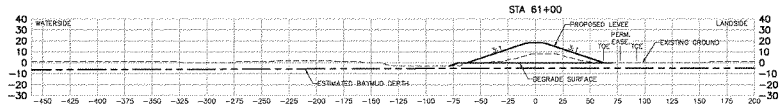

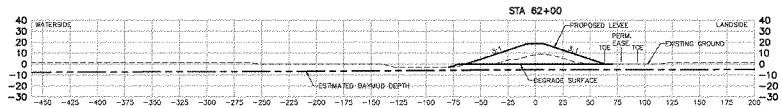

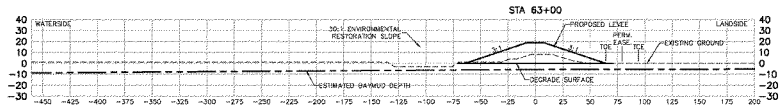

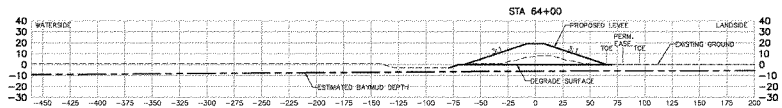

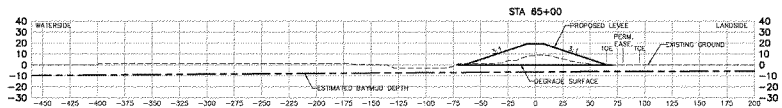

US Army Corps of Engineers
San Francisco District

Date	Revision	Description

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR Engineering, Inc.
8950 CORDOVA DRIVE
SACRAMENTO, CA 95826-4265

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 60+00 TO STA 65+00

Sheet reference number:
C-31

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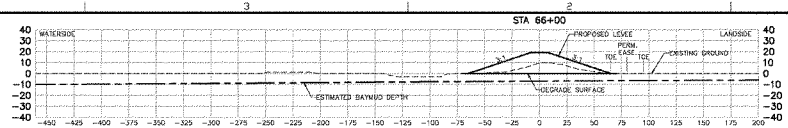
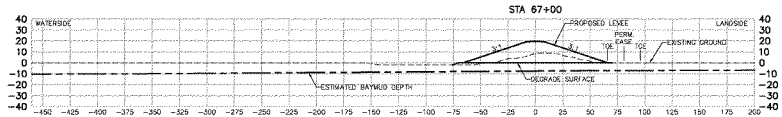
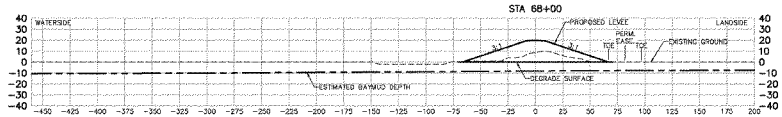
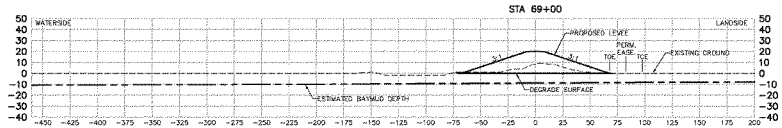
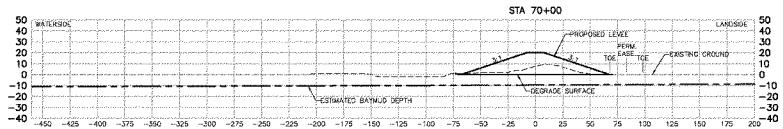
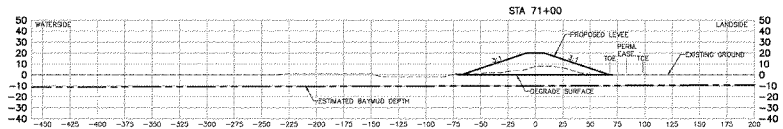












US Army Corps of Engineers
San Francisco District

Date	Description

Date: 06/09/2014
Drawn by: SM
Scale: 1:50
Design file no: 1
Survey data:
Revision: 1 - 2-D Deletions
File name: C-32.dgn
Sheet No.: C-32

Department of the Army
U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

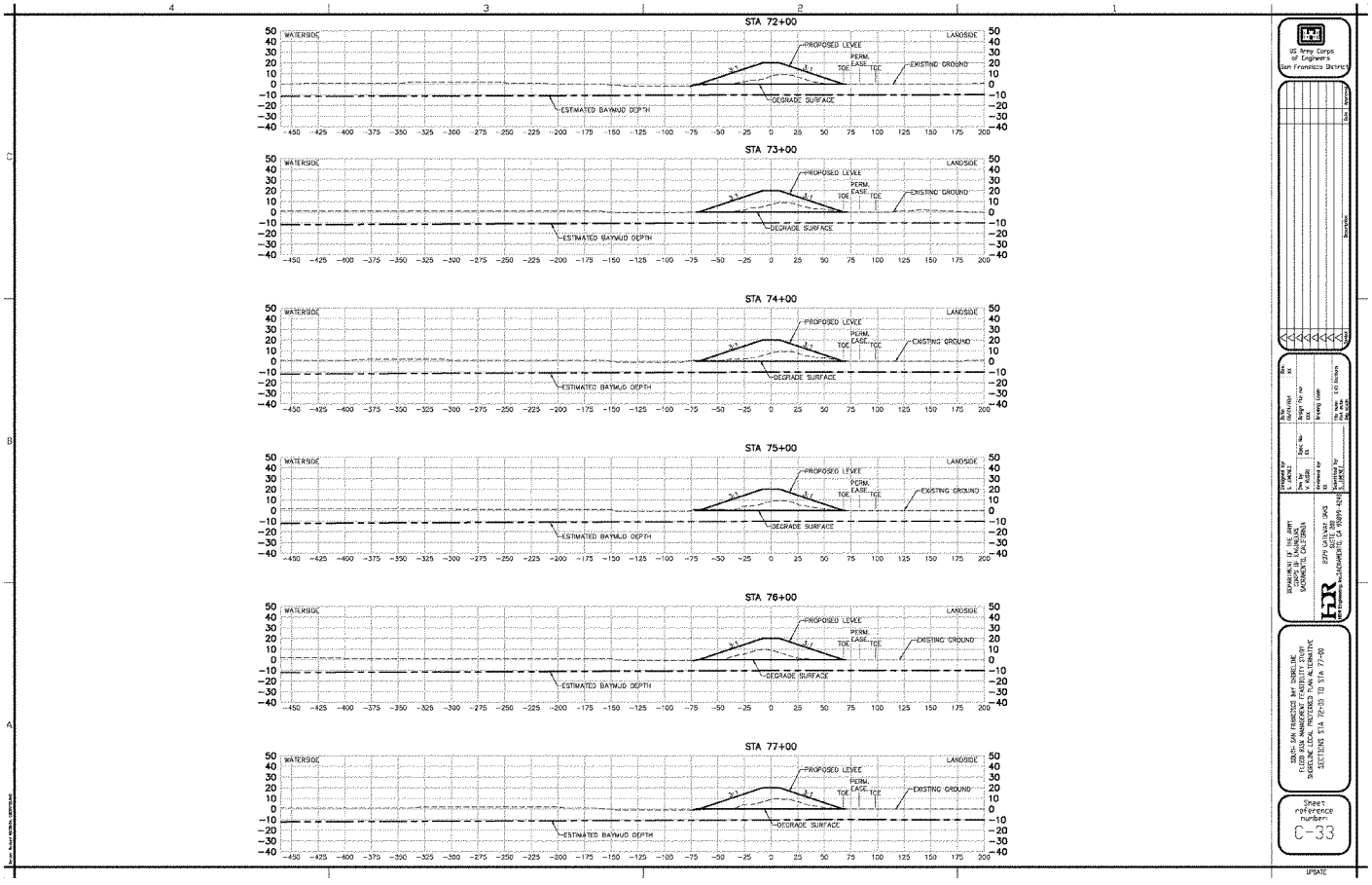
Prepared by: SM
Reviewed by: SL
Approved by: SL

HDR
HDR Engineering, Inc. 1209 Catalyst Circle
Sacramento, CA 95815-4610

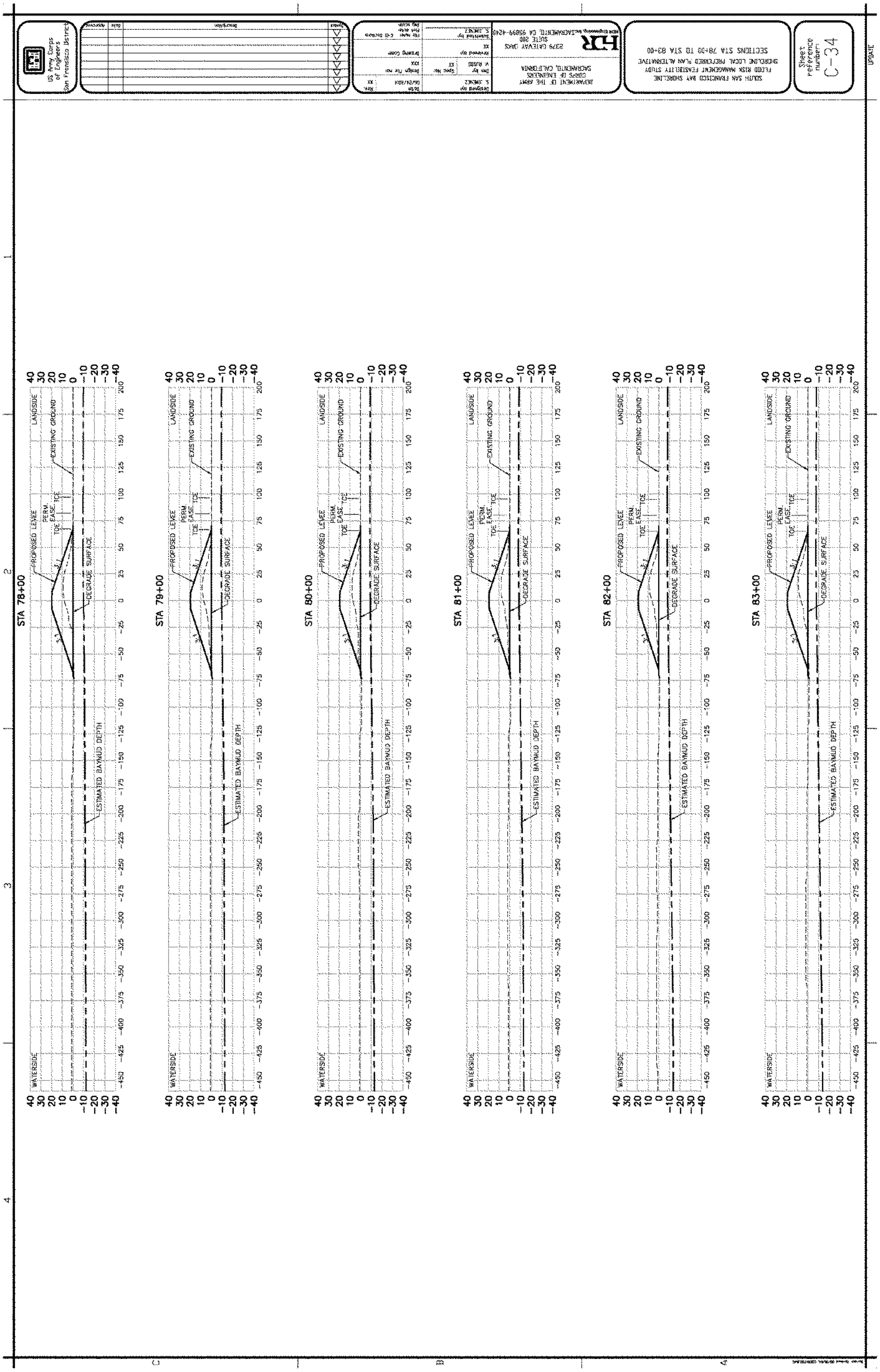
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 66+00 TO STA 71+00

Sheet reference number:
C-32

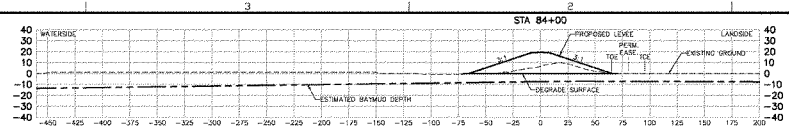
UPDATE

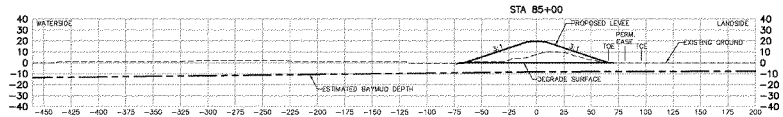

STA 72+00
STA 73+00
STA 74+00
STA 75+00
STA 76+00
STA 77+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
PERM. EASE
TOE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
3:1
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE SECTIONS STA 72+00 TO STA 77+00
Sheet reference number:
C-33
UPDATE

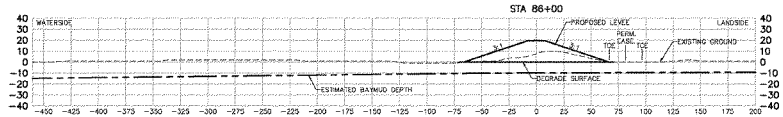
Appendix E1 - Civil Design

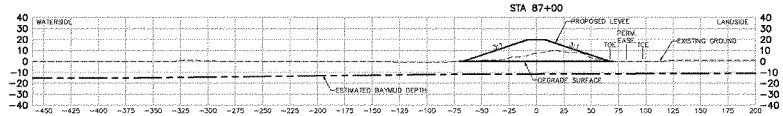


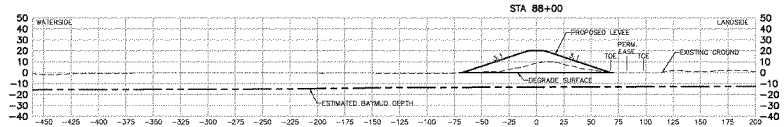
E1-202

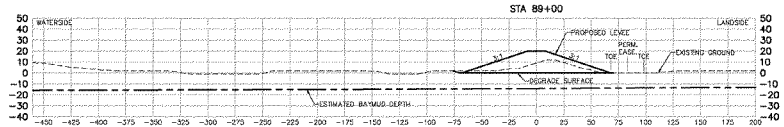












US Army Corps of Engineers
San Francisco District

Date	Revision	Description

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Date: 10/24/07
Checked by: SO
Date: 10/24/07
Scale: 30
Design file no: 01
Survey no: Survey 1000
Sheet No: 01
Contract No: W912P8-04-C-0043
Contract No: W912P8-04-C-0043
Revision No: 0
Revision No: 0
Date: 10/24/07
Date: 10/24/07
Title block: E-03 Revision
File name: 01-C-35.dwg
Plot scale: 1:1

DEPARTMENT OF THE ARMY
SACRAMENTO, CALIFORNIA
1325 J STREET
SACRAMENTO, CA 95814-2922
HDR
HDR Engineering, Inc. SACRAMENTO, CA 95814-4405

DELTA SPA CONNECTED WAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL FACILITIES PLAN ALTERNATIVE
SECTIONS STA 84+00 TO STA 89+00

Sheet reference number:
C-35

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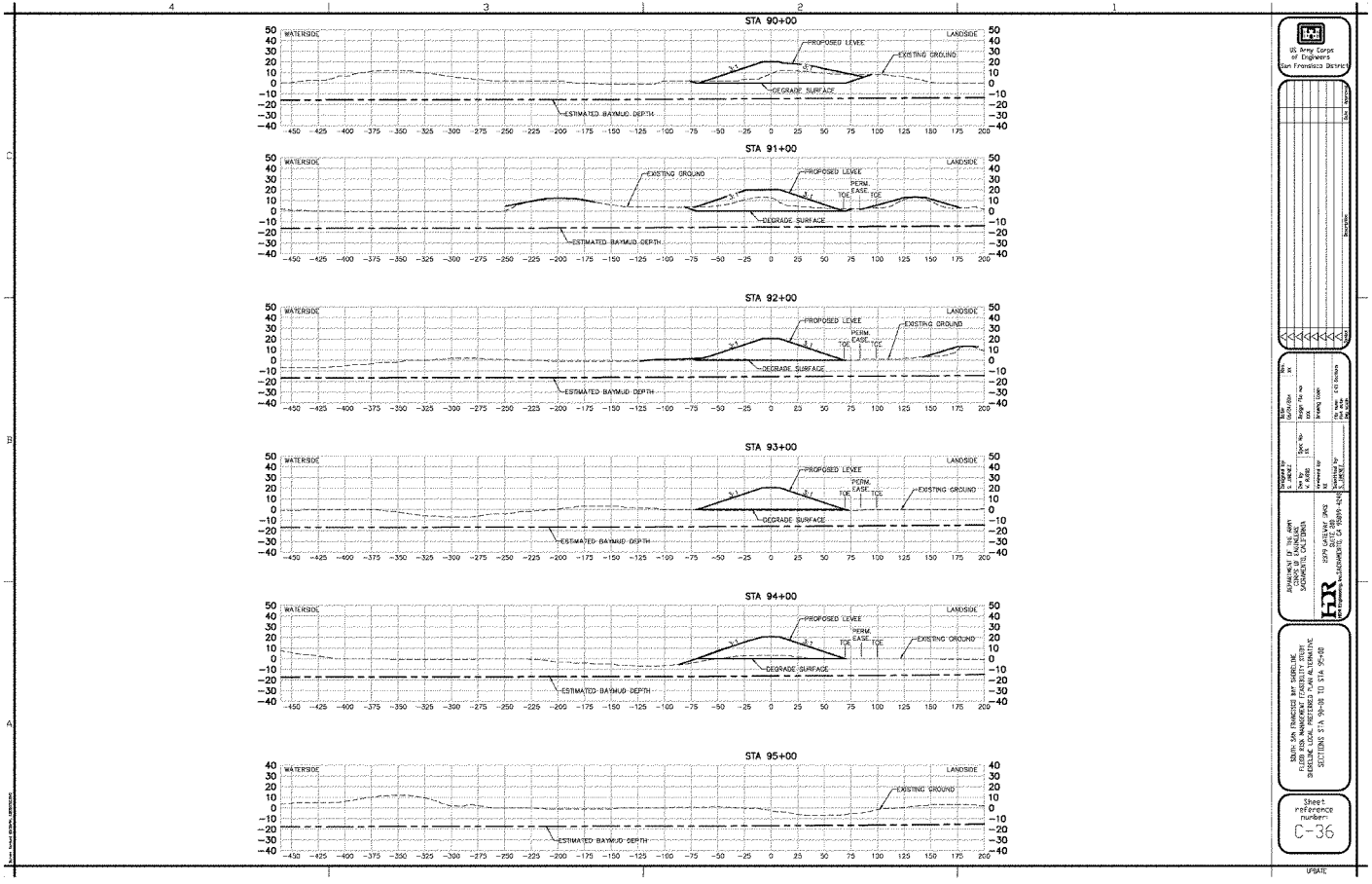
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WATERSIDE
LANDSIDE
PROPOSED LEVEE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
PERM. EASE
TOE
US Army Corps of Engineers San Francisco District
JOINT SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE SECTIONS STA 90+00 TO STA 95+00
Sheet reference number: C-36
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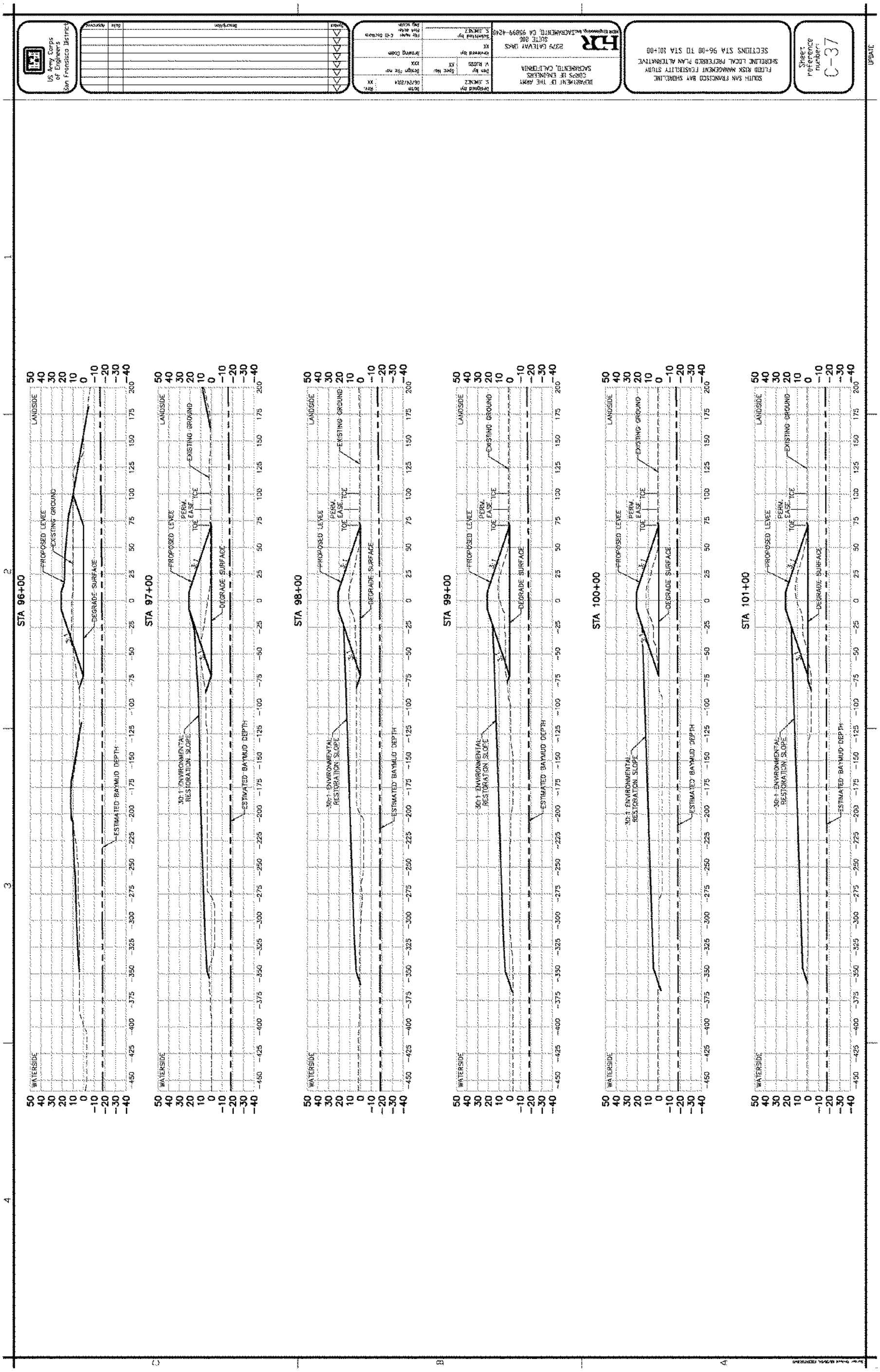
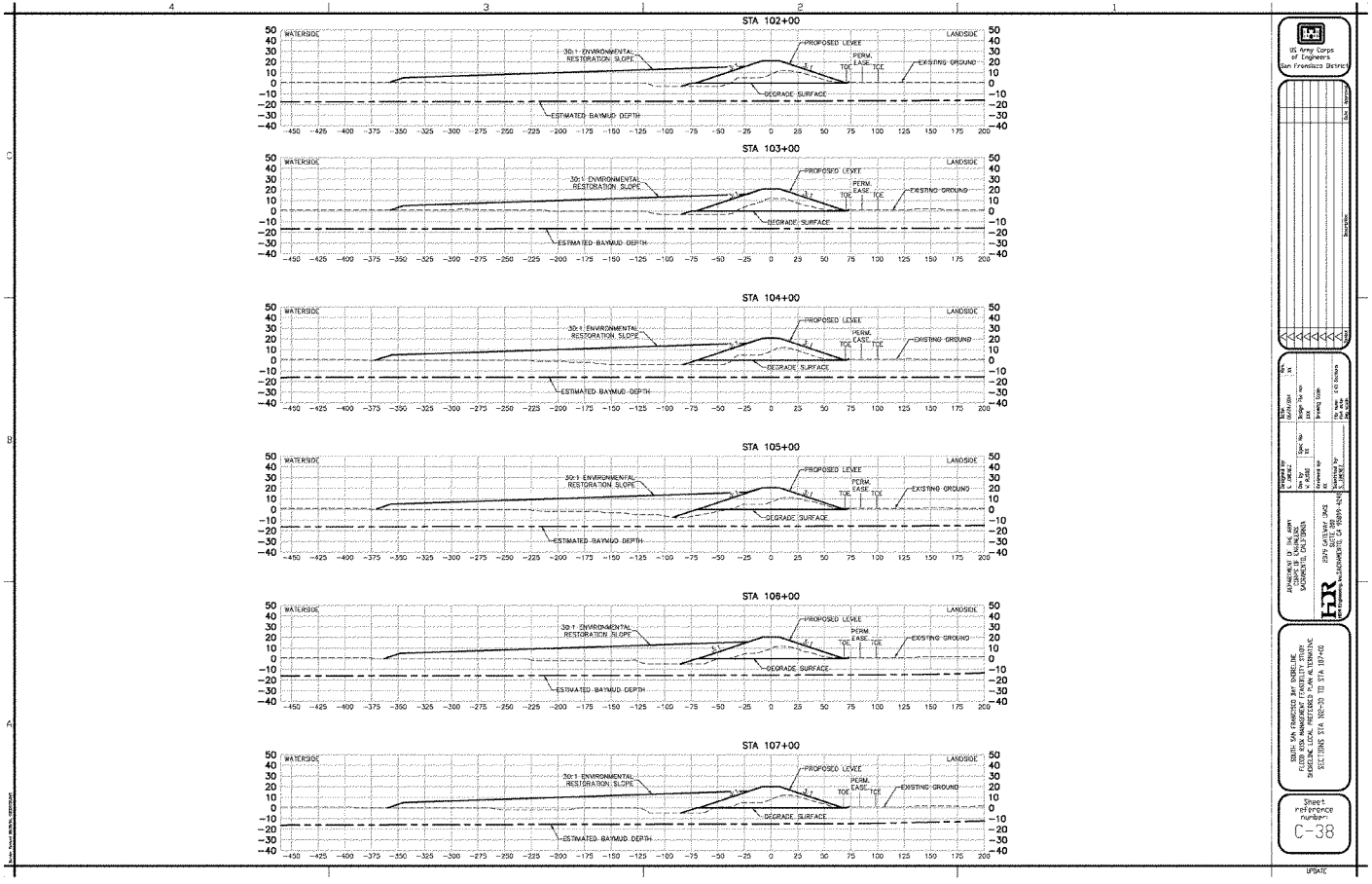

US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
2379 GATEWAY OAKS
SUITE 200
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
SECTIONS STA 96+00 TO STA 101+00
Sheet reference number:
C-37
STA 96+00
STA 97+00
STA 98+00
STA 99+00
STA 100+00
STA 101+00
WATERSIDE
LANDSIDE
PROPOSED LEVEE
EXISTING GROUND
DEGRADE SURFACE
PERM. EASE.
TOE
30:1 ENVIRONMENTAL RESTORATION SLOPE
ESTIMATED BAYMUD DEPTH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WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
Sheet reference number
C-38
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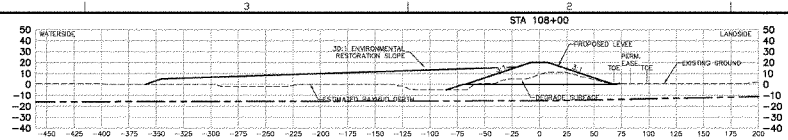

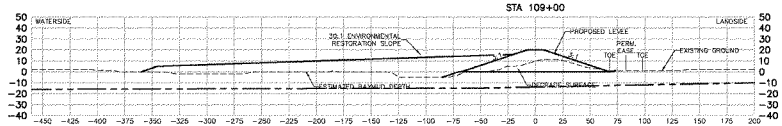

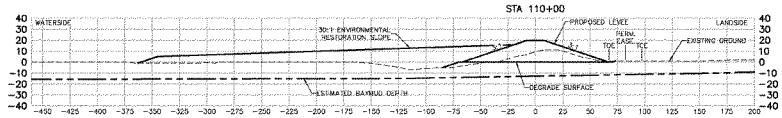

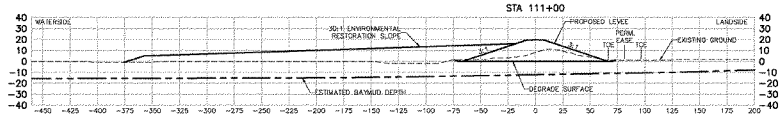

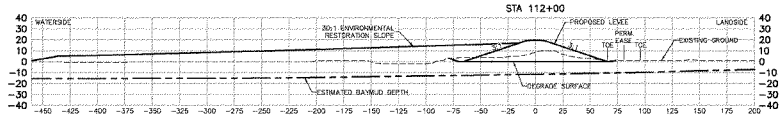

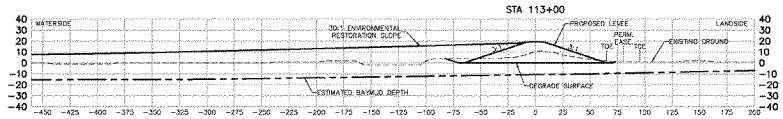

US Army Corps of Engineers
San Francisco District

Sym	Date	Revision	Description
A			
B			
C			
D			
E			
F			

Designed by: D. CHANG 12
Drawn by: BLAYLOCK
Sheet No: 30
Design File no: 01
Checked by: M.
Sec. No: 01
Drawing Date:
Reviewed by: BL
Approved by: S. LEVEL
Date: 11/2/2009
File name: 01-30.dgn
Plot Scale: 1:1

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

HDR
HDR Engineering, Inc.
2379 GATEWAY OAKS
SUITE 150
SACRAMENTO, CA 95833-4263

SUTTER SPA ENHANCED BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 108+00 TO STA 113+00

Sheet reference number
C-39

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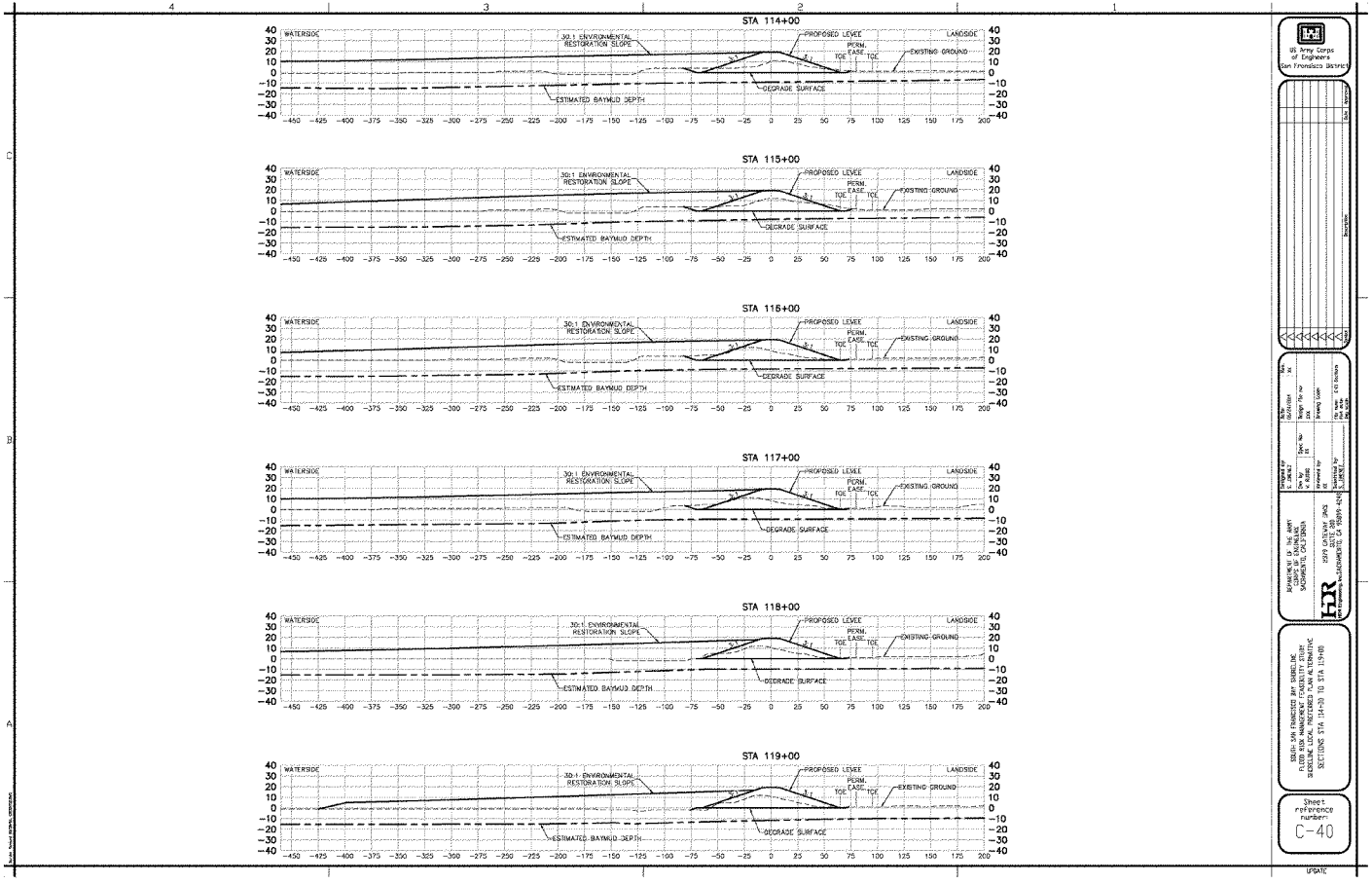
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STA 115+00
STA 116+00
STA 117+00
STA 118+00
STA 119+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 114+00 TO STA 119+00
Sheet reference number:
C-40
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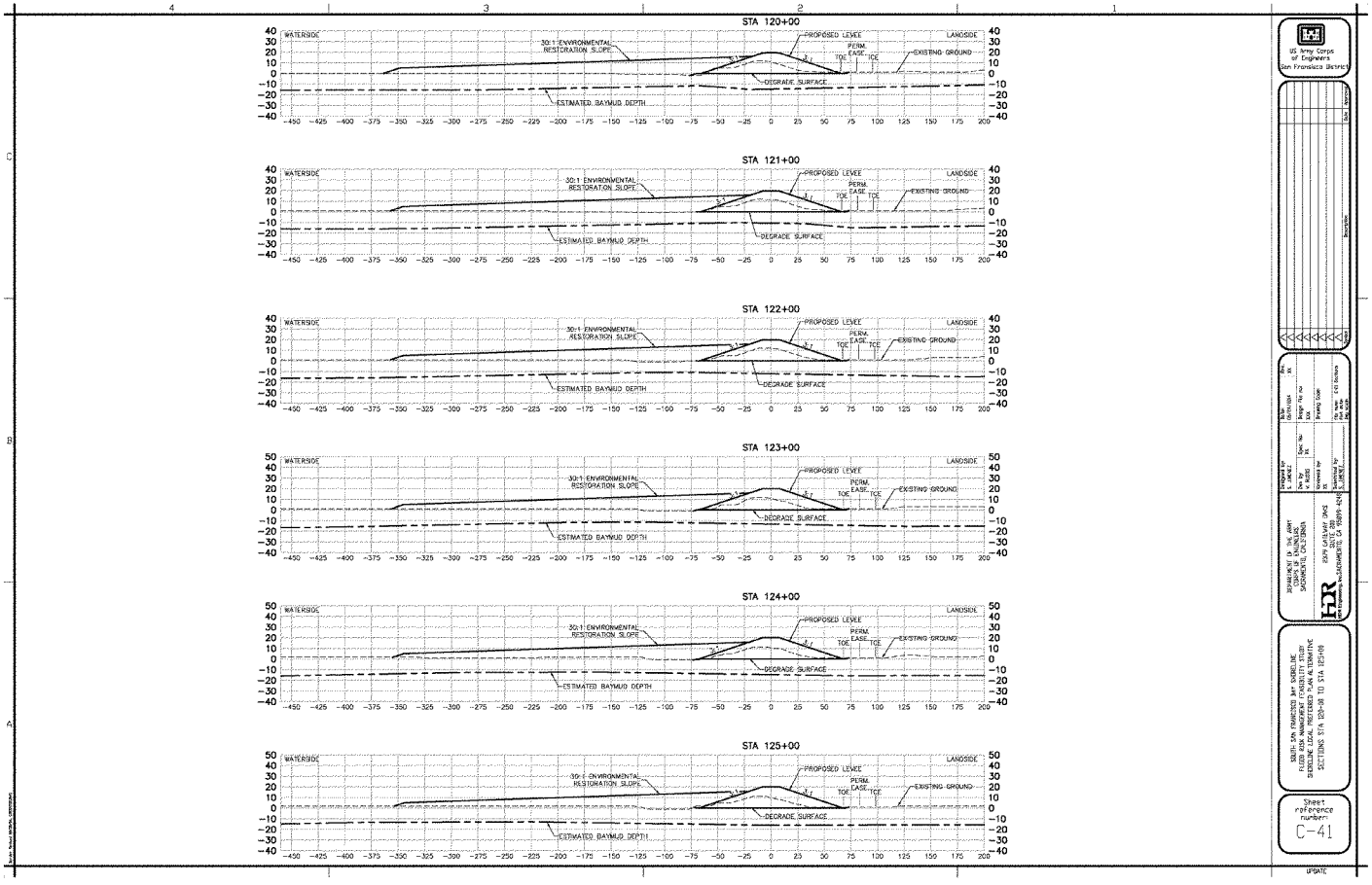
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STA 123+00
STA 124+00
STA 125+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE
SECTIONS STA 120+00 TO STA 125+00
Sheet reference number:
C-41
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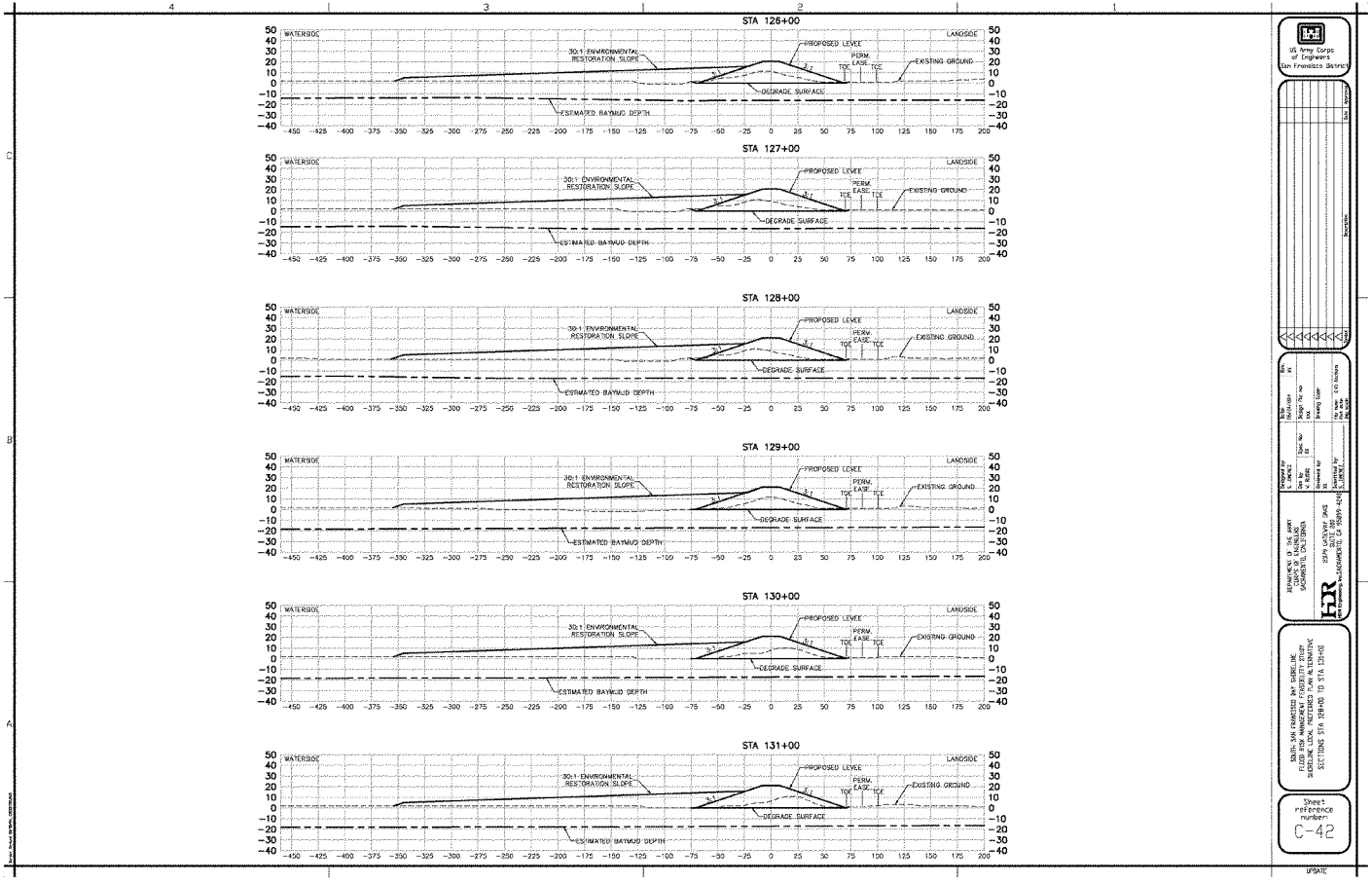
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STA 129+00
STA 130+00
STA 131+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 126+00 TO STA 131+00
Sheet reference number:
C-42
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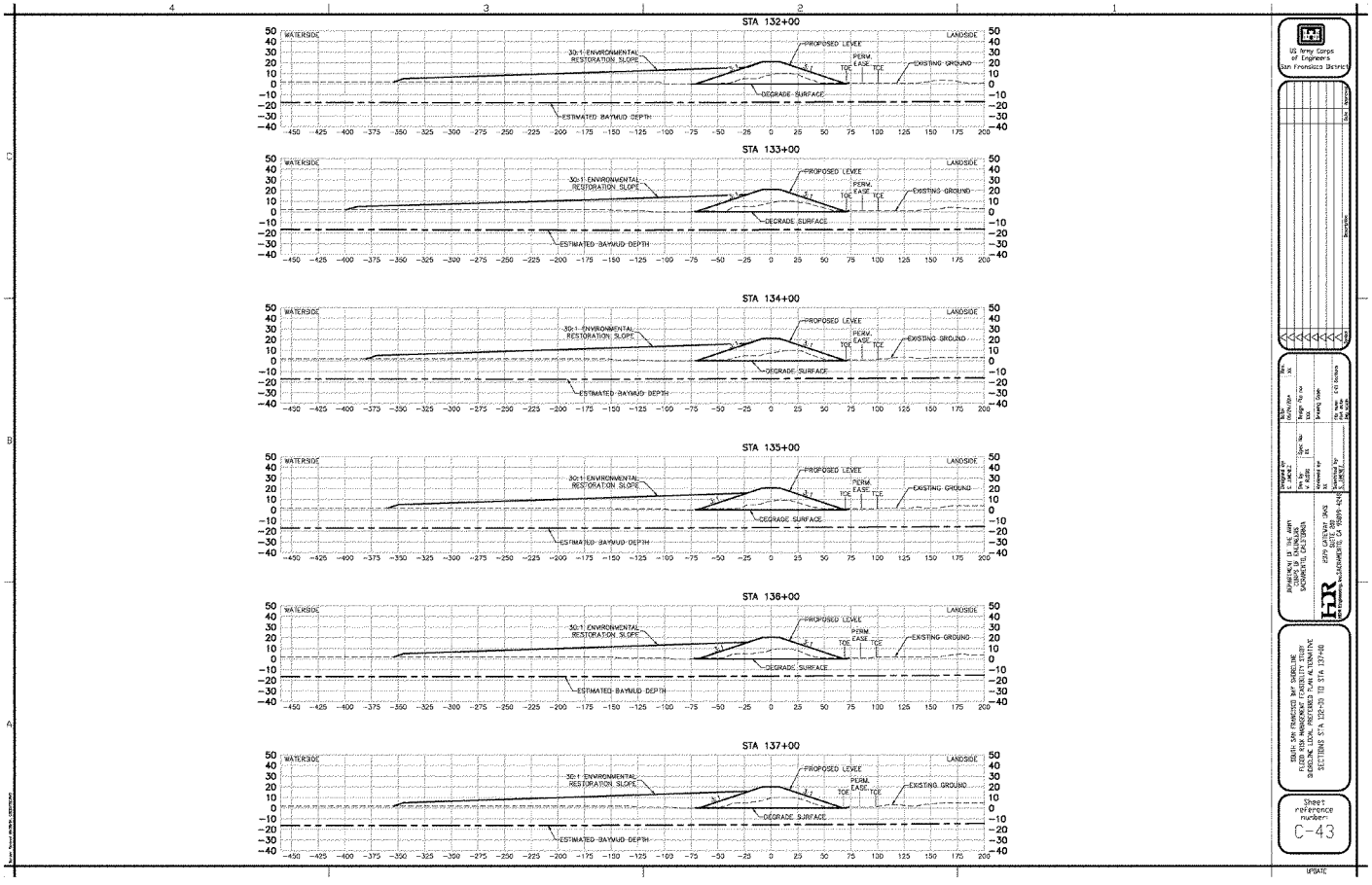
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STA 136+00
STA 137+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TCE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
Sheet reference number:
C-43
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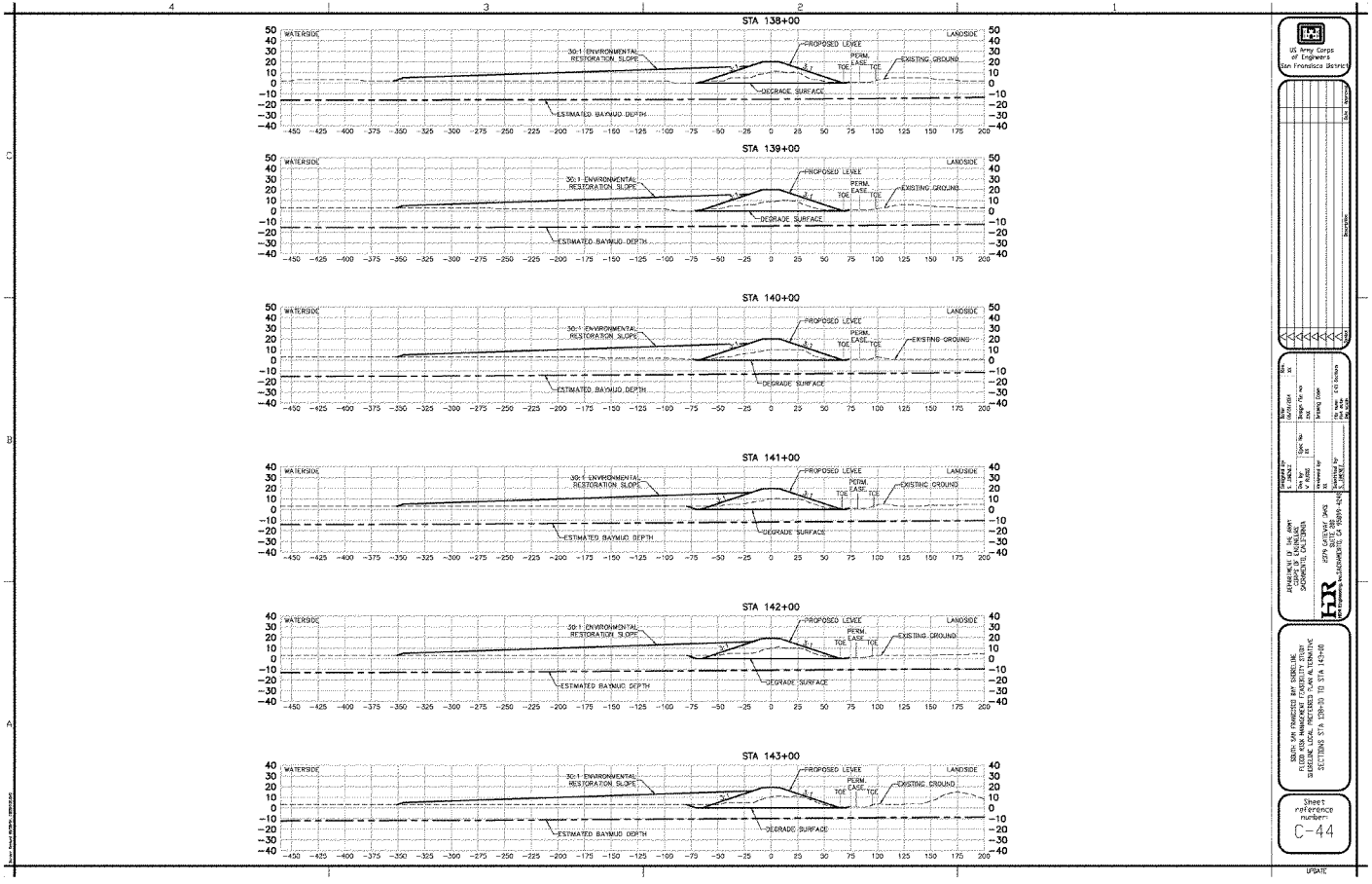
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STA 143+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
ESTIMATED BAYMUD DEPTH
US Army Corps of Engineers San Francisco District
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE SECTIONS STA 138+00 TO STA 143+00
Sheet reference number:
C-44
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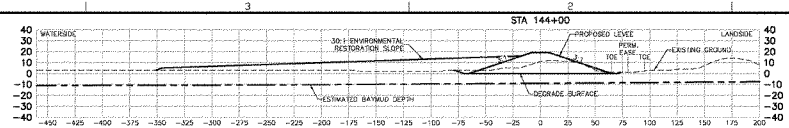
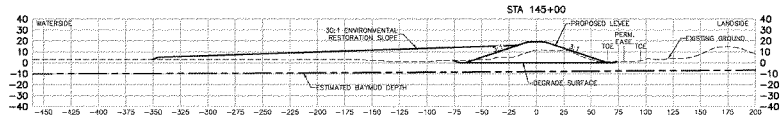
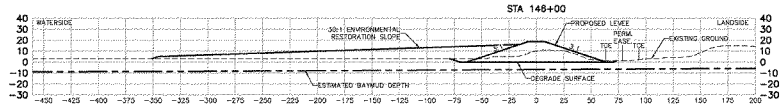
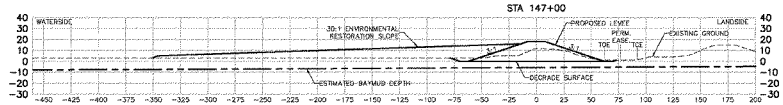
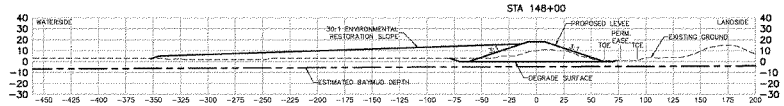
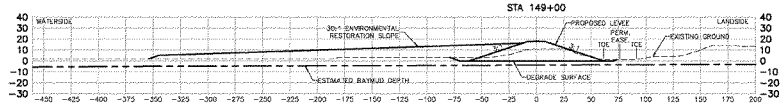












US Army Corps of Engineers
San Francisco District

Date	Revision	Description

Department of the Army
S. CHANG, P.E.
Date Begin: 01/01/01
Spec. No.: 01
Design Firm: HDR
Drawing Code:
Drawn by: DL
Checked by: DL
Approved by: DL
Date: 01/01/01
File name: 01-01-01.dwg
Sheet No.: C-45

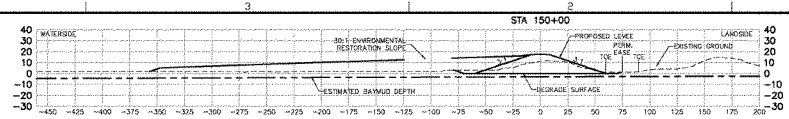
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
1325N GATEWAY OAKS
SACRAMENTO, CA 95833-4202
HDR
HDR Engineering, Inc.

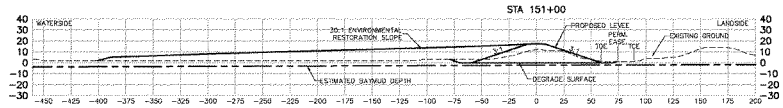
DELTA, SAN JOAQUIN & SUISUN LINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SACRELEVEE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 144+00 TO STA 149+00

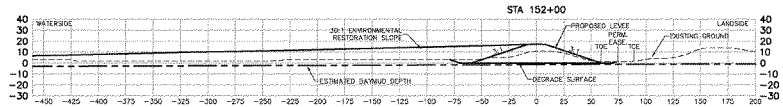
Sheet reference number:
C-45

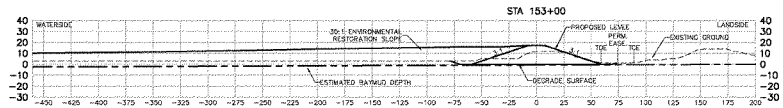
UPDATE

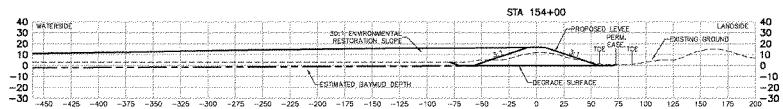
1203

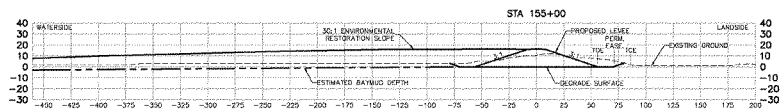












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

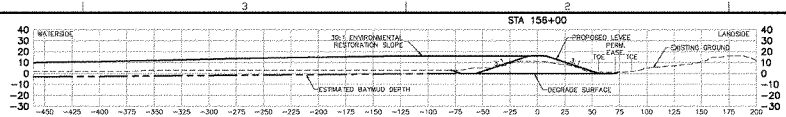
DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

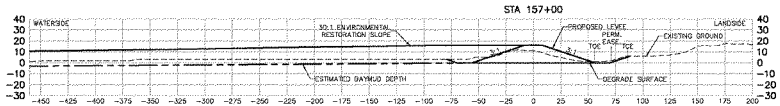
HDR Engineering, Inc.
1209 GARVEY AVE
SACRAMENTO CA 95814-4210

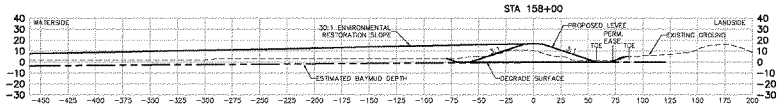
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION ALTERNATIVE
SECTIONS STA 104+00 TO STA 155+00

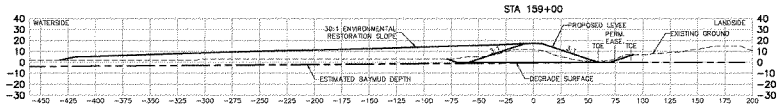
Sheet reference number:
C-46

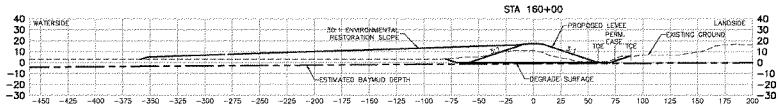
UPDATE

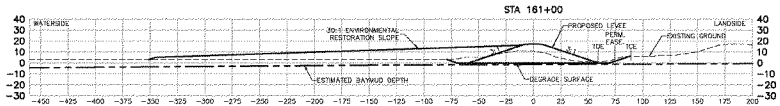












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

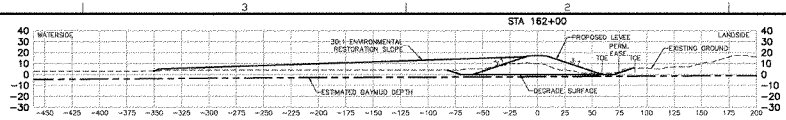
Designed by: CHANG, J. | Date: 06/09/2011 | Sheet No.: 30
Drn by: CHANG, J. | Chk by: | Sheet No.: 31
Reviewed by: | Drawing Code: Design file no
Approved by: | Drawing No.: | Title block: E1-C Sections
File name: | Plot scale: | Plot date:

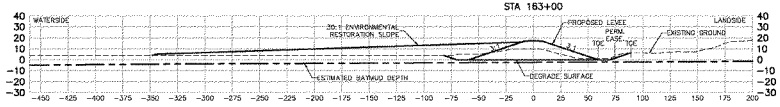
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR Inc. Engineers-Architects-Planners
8270 GOLDFINCH DRIVE
SACRAMENTO, CA 95826-4498

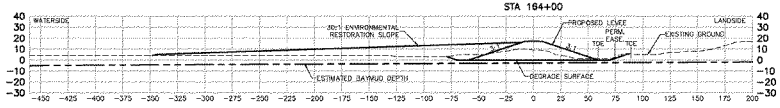
SUTTER SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN
SECTIONS STA 156+00 TO STA 161+00

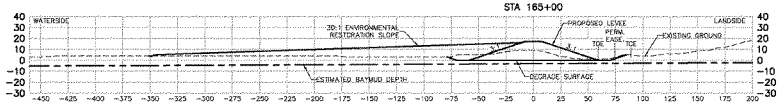
Sheet reference number:
C-47

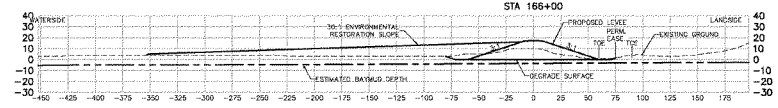
UPDATE

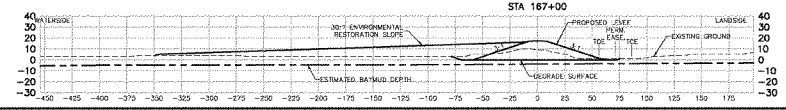












US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

Drawing Title: SECTIONS
Scale: 1" = 20'
Date: May 2011
Drawn by: JS
Designed by: JS
Sheet No: 25
Drawing Code:
Project No: 34
File name: 34-C-48.dwg
Revision No:
Checked by: JS
Approved by: JS

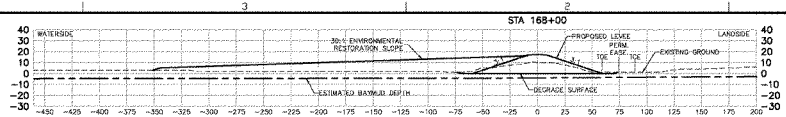
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

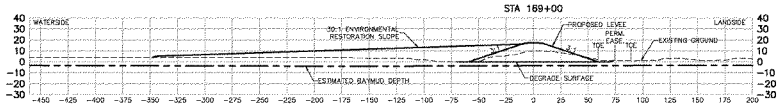
HDR
HDR Engineering, Inc.
1970 CATALYST CIRCLE
SACRAMENTO, CA 95815-4616

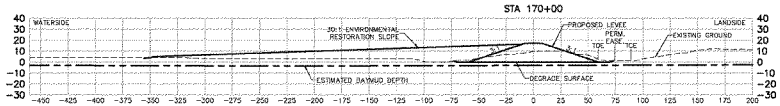
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION ALTERNATIVE
SECTIONS STA 162+00 TO STA 167+00

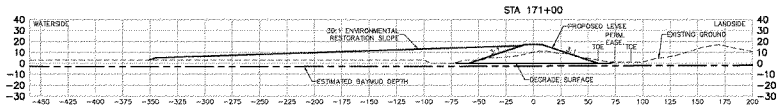
Sheet reference number:
C-48

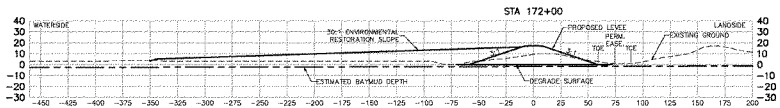
UPDATE

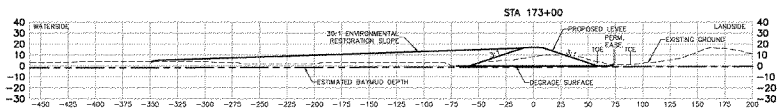












US Army Corps of Engineers
San Francisco District

Sym	Date	Revision	Description

Drawing No. 1 of 1 Sheets
Scale: AS NOTED
Date: Apr 2011
Spec. No: 11
Design No: 90
Drawing Code:
Drawn by: KS
Reviewed by:
Approved by:
Date: 01-Dec-2010
File name: C-49.dwg
Rev. Date: 01-Dec-2010

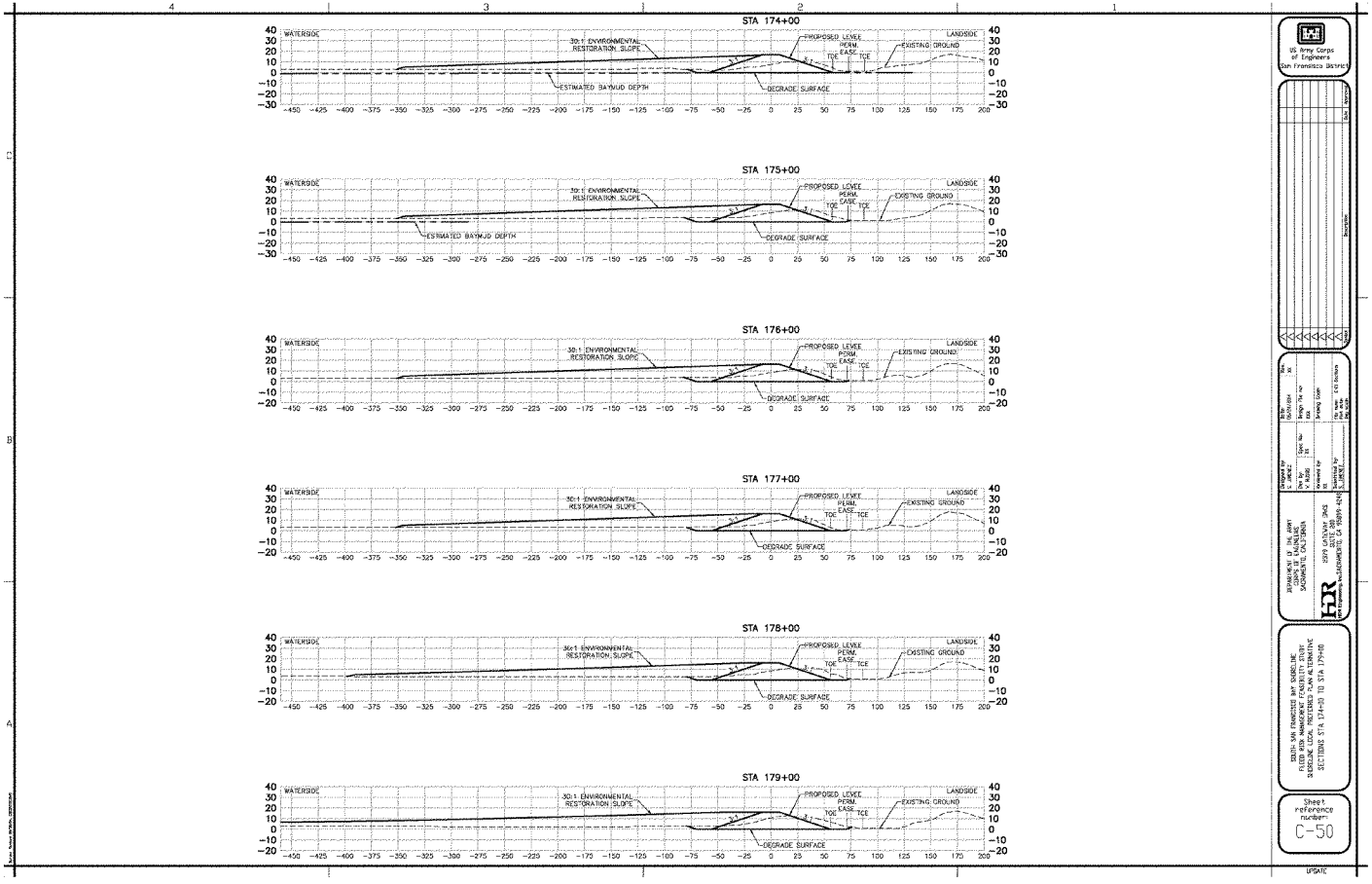
DEPARTMENT OF THE ARMY
SACRAMENTO, CALIFORNIA
1325 J STREET
SACRAMENTO, CA 95814-2922

HDR
HDR Engineering, Inc.
2365 IRON POINT ROAD, SUITE 300
SACRAMENTO, CA 95815-6943

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 168+00 TO STA 173+00

Sheet reference number:
C-49

UPDATE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STA 175+00
STA 176+00
STA 177+00
STA 178+00
STA 179+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
ESTIMATED BAYMUD DEPTH
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTIONS STA 174+00 TO STA 179+00
Sheet reference number:
C-50
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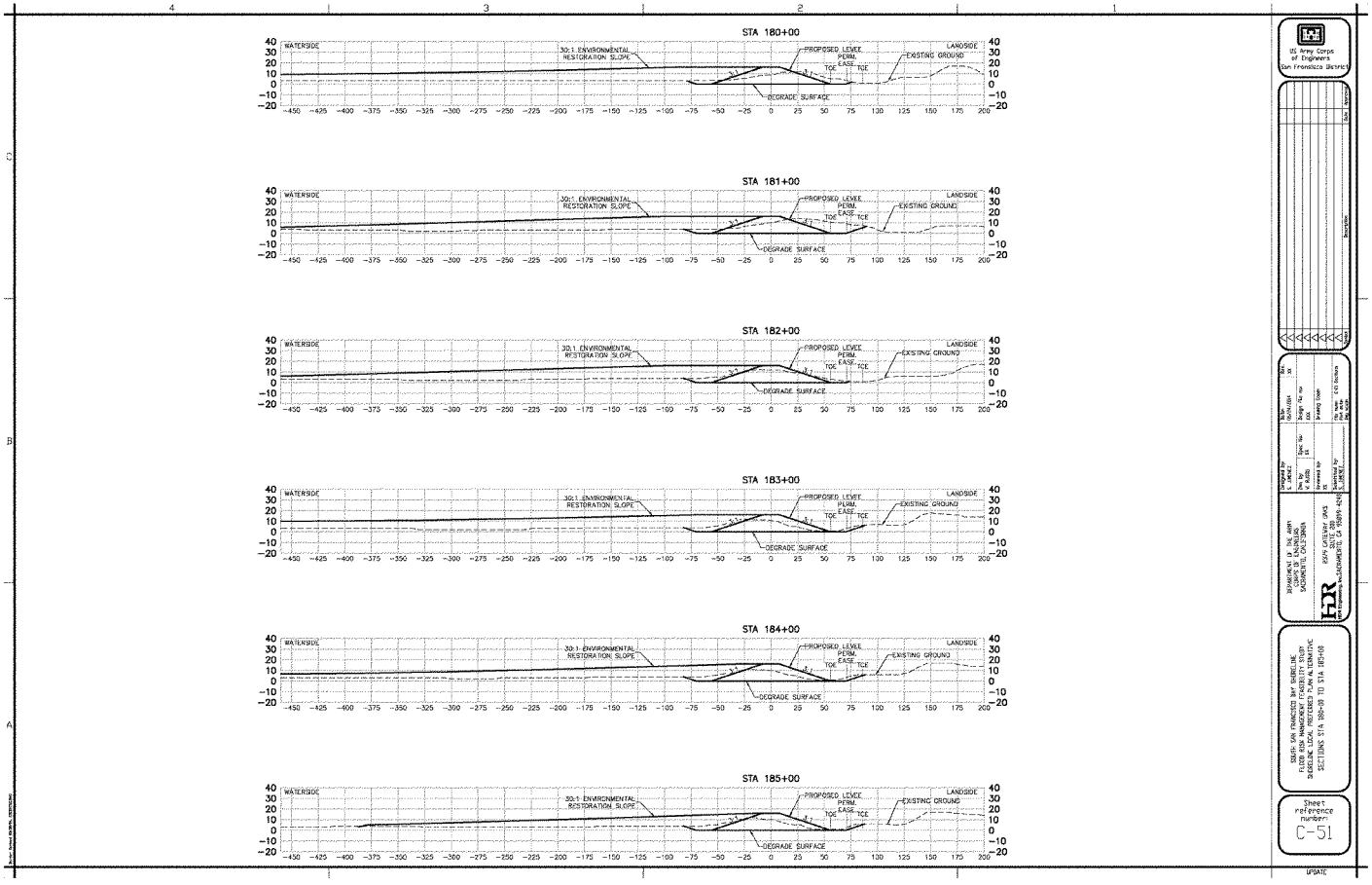
STA 180+00
STA 181+00
STA 182+00
STA 183+00
STA 184+00
STA 185+00
WATERSIDE
LANDSIDE
30:1 ENVIRONMENTAL RESTORATION SLOPE
PROPOSED LEVEE
PERM. EASE
TOE
EXISTING GROUND
DEGRADE SURFACE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HR
SECTIONS STA 180+00 TO STA 185+00
Sheet reference number:
C-51
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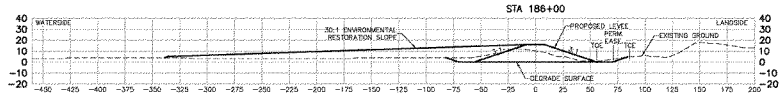
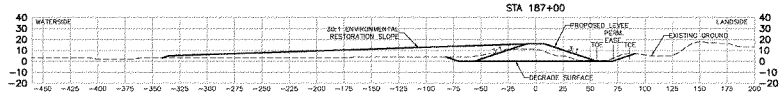
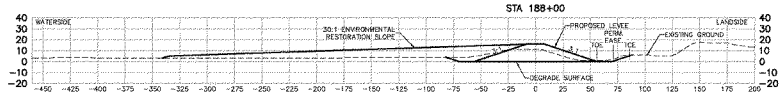
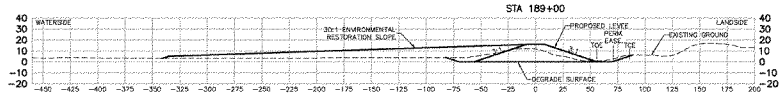
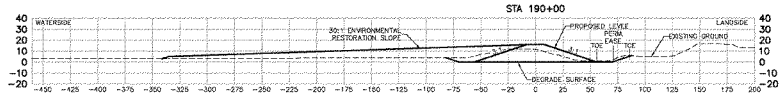
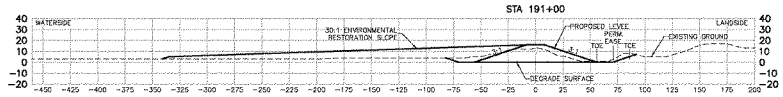












US Army Corps of Engineers San Francisco District

Symbol	Description	Date	Approved

Designed by: S. JAMIEZ
Drawn by: V. ALDAZ
Checked by: S. JAMIEZ
Submitted by: S. JAMIEZ

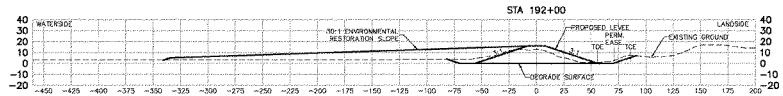
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

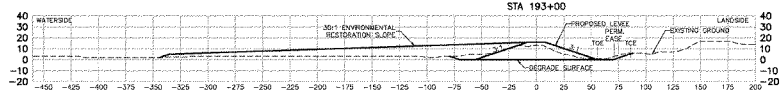
HDR ENGINEERING, INC.
1029 GATEWAY WAY, SUITE 200
SACRAMENTO, CA 95834-1003

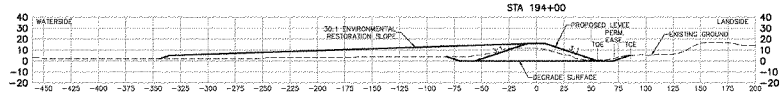
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD STUDY, HAYWARD, CALIFORNIA
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 186+00 TO STA 191+00

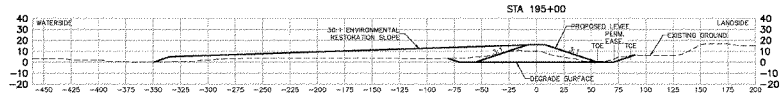
Sheet reference number:
C-52

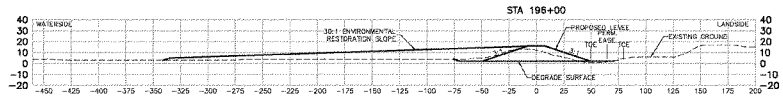
UPDATE

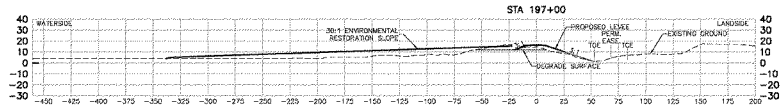












US Army Corps of Engineers
San Francisco District

Sec	Revision	Date	Description

Designed by: D. CHANG JR
Date: 10/29/2012
Drawn by: BJOHN JULY
Date: 10/29/2012
Checked by: TL
Sec. No: 14
Reviewed by: TL
Scale: 1" = 20'
Drawing Code: Design for new
Drawing Code: Existing Conditions
Approved by: TL
File name: C-53.dwg
Date: 10/29/2012

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CA 95814-2922
HDR Engineering, Inc.

DELTA, SAN JOAQUIN RIVER CORRIDOR
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SACRAMENTO LOCAL PROTECTED PLAN ALTERNATIVE
SECTIONS STA 192+00 TO STA 197+00

Sheet reference number:
C-53

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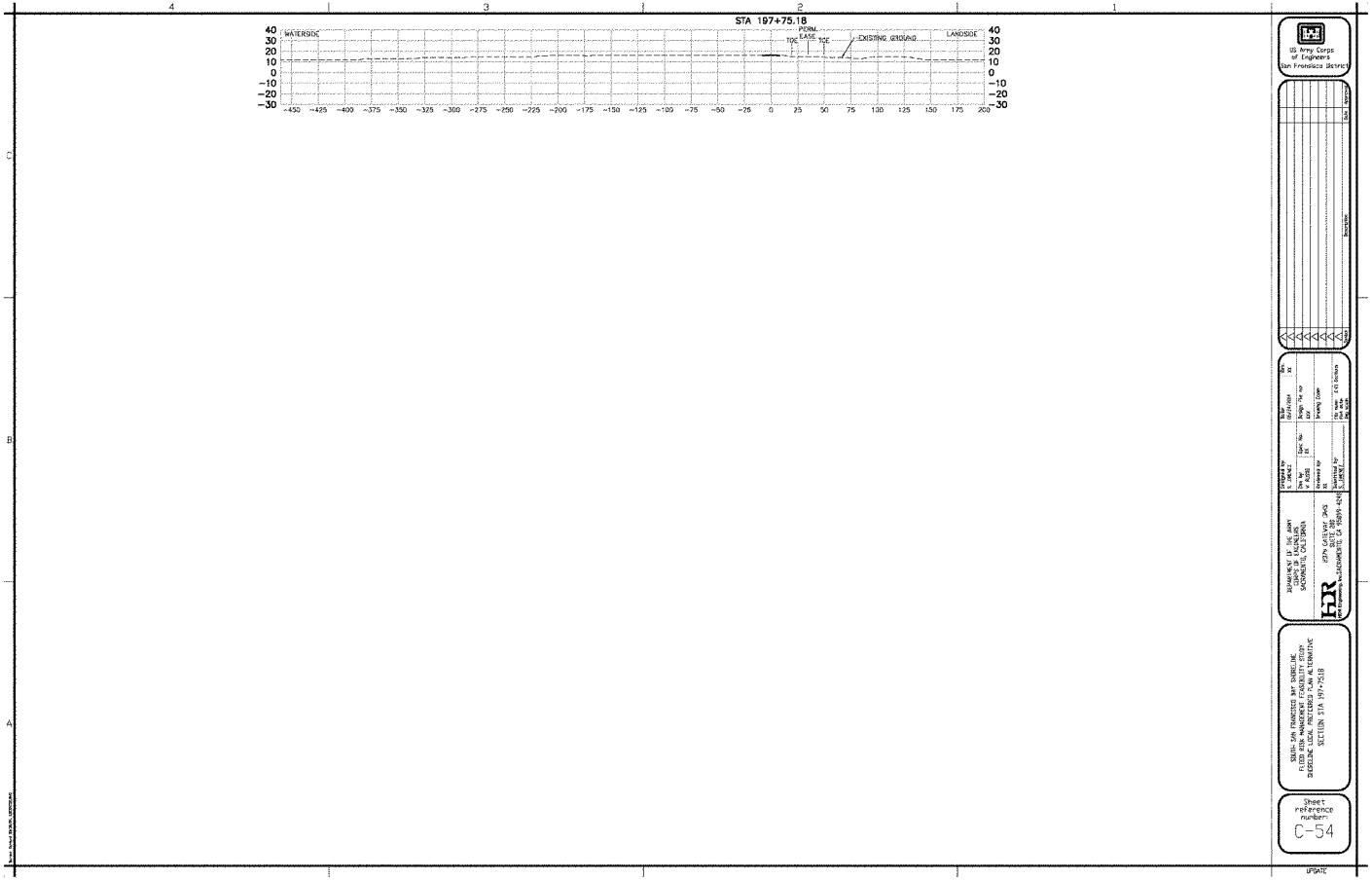
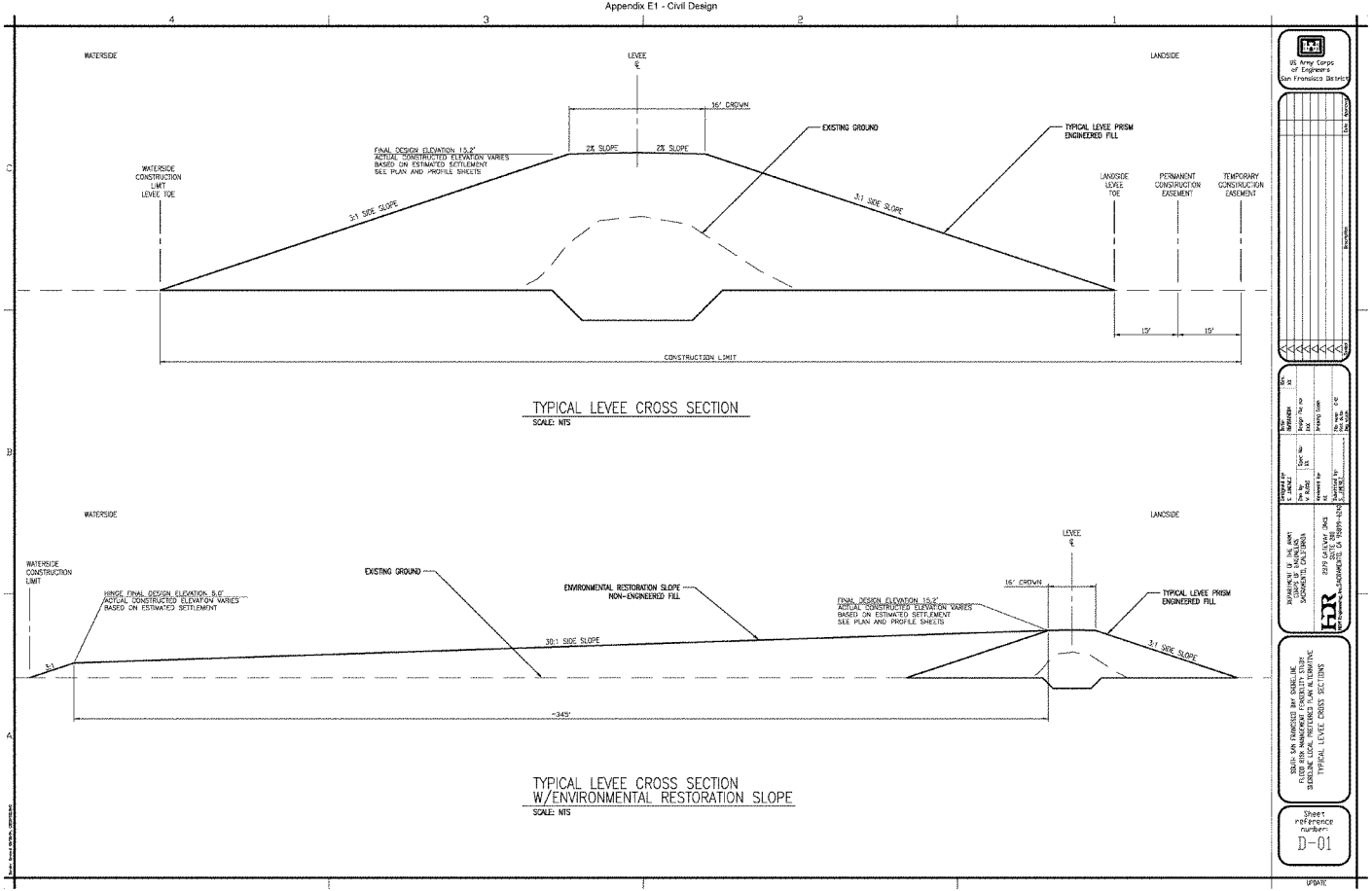

STA 197+75.18
WATERSIDE
PERM. EASE
TOE
TOE
EXISTING GROUND
LANDSIDE
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
HDR
2379 GATEWAY OAKS
SUITE 200
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTION PLAN ALTERNATIVE
SECTION STA 197+75.18
Sheet reference number:
C-54
UPDATE

M4
A21
A20
A19
BERM BREACH (TYP)
COYOTE CREEK
A9
DITCH BLOCK (TYP)
A14
A15
A17
A10
LEVEE BREACH (TYP)
A18
PILOT CHANNEL (TYP)
A11
A13
A16
EXISTING RAILROAD
A7
A6
A12
NEW CHICAGO MARSH
SANTA CLARA SJ/SC WPCP
ALVISO
A8
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE IN POND RESTORATION PLAN
Sheet reference number:
C-55
UPDATE


WATERSIDE
LEVEE ℄
LANDSIDE
16' CROWN
EXISTING GROUND
TYPICAL LEVEE PRISM ENGINEERED FILL
FINAL DESIGN ELEVATION 15.2'
ACTUAL CONSTRUCTED ELEVATION VARIES
BASED ON ESTIMATED SETTLEMENT
SEE PLAN AND PROFILE SHEETS
2% SLOPE
2% SLOPE
WATERSIDE CONSTRUCTION LIMIT LEVEE TOE
3:1 SIDE SLOPE
3:1 SIDE SLOPE
LANDSIDE LEVEE TOE
PERMANENT CONSTRUCTION EASEMENT
TEMPORARY CONSTRUCTION EASEMENT
15'
15'
CONSTRUCTION LIMIT
TYPICAL LEVEE CROSS SECTION
SCALE: NTS
WATERSIDE
LANDSIDE
LEVEE ℄
WATERSIDE CONSTRUCTION LIMIT
HINGE FINAL DESIGN ELEVATION 5.0'
ACTUAL CONSTRUCTED ELEVATION VARIES
BASED ON ESTIMATED SETTLEMENT
EXISTING GROUND
ENVIRONMENTAL RESTORATION SLOPE NON-ENGINEERED FILL
16' CROWN
FINAL DESIGN ELEVATION 15.2'
ACTUAL CONSTRUCTED ELEVATION VARIES
BASED ON ESTIMATED SETTLEMENT
SEE PLAN AND PROFILE SHEETS
TYPICAL LEVEE PRISM ENGINEERED FILL
30:1 SIDE SLOPE
3:1 SIDE SLOPE
3:1
~345'
TYPICAL LEVEE CROSS SECTION
W/ENVIRONMENTAL RESTORATION SLOPE
SCALE: NTS
US Army Corps of Engineers
San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95899-0245
SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
TYPICAL LEVEE CROSS SECTIONS
Sheet reference number:
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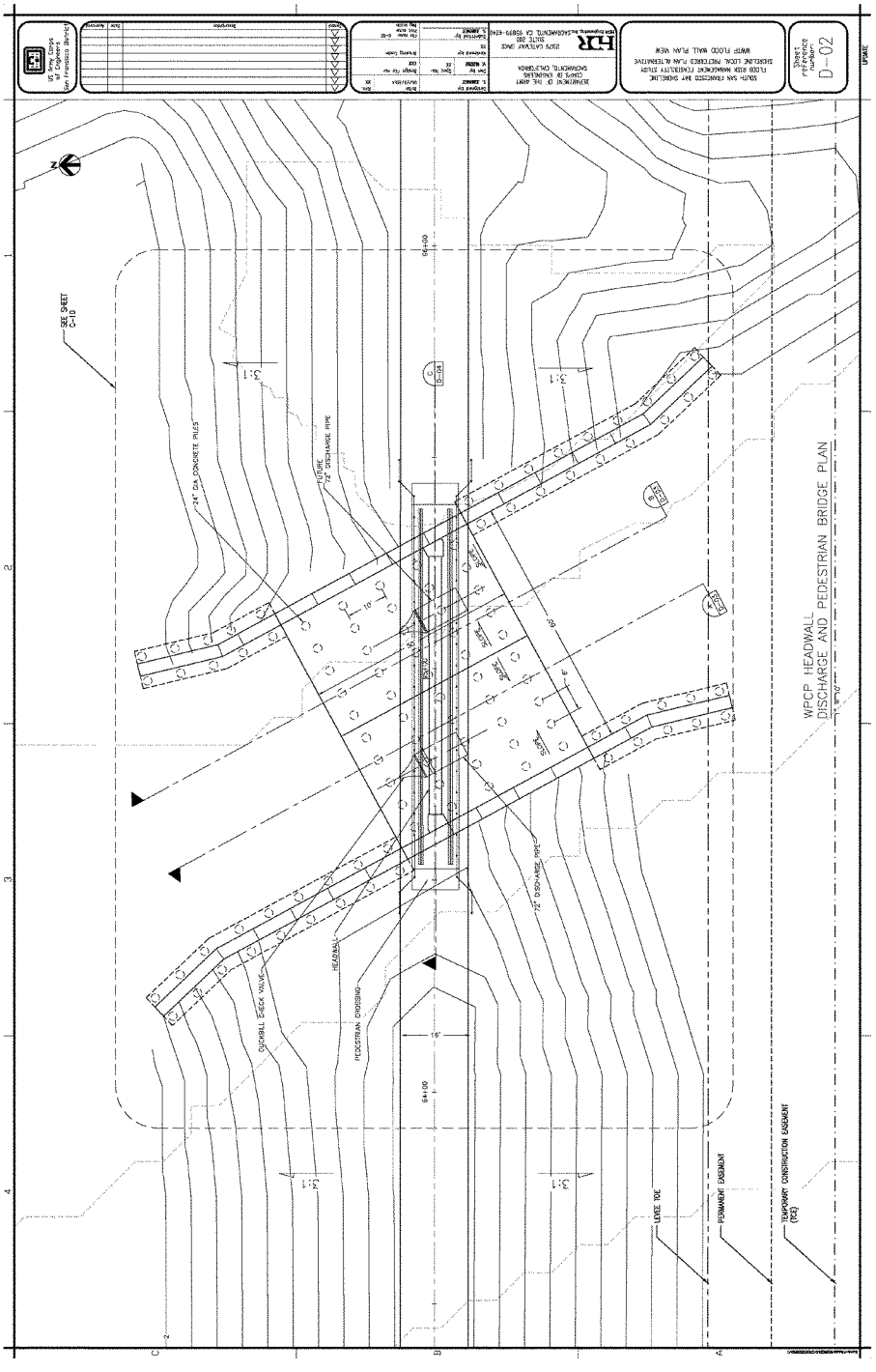
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FLOOD RISK MANAGEMENT FEASIBILITY STUDY
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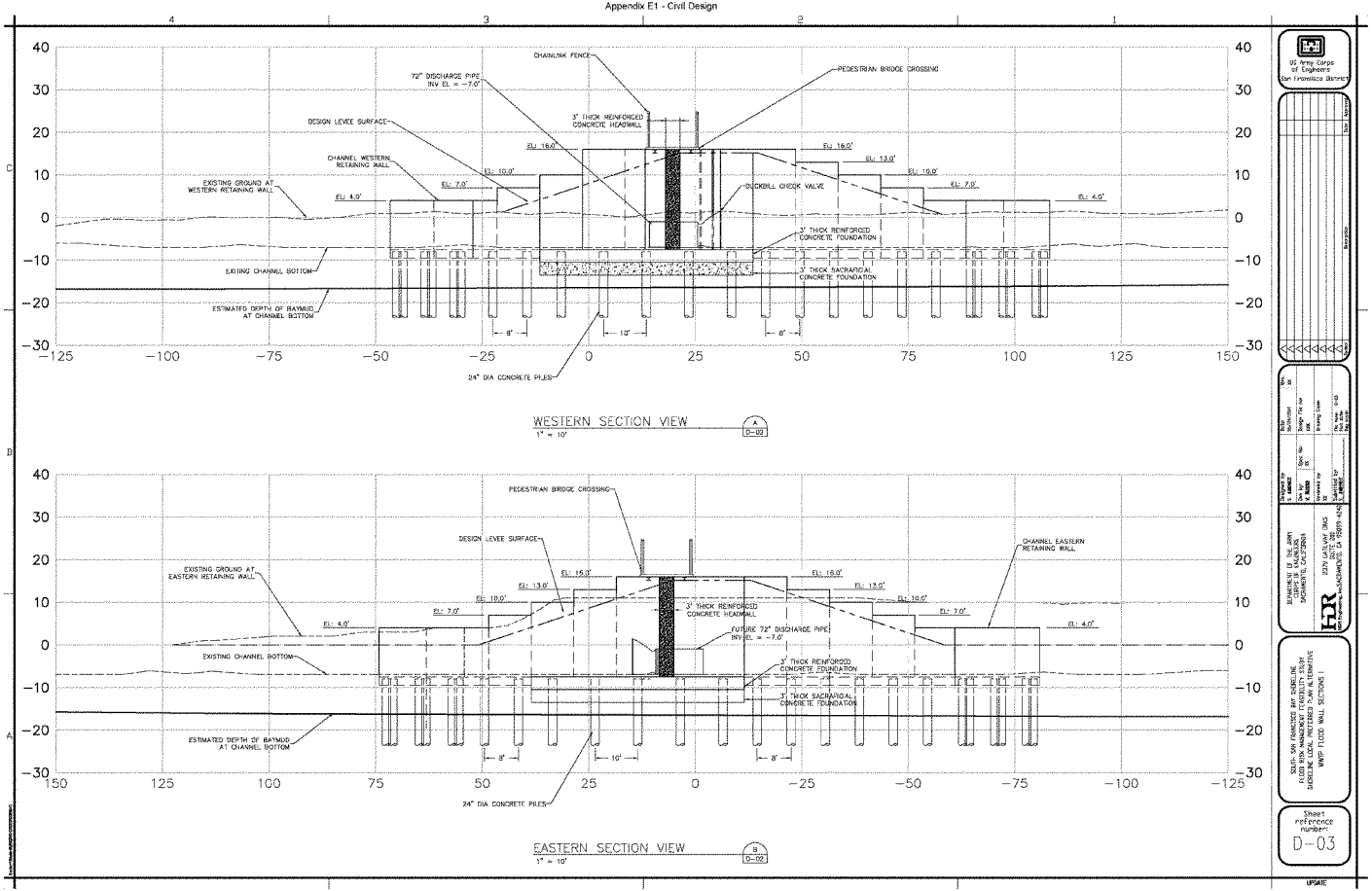
WWTP FLOOD WALL PLAN VIEW
Sheet reference number
D-02
UPDATE
SEE SHEET C-10
24" DIA CONCRETE PILES
FUTURE 72" DISCHARGE PIPE
72" DISCHARGE PIPE
QUICKBILL CHECK VALVE
HEADWALL
PEDESTRIAN CROSSING
SLOPE
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
WPCP HEADWALL
DISCHARGE AND PEDESTRIAN BRIDGE PLAN
E1-225


CHAINLINK FENCE
72" DISCHARGE PIPE INV EL = -7.0'
PEDESTRIAN BRIDGE CROSSING
DESIGN LEVEE SURFACE
3' THICK REINFORCED CONCRETE HEADWALL
CHANNEL WESTERN RETAINING WALL
EXISTING GROUND AT WESTERN RETAINING WALL
DUCKBILL CHECK VALVE
3' THICK REINFORCED CONCRETE FOUNDATION
EXITING CHANNEL BOTTOM
3' THICK SACRAFICIAL CONCRETE FOUNDATION
ESTIMATED DEPTH OF BAYMUD AT CHANNEL BOTTOM
24" DIA CONCRETE PILES
WESTERN SECTION VIEW
1" = 10'
PEDESTRIAN BRIDGE CROSSING
DESIGN LEVEE SURFACE
CHANNEL EASTERN RETAINING WALL
EXISTING GROUND AT EASTERN RETAINING WALL
3' THICK REINFORCED CONCRETE HEADWALL
FUTURE 72" DISCHARGE PIPE INV EL = -7.0'
EXISTING CHANNEL BOTTOM
3' THICK REINFORCED CONCRETE FOUNDATION
3' THICK SACRAFICIAL CONCRETE FOUNDATION
ESTIMATED DEPTH OF BAYMUD AT CHANNEL BOTTOM
24" DIA CONCRETE PILES
EASTERN SECTION VIEW
1" = 10'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
2020 GATEWAY DRIVE SUITE 200 SACRAMENTO, CA 95899-4245
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE WWTP FLOOD WALL SECTIONS I
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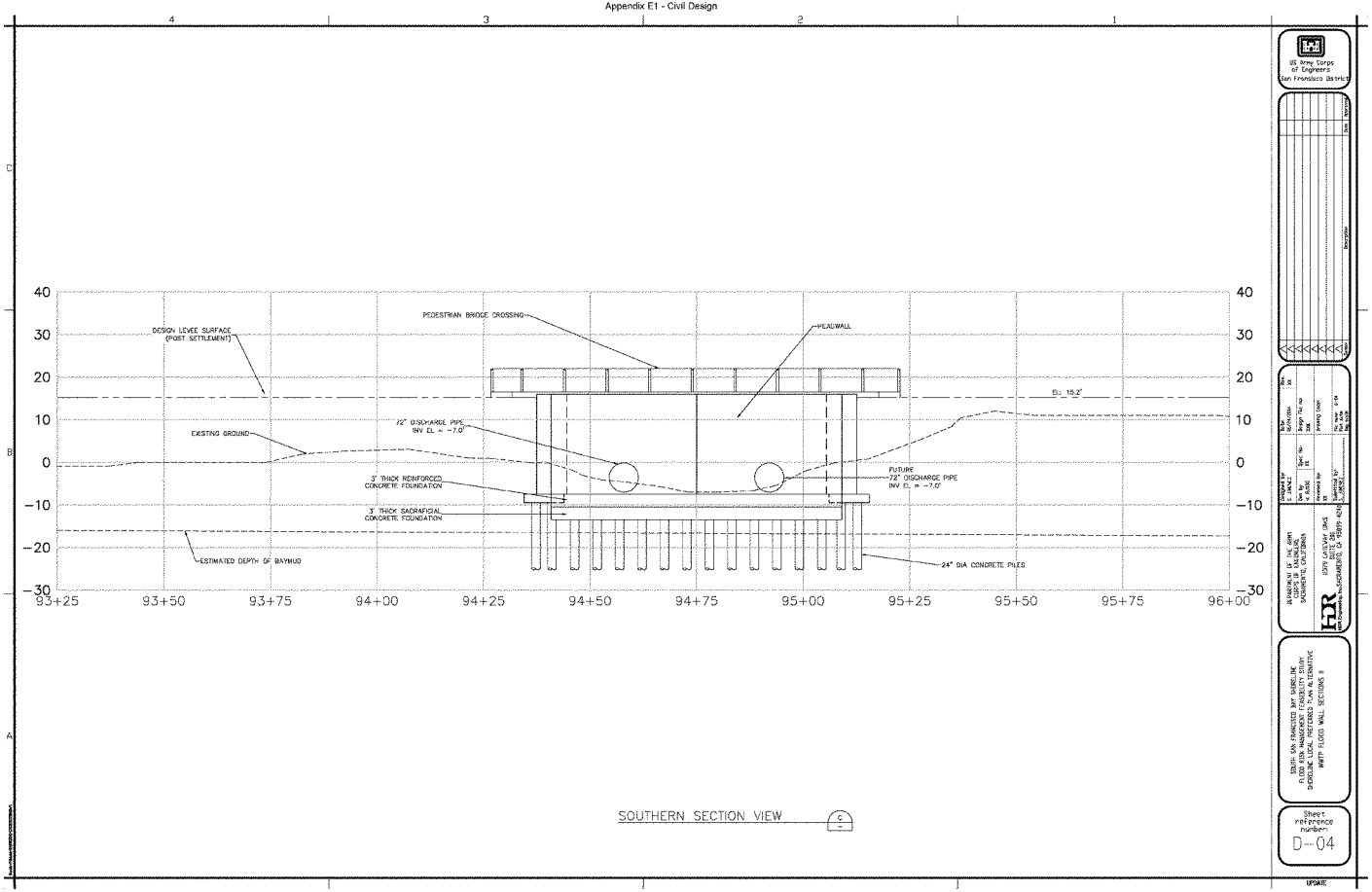

PEDESTRIAN BRIDGE CROSSING
HEADWALL
DESIGN LEVEE SURFACE (POST SETTLEMENT)
EL: 15.2'
72" DISCHARGE PIPE INV EL = -7.0'
EXISTING GROUND
3' THICK REINFORCED CONCRETE FOUNDATION
FUTURE 72" DISCHARGE PIPE INV EL = -7.0'
3' THICK SACRAFICIAL CONCRETE FOUNDATION
ESTIMATED DEPTH OF BAYMUD
24" DIA CONCRETE PILES
40
30
20
10
0
-10
-20
-30
93+25
93+50
93+75
94+00
94+25
94+50
94+75
95+00
95+25
95+50
95+75
96+00
SOUTHERN SECTION VIEW
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
HDR
SOUTH SAN FRANCISCO BAY SHORELINE FLOOD RISK MANAGEMENT FEASIBILITY STUDY SHORELINE LOCAL PREFERRED PLAN ALTERNATIVE WWTP FLOOD WALL SECTIONS II
Sheet reference number:
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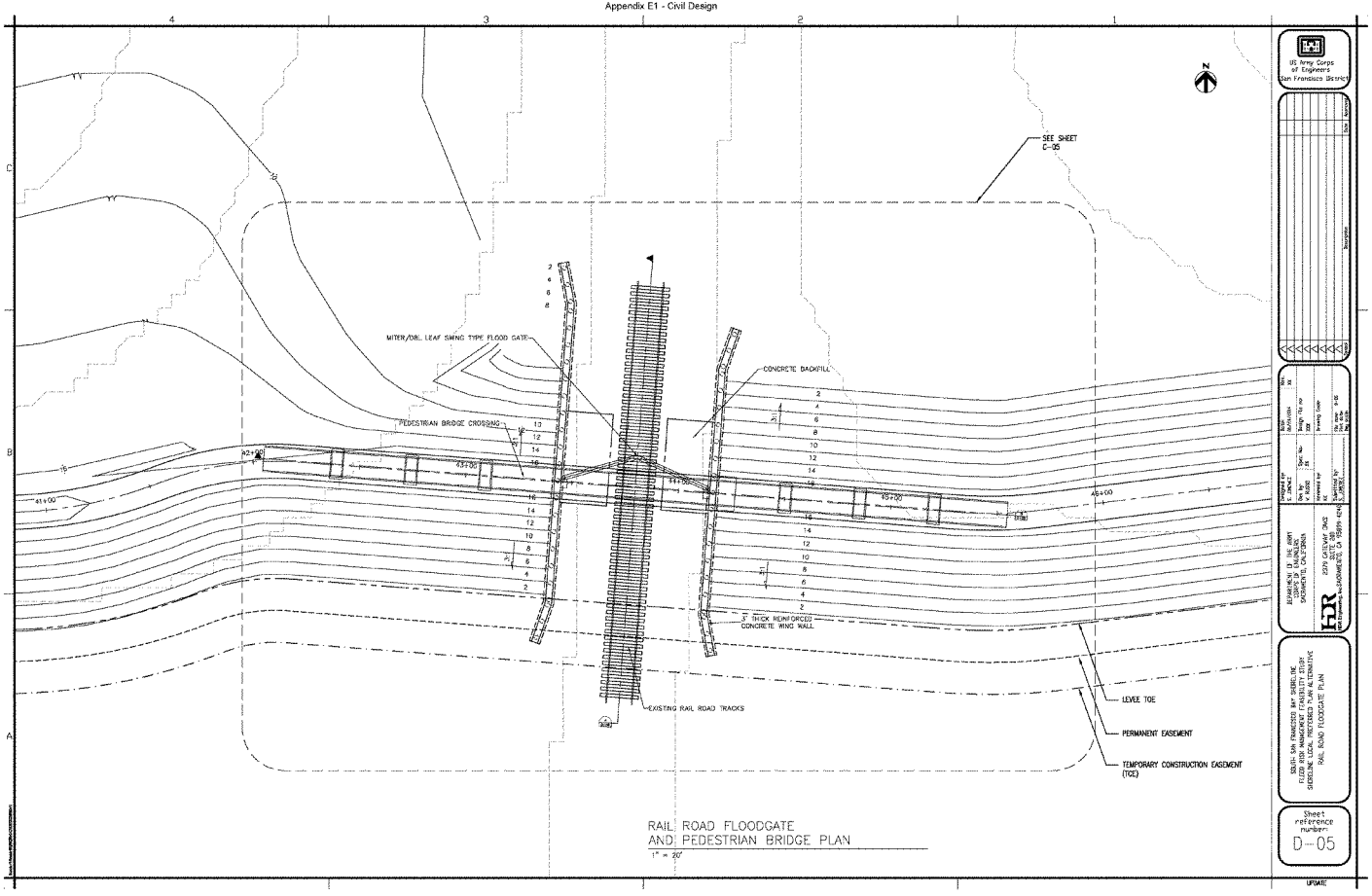
SEE SHEET C-05
MITER/DBL LEAF SWING TYPE FLOOD GATE
CONCRETE BACKFILL
PEDESTRIAN BRIDGE CROSSING
3' THICK REINFORCED CONCRETE WING WALL
EXISTING RAIL ROAD TRACKS
LEVEE TOE
PERMANENT EASEMENT
TEMPORARY CONSTRUCTION EASEMENT (TCE)
RAIL ROAD FLOODGATE
AND PEDESTRIAN BRIDGE PLAN
1" = 20'
US Army Corps of Engineers San Francisco District
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 200
SACRAMENTO, CA 95833-4254
SOUTH SAN FRANCISCO BAY SHORELINE
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SHORELINE LOCAL PROTECTED PLAN ALTERNATIVE
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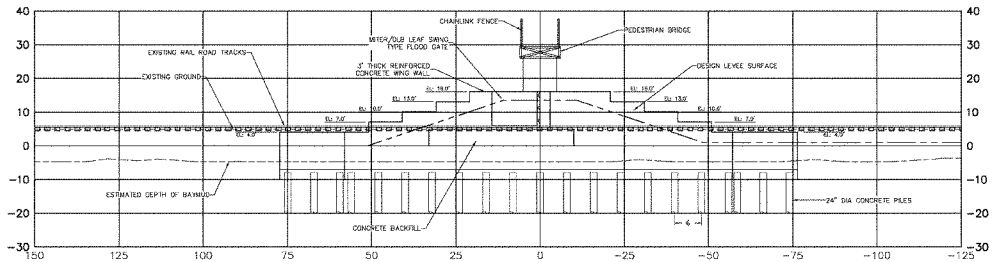

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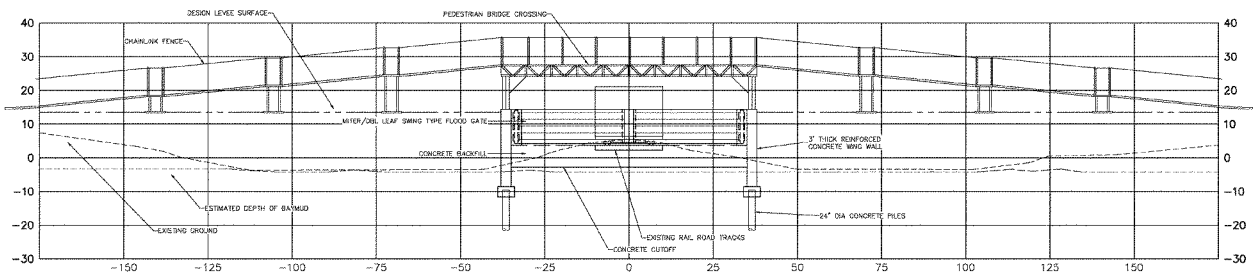


SECTION VIEW B
NTS

US Army Corps of Engineers
San Francisco District

Date	Revision
	Description

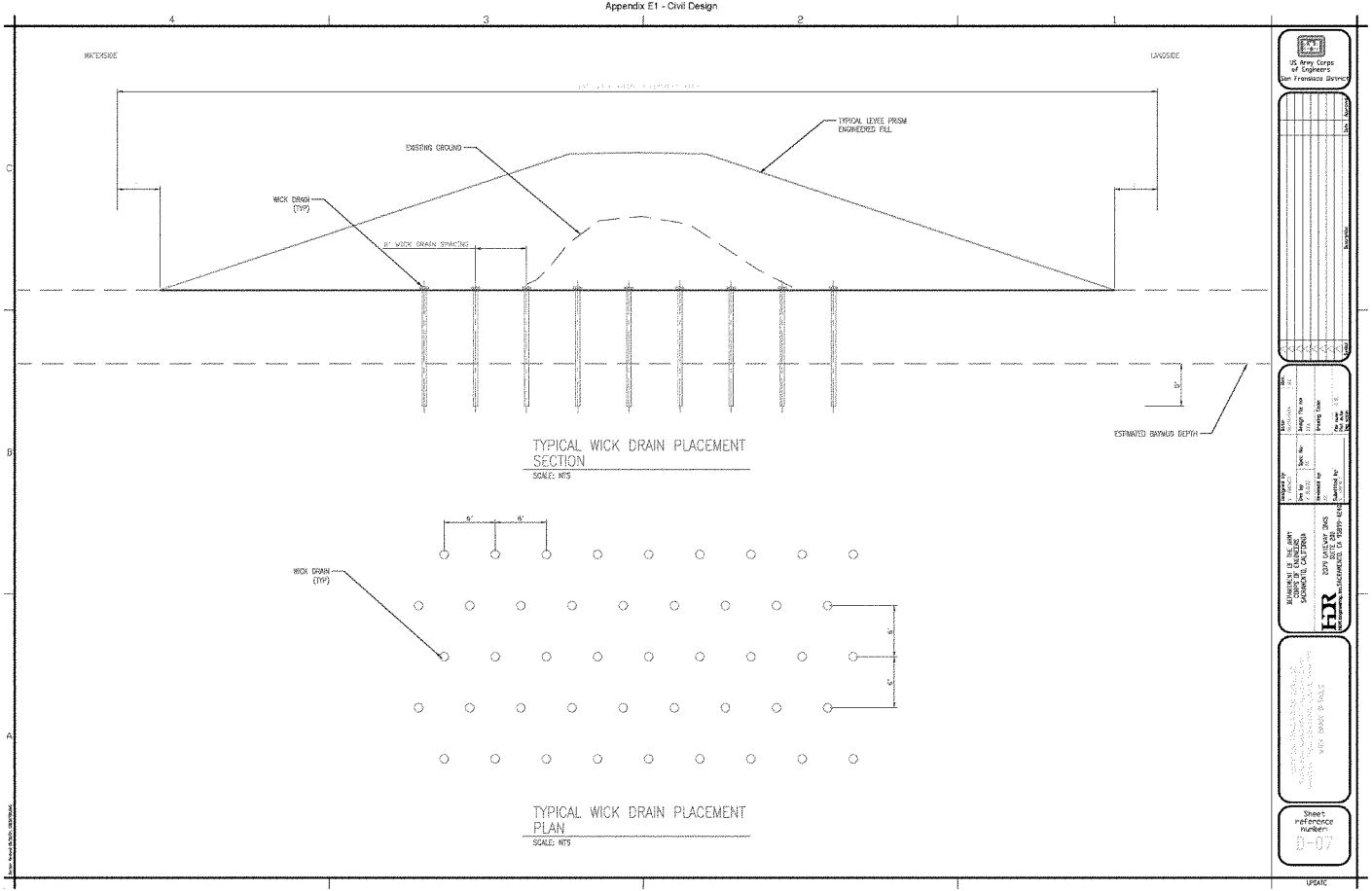
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
2379 GATEWAY OAKS
SUITE 150
SACRAMENTO, CA 95833-4245

Designed by: Chandra Z
Date: 06/09/2011
Drawn by: LE
Checked by: RC
Spec. No.: 01
Date: 06/09/2011
Scale: AS NOTED
Plot Date: 6/9/2011
File Name: D-06
Sheet No.: 06

SOUTH SAN FRANCISCO BAY SHORELINE
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
SHORELINE LEVEE PROTECTED PLAN ALTERNATIVE
WWTP FLOOD WALL SECTIONS I

Sheet reference number
D-06

UPDATE


WATERSIDE
LANDSIDE
TYPICAL LEVEE PRISM ENGINEERED FILL
EXISTING GROUND
WICK DRAIN (TYP)
8' WICK DRAIN SPACING
ESTIMATED BAYMUD DEPTH
TYPICAL WICK DRAIN PLACEMENT SECTION
SCALE: NTS
WICK DRAIN (TYP)
TYPICAL WICK DRAIN PLACEMENT PLAN
SCALE: NTS
US Army Corps of Engineers
San Francisco District
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Sheet reference number:
D-07
UPDATE

Appendix E2

Basis of Cost Estimate Memorandum

September 2015

(revised December 2015)

Basis of Cost Estimate

The cost estimate for the South SF Bay Shoreline Study was developed jointly by HDR and USACE San Francisco District. The cost estimate is based on USACE cost estimating standards and the combined cost estimating knowledge and judgment of both HDR and USACE as it applies to civil works projects. This memo describes the key assumptions applied during the production of the cost estimate.

General Assumptions and Qualifications

1. This estimate specifically excludes the following:
    a. Permit and Plan check fees
    b. Testing and Inspection
    c. Owner's administration and other soft costs, except for real estate estimate where administration fees were developed by the USACE real estate team
    d. Cost escalation beyond the assumed construction schedule

2. The work will be constructed in multiple phases.

3. All work will be done during regular working hours (8-hours/day) with no overtime considered.

4. FRM options will be constructed over a period of 3 years (on average) and ER options constructed in 3 phases with duration of 1-year per phase.

5. The estimate is based on FY15 price levels.

6. Levee fill is assumed to be available at borrow sites within 30 miles of the construction site. Three sites that fit this criterion and are likely to supply the project are identified in the Civil Design Appendix. Cost are included the excavation at the borrow site and delivery to the project site.

7. Bench material is generated by the demolition of the existing inboard dike. Minimal to no hauling of bench material is anticipated since dike demolition and bench construction can be performed in one action. Ecotone material is assumed to be delivered and stockpiled on site at no cost to the project sponsor or USACE. Excess material suitable for refuge purposes is often produced by other nearby projects. These other projects will pay fees for placing material at the project site as part of their offhaul costs. Material will still require transport from the stockpile area to the location of ecotone. The cost for this work is included in the LPP Ecotone and NED Bench estimates.

8. Basis for Pricing:
    a. In pricing the estimate, the following sources served as references for cost data:
        i. Historical cost date (for flood/tide gates, operations and maintenance, and material costs)
        ii. 2015 Davis Bacon Rates
        iii. 2014 MII Equipment Cost Book for Region 7

iv. Construction Economics in Engineering-New-Record (ENR) (for material costs and building market trends)
v. Santi, P.M.; Elifritis, C.D.; and Liljegren, J.A., 2003, Demonstration Projects Using Wick Drains to Stabilize Landslides; *Environmental & Engineering Geoscience*, Vol. IX, No.4, p. 339-350
vi. Alviso Slough Pedestrian Bridge Feasibility Study
vii. Discussions with special subcontractors

b. Direct unit costs include costs for material, labor and equipment, sales taxes, delivery charges, and markups for subcontractors and suppliers

9. General Contractor's fees are included to cover home office overhead of 10%, job office overhead of 12%, profit of 9%, and bond of 2%. Office overhead include sales, marketing, accounting, office rental, furniture, equipment and expenses, office support staff, etc. Job office overhead is separate from the explicit field office expenses included in the estimate which does not include staffing, specific utilities, amenities, etc. Profit is the expected compensation for Contractor's undertaking of the project.

10. Monitoring and Adaptive Management Costs were provided by the USACE.

11. Construction Management is equal to 10% of construction costs. Monitoring was the only construction cost that was assumed to have no Construction Management associated with it.

12. Preconstruction Engineering and Design is equal to 20% of construction cost and accounts for Project Management, Planning and Environmental Compliance, Engineering and Design, and Engineering Technical Review, ITR and VE.

13. Construction Supervision and Inspection overhead (SIOH) is not included in the MCACES estimate. The fully marked up total project cost which includes SIOH can be found in the Total Project Cost Summary (TPCS).

14. A cost and schedule risk analysis (CSRA) was performed on project management, contract acquisition, engineering design, environmental, construction, estimate and schedule, economic, and programmatic events. After the PDT concurred on the possible risk events for the project, each risk was then quantified using the USACE approved Crystal Ball software. Costs for each applicable element include 27% for contingency for the NED/NER and 26% contingency for the LPP.

SOUTH SAN FRANCISCO BAY SHORELINE STUDY

Monitoring and Adaptive Management Plan for Ecosystem Restoration

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GLOSSARY

Adaptive management action. Actions undertaken to improve performance if restoration targets are not met. Actions may consist of assessments, construction, phasing, and operations and maintenance.

Conceptual Model. A simple, qualitative model that describes general functional relationships among essential components of a system.

Consideration. A statement of conditions the alternative plans should avoid, minimize, or mitigate, as possible. Considerations are less restrictive than constraints.

Constraint. A restriction that limits the extent of the planning process. It is a statement of things the plan should avoid.

Monitoring metric. A measure for assessing change with respect to a specific restoration target. Each restoration target has at least one metric that would be measured during monitoring and is expected to provide insight into the project's progress towards that target.

Objective. Statement of project purpose.

"Staircase." Terminology adopted from the SBSP Restoration Project. The SBSP Restoration Project uses a "staircase" analogy to describe the proposed project, with each step on the staircase representing one phase of tidal restoration implementation. Adaptive management determines how far up the "staircase" the project proceeds. The "staircase" issues are those that determine whether the Shoreline Study proceeds through the later phases, or halts before all phases are completed.

Target. A performance measure that provides quantifiable restoration metrics used to assess project performance with respect to project objectives, constraints, and considerations.

Trigger. Management triggers identify the point at which the system may not be performing or progressing as expected.

Uncertainty. Disagreement or lack of knowledge about how a system functions, specifically, how a restoration action may or may not result in the desired outcome.

1. Introduction

This document provides the feasibility-level monitoring and adaptive management plan for the South San Francisco Bay Shoreline Study (Shoreline Study). The Shoreline Study is a flood risk management and ecosystem restoration effort that is recommending a project to reduce tidal flood risk and restore tidal marsh habitat along southern San Francisco Bay.

This plan identifies potential monitoring activities, outlines how results from the monitoring would be used to assess project success and, if needed, adaptively manage the project to achieve the desired ecosystem restoration objectives. The plan specifies who would be responsible for monitoring and adaptive management activities and provides estimated costs.

1.1 Authorization for Monitoring and Adaptive Management

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure that, when conducting a feasibility study for a project (or component of a project) for ecosystem restoration, the recommended project includes a plan for monitoring the success of the ecosystem restoration. The implementation guidance for Section 2039 (USACE 2009) specifies that ecosystem restoration projects include plans to track and improve restoration success through monitoring and adaptive management.

1.2 Relation to South Bay Salt Pond Restoration Project Adaptive Management and Monitoring

The non-Federal sponsors for the Shoreline Study are currently collaborating to implement the South Bay Salt Pond (SBSP) Restoration Project, which encompasses 15,100 acres in the South Bay and includes the USFWS-owned parts of the Shoreline Study area. In 2009, the SBSP Restoration Project completed program-level planning, program-level NEPA compliance, and program-level permitting for the entire 15,100 acres, including the Shoreline Study project area. The USFWS was the lead agency for NEPA; the USACE was a cooperating/responsible agency.

Adaptive management is an integral component of the SBSP Restoration Project (EDAW et al 2007). The SBSP Restoration Project identifies a range of potential implementation and habitat outcomes, with the endpoint to be determined through phased implementation guided by adaptive management. One of the fundamental project trade-offs is the conversion of existing waterfowl and shorebird habitat in the former salt ponds to tidal wetland habitat for a range of native marsh-dependent species. The two defined project endpoints are a 50:50 ratio of tidal and managed pond habitats or a 90:10 ratio, depending on how successfully the restored and enhanced ponds are able to maintain existing populations of waterfowl and shorebirds. The final habitat mix may be at either endpoint, or somewhere between the two.

The SBSP Restoration Project uses a "staircase" analogy to describe the proposed project, with each step on the staircase representing one phase of tidal restoration implementation. Adaptive implementation determines how far "up the staircase" the project proceeds. Before proceeding with each subsequent phase, the SBSP Restoration Project decision makers would consider the staircase issues. If the restoration is not transpiring as expected and no other solutions (through construction, operations, maintenance, or phasing) are feasible, the decision could be made to halt the project before continuing to subsequent phases.

The SBSP Restoration Project Management Team includes members of the Shoreline Study project delivery team (PDT), who represent the specific needs of the Shoreline Study and its project area. The goals and objectives for the Shoreline Study and the SBSP Restoration Project are very similar; however the geographic footprint of the two efforts is not identical. The Shoreline Study is being conducted as a series of interim feasibility studies, the first of which focuses on Ponds A9-A15 (owned by USFWS) and Pond A18 (currently

owned by the City of San Jose and not within the SBSP Restoration Project footprint). Because the current interim feasibility study includes a subset of ponds within the SBSP Restoration Project, this report draws from the monitoring and applied studies being conducted by the larger SBSP Restoration Project.

1.3 Procedure for Drafting the Monitoring and Adaptive Management Plan

This Monitoring and Adaptive Management and Monitoring Plan (MAMP) was prepared by members of the Shoreline Study PDT and SBSP Restoration Project – including staff from the U.S. Army Corps of Engineers (USACE) San Francisco District, staff from the California State Coastal Conservancy, the SBSP Restoration Project Executive Project Manager, and the SBSP Restoration Project Lead Scientist – and staff from the consulting firms ESA PWA and HT Harvey & Associates, under contract to the California State Coastal Conservancy.

The Shoreline Study MAMP is consistent with the plan developed for the SBSP Restoration Project (2007), but reflects Shoreline Study-specific goals, objectives, and geography. The Shoreline Study MAMP was developed to be consistent with the framework for adaptive management in the previously mentioned USACE implementation guidance (USACE 2009).

1.4 Rationale for Adaptive Management

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes given project uncertainties. All ecosystem restoration projects face uncertainty due to incomplete understanding of relevant ecosystem structure and function, resulting in imprecise relationships between project actions and corresponding outcomes. Flood protection projects, too, face engineering uncertainties. Given these uncertainties, adaptive management provides an organized and coherent process that suggests management actions in relation to measured project performance compared to desired project outcomes. Adaptive management establishes the critical feedback among project monitoring, and informed project management, and learning through reduced uncertainty.

In the case of the Shoreline Study, cost-shared monitoring and adaptive management will focus on the constructed ecosystem restoration elements of the project to ensure their success. However, the Shoreline Study also fits within the larger context of the SBSP Restoration Project, which examines larger-scale (regional) effects that set the context for site-specific analysis of implemented restoration projects. These include:

- Determining species presence and landscape/ecosystem evolution in response to restoration activities,
- Signaling that the phased restoration can proceed or determine that additional actions are necessary before moving forward, and
- Determining if and when tidal marsh restoration should halt due to undesired consequences on the natural system.

The future project recommended by the Shoreline Study would implement tidal restoration of existing managed ponds in phases. While the expectation is that all phases will be constructed, there are landscape-scale uncertainties that could cause implementation of future restoration features to halt because of undesired changes to ecosystems and populations outside of the project area. In addition, the presence of mercury in the sediments and risk of increasing bioaccumulation of mercury in the food web within the study area is a key project constraint that may delay or halt the restoration of certain ponds. The significance of this risk will be unknown until project implementation is begun. Monitoring for the "phased implementation" and mercury-related aspects of the project are not included as part of the cost-shared Shoreline Study monitoring and adaptive management program, but rather will be conducted by the SBSP Restoration Project.

For flood risk management and public access components of the project, cost-shared monitoring and adaptive management activities are not recommended. Minor adjustments to these features will be covered as routine operation and maintenance performed by the non-Federal sponsors. Major adjustments to such features to adjust to changed conditions after project implementation would require a post-authorization-change process.

Adaptive Management Team

Under the SBSP Restoration Project's organizational structure, the Adaptive Management Team (AMT) is the group responsible for making decisions about adaptive management. The AMT consists of a subset of the SBSP Restoration's Project Management Team (PMT) members. Figure 1 (SBSP Restoration Project Organizational Structure and Functions) shows the participants in the adaptive management process for the SBSP Restoration Project, who would also make adaptive management decisions for the future project recommended by the Shoreline Study.

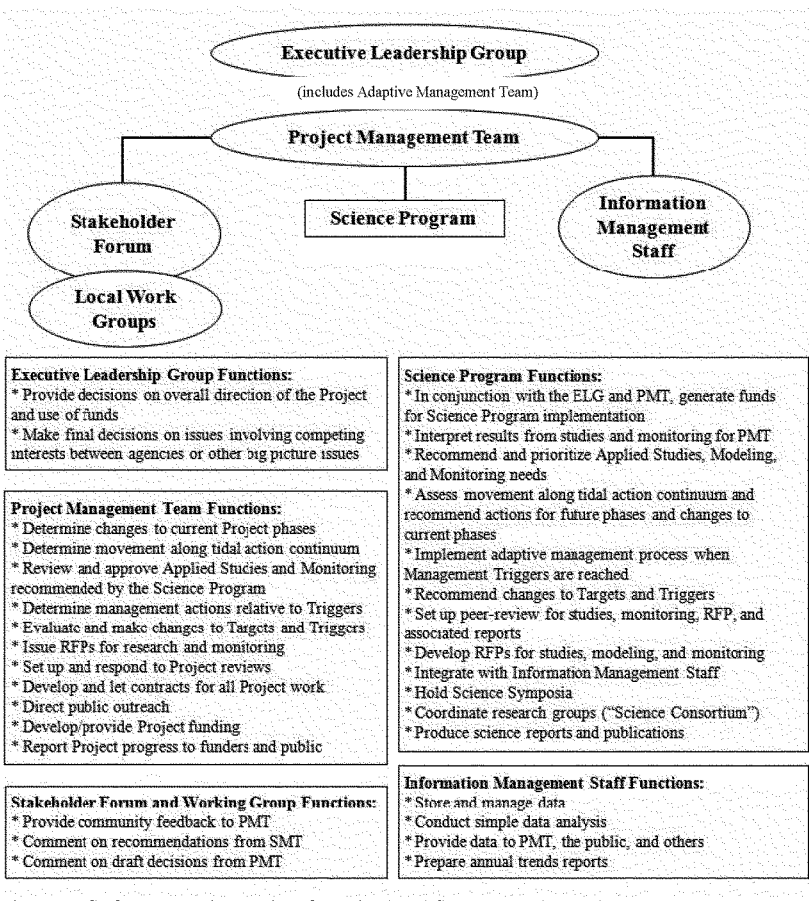

Figure 1. SBSP Restoration Project Organizational Structure and Functions

The AMT considers input from the Science Team (through the Lead Scientist), Stakeholder Forum, and Local Work Groups, as necessary, when making decisions. The Executive Leadership Group provides decisions on overall direction of the future project and on issues involving competing interests between agencies. Information Management Staff provide data management services for the AMT.

Participants in each group are listed below for the SBSP Restoration Project. The SBSP Restoration Project AMMP (2007) provides a detailed description of each group. For the Shoreline Study specifically, the landowners are USFWS and the San Jose/Santa Clara Water Pollution Control Plant, the local flood control district is the Santa Clara Valley Water District, and the Stakeholder Forum and Local Work Groups include only participants relevant to the Shoreline Study project area.

Executive Leadership Group = heads of the Project Management Team agencies, consisting of the California State Coastal Conservancy (SCC), the landowning and management agencies, local flood control districts, the Army Corps of Engineers, and Project funders.
AMT = U.S. Fish & Wildlife Service, California Department of Fish & Wildlife, SCC, local flood control districts, USACE, Lead Scientist, some regulatory staff, and other involved organizations.
Science Program = science directors and contractors, with a Lead Scientist responsible for coordination with the PMT.
Information Management = San Francisco Estuary Institute (or equivalent entity) as a contractor to the SCC.
Stakeholder Forum = core stakeholders with demonstrated, ongoing interest in South San Francisco Bay ecosystem restoration (local business and land owners, environmental orgs, public access/recreation, infrastructure, advocates and institutions, flood management, public works/health), local government staff and elected officials.
Local Work Groups = associated with each pond complex

Overview of Adaptive Management

Adaptive management is an iterative process that uses regular monitoring and assessments to determine whether follow-up actions are necessary to keep the project on track towards its objectives. For the purposes of this plan, monitoring and adaptive management are presented in four steps. These steps are shown graphically in Figure 2 (Adaptive Management Process) and discussed in the following sections.

Adaptive management planning (Section 4)
Monitoring (Section 5)
Regular assessments (Section 6)
Decision making (Section 7)

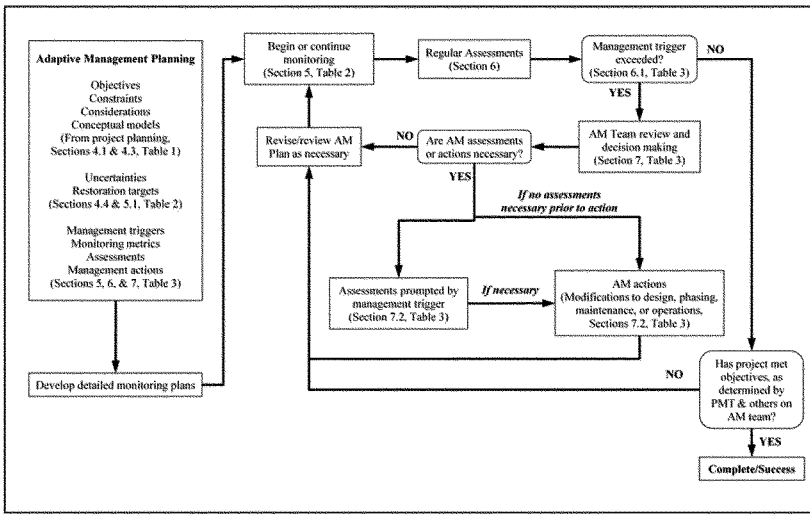

Figure 2. Adaptive Management Process

Adaptive management planning consists of identifying project objectives, constraints, and considerations; describing conceptual models; and identifying key uncertainties. Adaptive management planning sets the stage for determining what monitoring is required to assess whether the project is progressing toward the desired outcome. Regular assessments check monitoring results against restoration targets (desired outcomes) and management triggers (negative outcomes). The decision-making process determines if and when adaptive management actions should be implemented.

The adaptive management steps described in the sections below will be flexible to accommodate lessons learned from the monitoring results. For example, as new information becomes available, the Adaptive Management Team will update the conceptual models and may revise the monitoring metrics and methods to better address the remaining uncertainties. In the event that unanticipated uncertainties are identified, the adaptive management process will be adjusted as needed to support decision-making, so the Adaptive Management Team can continue to steer the project towards the desired outcome.

2. Adaptive Management Planning

This section: (1) identifies objectives, constraints, and considerations identified for the Shoreline Study, (2) outlines ecosystem restoration actions included in the recommended plan, (3) presents conceptual models that relate project actions (and potential adaptive management actions) to desired project outcomes, and (4) lists sources of uncertainty.

2.1 Project Objectives, Constraints and Considerations

During the initial problem identification phase of the feasibility study, the PDT, with stakeholder input, identified planning objectives, constraints, and considerations that would guide the development of ecosystem restoration, flood risk management, and recreation aspects of the future project (Table 1. Planning Objectives, Constraints, Considerations, and Uncertainties).

For these objectives, constraints, and considerations, the team also identified related uncertainties in future conditions, which are described in Section 4.4 below.

Table 1. Planning Objectives, Constraints, Considerations, and Uncertainties

Objectives			Uncertainties
1.	Reduce potential economic damages due to tidal flooding in areas near the South Bay shoreline in Santa Clara County.		• Flood and infrastructure performance□• Climate change
2.	Reduce the risk to public health, human safety and the environment due to flooding from tidal sources along the South Bay shoreline in Santa Clara County.		• Flood and infrastructure performance□• Climate change
3.	Increase contiguous marsh to restore ecological function and habitat quantity, quality, and connectivity (including transition zones) in the study area for native, resident plant and animal species including special-status species such as steelhead trout, Ridgway's rail, and salt marsh harvest mouse.		• Sediment dynamics□• Effects on non-avian species□• Ecotones□• Climate change
4.	Provide opportunities for public access, education, and recreation in the study area.		• Public access & wildlife
Constraints			Uncertainties
1.	Do not jeopardize any listed species.		• Bird use of changing habitats□• Sediment dynamics
2.	Do not significantly increase the potential for bioaccumulation of mercury in the food web within the study area.		• Mercury
3.	Recreational features must be compatible with ecosystem restoration objectives and flood risk management objectives.		• Public access and wildlife
4.	Comply with applicable regulatory requirements.		• No major uncertainties
5.	Do not negatively impact groundwater quality.		• No major uncertainties
6.	No negative permanent impacts on function of existing major infrastructure (wastewater treatment plant, PG&E, railroad, stormwater pump station, landfill, recycling facilities).		• Flood and infrastructure performance
Considerations (Avoid, minimize, or mitigate)			Uncertainties

1.	Loss of existing outboard marshes and mudflats in the study area.		• Sediment dynamics
2.	Reduction in the quality of existing tidal marsh, including fragmentation and increased edge effects.		• Sediment dynamics
3.	Creation of new tidal areas without transition zones.		• No major uncertainties
4.	Negative impacts to threatened and endangered species.		• Bird use of changing habitats□• Effects on non-avian species□• Sediment dynamics
5.	Net reduction of total habitat value for major categories of water birds, including shorebirds, waterfowl, and miscellaneous species that use these habitats within the larger SBSP Project area.		• Bird use of changing habitats
6.	Proliferation of nonnative and/or undesirable species in the study area.		• Invasive and nuisance species
7.	Access by predators to special-status species habitat in the study area.		• Invasive and nuisance species
8.	Negative impacts to cultural resources.		• No major uncertainties
9.	Negative impacts to existing recreational infrastructure function within the study area.		• Public access and wildlife
10.	Increases in vector populations in the study area.		• Invasive and nuisance species
11.	Negative impacts to existing water quality and sediment quality in the study area.		• Mercury□• Sediment dynamics

2.2 Proposed Ecosystem Restoration Actions

The Shoreline Study proposes to restore approximately 2,900 acres of former commercial salt production ponds to tidal marsh and associated habitats. Tidal habitat restoration will be phased and achieved mainly through restoration of natural physical and ecological processes rather than through constructed physical features or plantings. In addition, the project proposes to construct 3.5 miles of levees to provide coastal flood protection.

The proposed project includes construction of outboard levee breaches and internal berm breaches to introduce tidal flows to the ponds. Some of the outboard levees and internal berms would be lowered to reconnect marsh to mudflat, improving water, sediment, and organism exchange. Pilot channels, starter channels, ditch blocks and side cast natural berms will be used to accelerate evolution of the ponds and enhance habitat.

The ecosystem restoration component of the proposed project would occur as three phases of pond breaches to establish tidal connection, with five years between each set of breaches (Figure 3. Project Implementation Schedule). The first phase would breach Ponds A12 and A18 (in 2020), the second would breach Ponds A9, A10, and A11 (in 2025), and the third would breach Ponds A13, A14, and A15 (in 2030). Under the adaptive implementation concept, design and construction of the later phases may be modified based on what is learned in monitoring of earlier phases. In the unlikely event that the results of the earlier phase(s) indicate undesirable outcomes that cannot be avoided by adaptive management actions, project implementation would be halted prior to construction of the later phase(s).

Through its phased implementation approach, it is possible that the Shoreline Study may cease tidal restoration actions after either the first or second phase. This would only take place if the USACE and the Adaptive Management Team decided, based on the latest monitoring and science available on issues such as

bird use and mercury contamination, that the highest ecological value of those particular ponds were for them to remain as pond habitat for specific guilds of birds. The proposed phases were selected specifically because they could be implemented as separable elements, although with cumulative synergistic benefits. However, regardless of the ultimate endpoint, the Shoreline Study will have implemented a cost effective restoration project and achieve significant ecological benefits as part of a nationally significant restoration effort.

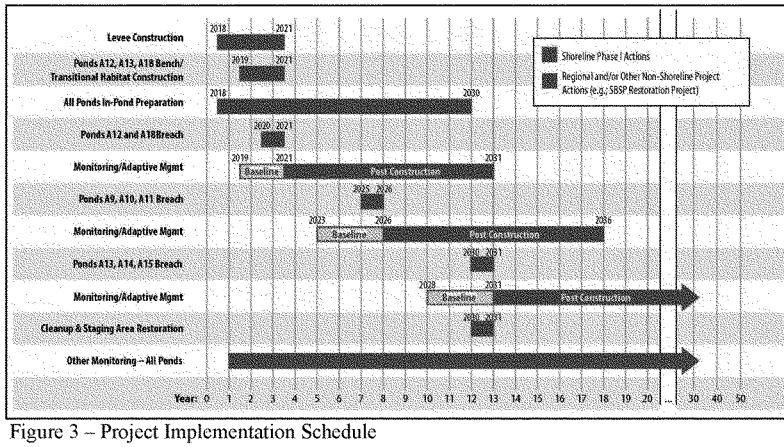

Figure 3 – Project Implementation Schedule

2.3 Conceptual Models

The purpose of the conceptual model is to provide the linkage between project actions and expected system response. Planning for the Shoreline Study used the conceptual ecological model developed for the SBSP Restoration Project (Trulio et al 2007) to represent current understanding of ecosystem structure and function in the project area, identify performance measures, and help select parameters for monitoring. The model illustrates the effects of important natural and anthropogenic activities that result in different ecological stressors on the system. Figures 4, 5, and 6 present the conceptual models for tidal habitat, managed pond habitat, and overall landscape habitat interactions.

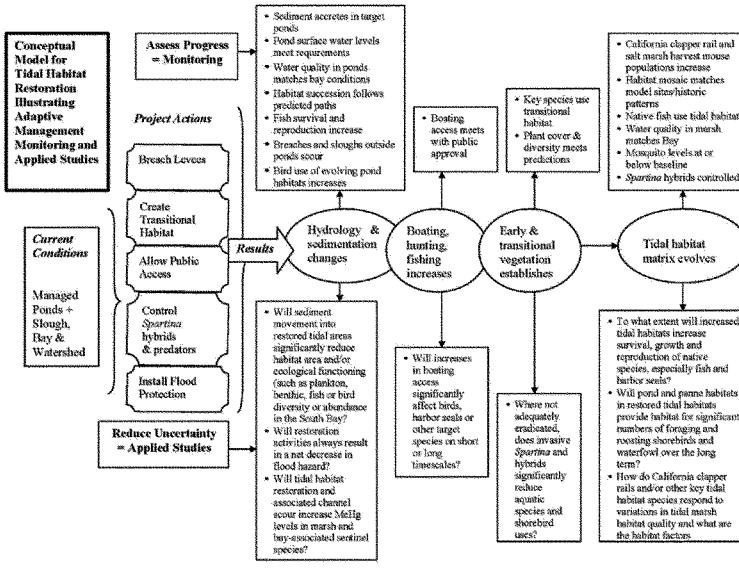

Figure 4. Tidal habitat conceptual model

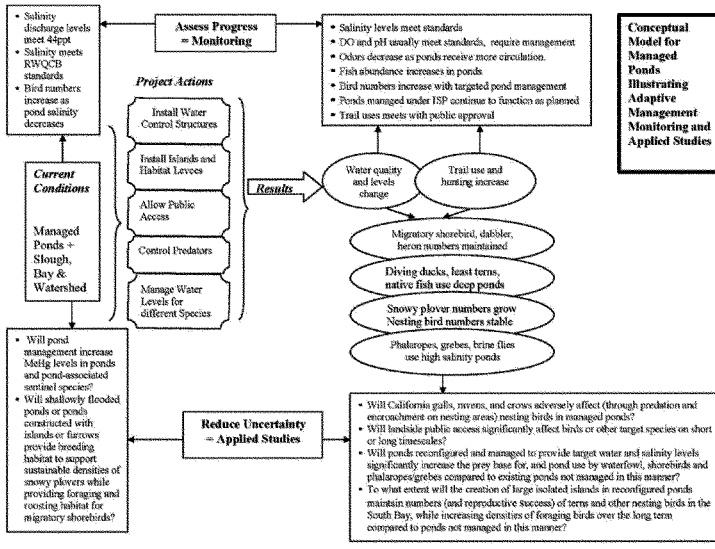

Figure 5. Managed pond conceptual model

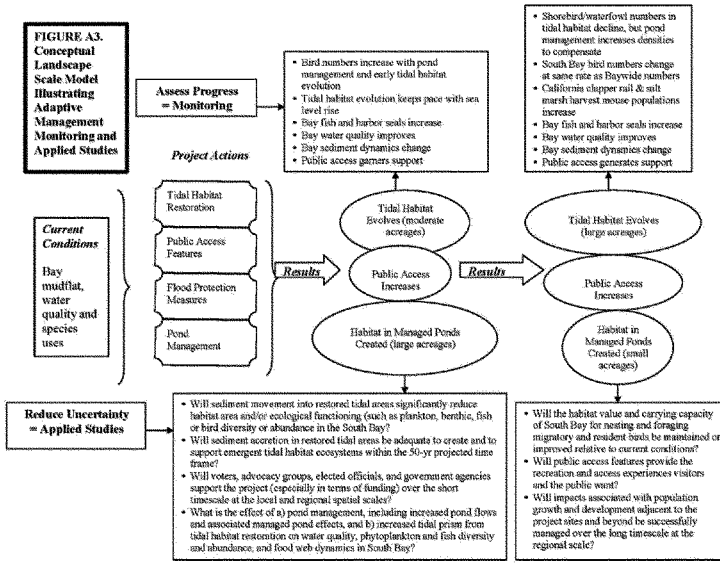

Figure 6. Landscape conceptual model

The tidal habitat conceptual model is directly relevant to the desired habitat type and ecosystem restoration objectives for the Shoreline Study. The managed pond and landscape conceptual models are relevant in that they describe the "staircase" issues (associated with phased implementation), issues that determine whether the project recommended by the Shoreline Study proceeds beyond the first phase of tidal marsh restoration, or halts before all phases are completed (see Section 9).

2.4 Sources of Uncertainty

Gaps in our knowledge about South San Francisco Bay ecosystem function and the landscape-scale effects of restoration actions can influence how we achieve the project objectives over the course of implementation. Key uncertainties associated with ecosystem restoration, flood risk management, and public access were identified so that monitoring could be targeted to reduce these uncertainties and guide future actions, including cost-shared adaptive management.

Sediment dynamics, including the extent to which estuarine sedimentation is sufficient to convert mudflats to vegetated marsh and extent to which tidal habitat restoration might result in the loss of slough and bay tidal mudflat habitat regionally.

Bird use of changing habitats, including the extent to which tidal habitat species can be recovered while maintaining the diversity and abundance of nesting and migratory waterbirds observed during pre-project conditions.

Effects on non-avian species, including the extent to which restoration will affect fish, mammals, and other critical species in the South Bay ecosystem.

Mercury, including the extent to which the future project's ecosystem restoration and other actions might result in an increase in bioavailable mercury in the food chain.

Invasive and nuisance species, including the invasive *Spartina* hybrids, red foxes, California gulls, and mosquitoes.

Public access and wildlife, including the extent to which various forms of public access and recreation can be integrated into the future project without significantly affecting wildlife.

Ecotones, including the extent to which the ecotones (transitional habitat located between tidal marsh and upland habitats) will support desirable vegetation and not support invasive vegetation.

Flood and infrastructure performance, including the extent to which the new infrastructure will perform as designed.

Climate change, including whether sea level rise will be greater than assumed in the design.

Table 1 (Planning Objectives, Constraints, Considerations, and Uncertainties) lists the uncertainties as they relate to each of the project objectives, constraints, and considerations. Some of these uncertainties relate directly to the efficacy of actions being proposed (e.g., ability to meet ecosystem restoration objectives), while others take into account the landscape-scale effects of multiple restoration actions in South San Francisco Bay (thus relating to adaptive implementation).

3. Monitoring

The purposes of monitoring are to assess progress towards project objectives, detect early signs of potential problems, and reduce uncertainties. For each key uncertainty, restoration targets (success criteria) were developed to identify the desirable outcome, and then monitoring metrics defined for measuring each restoration target (Table 2. Monitoring topics, targets, and metrics associated with ecosystem restoration objectives). The monitoring elements included in this table have been limited to activities associated with ecosystem restoration project objectives. The restoration targets and success criteria define how the project will know when ecosystem restoration success has been achieved and monitoring activities can cease.

Table 2. Monitoring topics, targets, and metrics associated with ecosystem restoration objectives

Primary Monitoring Topics		Category	Restoration Targets/Success Criteria	Monitoring Metrics
1.	Sediment dynamics	Sedimentation Inside the Ponds	Water levels inside the ponds are similar to just outside the ponds, allowing full exchange of water and sediments (Years 1-3 of breaching phase only). Accretion rate of the breached ponds is sufficient to reach marsh vegetation colonization elevations within the planning time frame (Years 1-5 of breaching phase only). Initial modeling projects that the ponds will reach marsh plain elevation within 15-20 years after breaching. Since this is beyond the monitoring period for the project, the restoration target for the first 10 years will be that the accretion rates are on a trajectory toward meeting that criterion. Specific elevation targets for each pond will be refined based on the ponds' initial bottom elevation, and the sediment accretion curves developed from the previous restoration of adjacent Ponds A6, A19, A20 and A21.	• Water levels in ponds • Sedimentation rates in ponds • Suspended sediment concentrations in ponds

		Restored Tidal Marsh Habitat (Inside the Ponds)	Tidal marsh vegetation is on a trajectory toward other successful marsh restoration sites in South San Francisco Bay. Native tidal marsh species, including pickleweed (both annual and perennial species) and cordgrass, are expected to begin naturally colonizing the marsh plain within 2 years of pond bottom reaching the appropriate elevations through natural sedimentation (typically an elevation between Mean Tide Level and Mean Higher High Water).	• Tidal marsh habitat acreage in ponds
2.	Bird use of changing habitats	Ridgway's Rail	• Contribute to the recovery of the Ridgway's rail by providing new tidal marsh habitat and ensuring restored marshes are on a trajectory toward vegetated marsh.	• Tidal marsh habitat acreage in ponds (see Item 1 above)
3.	Non-avian species	Salt Marsh Harvest Mouse	• Contribute to the recovery of the salt marsh harvest mouse by providing new tidal marsh habitat by providing new tidal marsh habitat and ensuring restored marshes are on a trajectory toward vegetated marsh.	• Tidal marsh habitat acreage in ponds (see Item 1 above)
4.	Invasive and nuisance species	Invasive and Nuisance Plants	• Habitat trajectory toward native/non-native composition of a reference marsh and other restoration sites. Qualitative inspections for invasive species (especially *Spartina hybrids* and *Lepidium latifolia*) will occur annually, quadrant or transect sampling once marsh has 20% vegetation cover. Any hybrid *Spartina* presence will be reported to the regional control effort, and any marsh containing over 30% *Lepidium* will trigger control activities.	• Abundance of non-native species

5.	Ecotones	Transition zones	• Transition zone habitat comprising wide, gently-sloped vegetated terrain with a diverse habitat mosaic dominated by (>50% relative cover) perennial native grassland and for species interspersed with salt panne and seasonal wetland habitats transitioning along a salinity gradient to native salt marsh community representative of historic transition zone habitats.	• Plant species composition in transition zones

Monitoring activities associated with flood risk management, adaptive implementation, or permit compliance for the recommended project will not be cost shared by the USACE, but will be funded and implemented by the non-Federal sponsor through the SBSP Restoration Project. However, information collected through these types of monitoring activities may result in future cost-shared activities (e.g., changes to the authorized project).

Monitoring and activities that address regional changes from the combined effects of Shoreline Study and SBSP Restoration Project will not be cost shared by the USACE unless they are also linked directly to the Shoreline Study's ecosystem restoration objectives and are conducted within the Shoreline project footprint. These activities related to regional changes will be conducted as the continuation of ongoing activities currently performed under the SBSP Restoration Project. Coordination of the future Shoreline Project with the SBSP Restoration Project will allow for more complete and consistent information to guide decision-making as bay-wide effects are considered. Regional monitoring includes monitoring of changes to mudflat and tidal marsh acreages, changes to bird populations and abundance, and mercury bioavailability.

Each monitoring metric was detailed in terms of monitoring methods, locations, frequency and duration in order to develop a cost estimate (See Table 3. Monitoring Cost Estimate). The monitoring cost estimate is $968,000 (First Cost October 2014 price level).

Although the monitoring cost estimates presented in this document display activities during the proposed ten years of cost-shared monitoring after construction, monitoring will continue beyond the initial ten years, funded by the non-Federal sponsor, if the criteria for ecosystem success have not yet been met (see Table 2. Monitoring topics, targets, and metrics associated with ecosystem restoration objectives).

Table 3. Monitoring Cost Estimate

Restoration Target Category	Monitoring Metric (Brief)	Monitoring Metric & Method	Which Years?	# Years	Cost/Unit (before SS adjustment)	Cost/Unit *	Unit	# Units	Total Cost*	Notes
Sedimentation Inside the Ponds	Water levels in ponds	• Water levels inside the ponds collected using pressure transducers in the ponds and adjacent sloughs. Monitor until no damping observed.	0*, 1, 2 after each phase	9	$ 50,000	$ 50,000	1 phase (3 yr/phase, 2 wk/yr)	3	$ 150,000	Approximately $16,700 per year for three years per phase (2-3 wks/year) Note: SBSP is not monitoring water levels currently.
Sedimentation Inside the Ponds	Sedimentation rates in ponds	• Sedimentation rates inside ponds. Transects or SET's in breached ponds, annually at first and then less frequently as rates of accretion slow. Consider using Regional Sediment Dynamics monitoring data, such as LiDAR surveys if sufficiently detailed for use inside ponds.	0*, 2, 5, 10 after each phase	12	$ 25,000	$ 25,000	1 event	12	$ 300,000	Assume same methods as at Island Ponds and Pond A8. Investigate using bathymetry or LiDAR inside the breached ponds
Sedimentation Inside the Ponds	Suspended sediment concentration in ponds	• Suspended sediment concentration monitoring • See related monitoring in Regional Mudflat Habitat and Sediment Dynamics	10	1	$ 150,000	$150,000	1 event	1	$ 150,000	Estimate is cost for conducting sampling for input variables to model, and running marsh sustainability model Assume model is run at Year 10, though timing may vary
Restored Tidal Marsh Habitat (Inside the Ponds)	Tidal marsh habitat acreage in ponds	• Tidal marsh habitat acreage inside the ponds. Collect acreages via remote imagery with limited ground-truthing	5, 10	2	$ 300,000	$ 54,000	2	1	$ 108,000	Included in Regional Tidal Marsh Habitat. No costs for vegetation community surveys since these will not be conducted within 10 years of breaching.
Ridgeway's Rail	Presence of tidal marsh habitat	• Tidal marsh habitat acreage inside the ponds. Collect acreages via remote imagery with limited ground-truthing (as above)							$ -	cost already covered by tidal marsh acreage monitoring
Salt Marsh Harvest Mouse	Presence of tidal marsh habitat	• Tidal marsh habitat acreage inside the ponds. Collect acreages via remote imagery with limited ground-truthing (as above)							$ -	cost already covered by tidal marsh acreage monitoring
Invasive and Nuisance Plants	Abundance of non-native species	• Abundance of non-natives such as non-native Spartina spp. (Qualitative assessments for invasive species will occur annually.)						N/A (see note)	$ -	Covered by SBSP and transition zone monitoring
Transition zones	Plant species composition in transition zones	• Plant species composition including abundance of native species. • Annual habitat monitoring during a 3-year plant establishment period to ensure establishment of native plant species • Annual qualitative assessments for invasive species.	0, 1, 2, 5, 7, 10	6	**No Fill** - $8,000 - $10,000/year. **30:1 Fill** - $25,000 - $30,000/yr. **100:1 Fill** $66,000	$8,000 - $30,000/year	1 event	6	$ 54,000	6 Years Monitoring (Total) includes habitat monitoring, species composition, and qualitative assessments. Estimate based on total transition zone acreage
		SUBTOTAL							$ 762,000	
		27% Contingency							$ 205,740	
		TOTAL (First cost Oct 2014 price levels)							$ 967,740	
		AVERAGE ANNUAL COST (APPROX)							$ 48,387	
		*Assumes Shoreline Study cost is 10% of entire cost estimate for SBSP Restoration Project, based on relative acreages to be monitored.								
		Assume projects constructed in three phases from 2017 to 2035, with monitoring and adaptive management 2021 to 2041 (20 years following each phase for a total of 20 years).								
		Note: Year 0= return immediately after breaching								
		Any monitoring that occurs after 10 years post construction will be a 100% non-Federal responsibility								

3.1 Targets

Table 2 (Monitoring topics, targets, and metrics associated with ecosystem restoration objectives) lists the restoration targets as related to the project uncertainties, which are directly linked to the project objectives, constraints, and considerations (Table 1. Planning Objectives, Constraints, Considerations, and Uncertainties) and indicate how the project will know when ecological success has been achieved and monitoring activities can cease. Typical data sources for developing these targets are the published academic literature, quantitative baseline data, or requirements set by a regulatory agency. Targets include both long-term goals and intermediate conditions as the ecosystem changes. Quantitative targets, such as minimum numbers or ranges of variability, do not yet exist for all restoration targets. These targets will be developed using existing data or regulations and many are expected to evolve as monitoring and assessments are conducted. References to "significant impacts" in the target descriptions are related to National Environmental Policy Act and California Environmental Quality Act significance, which will be identified in the Environmental Impact Statement/Report.

Restoration targets are intended to hold the Shoreline Study to levels of performance that are under the Shoreline Study's control, and not to levels controlled by external factors.

The monitoring is organized by "Restoration Target Categories," which are specific sub-categories within each of the key uncertainties. Categories are the basic elements of the ecosystem that must be monitored to determine whether the project objectives are being met, or are likely to be met in the future. Use of the Restoration Target Categories helps in cross-referencing the monitoring to later assessment and decisions-making steps by allowing cross-referencing between tables.

3.2 Monitoring Metrics

Specific, measureable monitoring metrics, or parameters, to assess change with respect to the restoration targets are presented in Table 2 (Monitoring topics, targets, and metrics associated with ecosystem restoration objectives). Note that while habitat creation for the Federally protected Ridgway's rail (formerly the California clapper rail, *Rallus longirostris obsoletus*) and the salt marsh harvest mouse (*Reithrodontomys raviventris*) is a project objective, the monitoring metrics for these species within this MAMP only includes the establishment of the target habitat. The timing of adequate habitat development to support these species varies greatly between the individual ponds, depending on their initial bottom elevations. For example, in the nearby Pond A21 (restored in 2006), rails were detected using the restored marsh habitat in Year 8 post-restoration.

3.3 Monitoring Methods

Table 3 (Monitoring Cost Estimate) describes the monitoring metrics and methods in additional detail, such as timing relative to restoration phases, spatial extent, and frequency. Each of the three pond breaching phases will have its own timeframe for baseline monitoring, construction, post-construction monitoring and adaptive management, and turnover to the non-Federal sponsor for operation and maintenance. For each phase of pond breaching, baseline monitoring would begin three years prior to breaching and post-construction monitoring would continue until ecological success criteria are met. Extensive monitoring that has already occurred in these areas indicates that bird use has a high degree of inter-annual variability. Therefore, to understand the immediate, as well as cumulative, effects of

the restoration actions, continued baseline monitoring is essential. Although previous and ongoing monitoring results are available and will inform the proposed project, this information provides a general understanding of what will happen within the restored ponds, but the bigger picture of cumulative effects across multiple ponds, is unknown. The period of cost-shared monitoring will not exceed ten years (Figure 3. Project Implementation Schedule). Section 7.3 provides additional discussion of monitoring duration as related to project close out.

The monitoring method summaries in Table 3 (Monitoring Cost Estimate) are described in enough detail to make the approach clear, but do not fully describe the monitoring regime. A monitoring plan with detailed methods, protocols, timing, and responsible parties will be developed prior to start of monitoring, as each monitoring study is contracted.

3.4 Database Management

Database management will be provided by the SCC, who will likely contract with the San Francisco Estuary Institute (SFEI) or other similar entity for this role. The database manager will be responsible for storing final monitoring reports and other Shoreline Study documentation (decisions, agendas, reports) and making them available on the SBSP Restoration Project website. Monitoring reports will be searchable by topic and principle author.

The database will be designed to store and archive the Shoreline Study monitoring data. The format of each monitoring data set will vary as appropriate to the type of monitoring. Therefore, data are expected to be archived separately by study, rather than collated in one master database. Each dataset will include:

- Data and metadata transfer and input policies and standards
- Data validation procedures
- Mechanisms to ensure data security and integrity

Monitoring data sets will be available to the public upon request.

4. Regular Assessments

The assessment phase compares the results of the monitoring efforts to the desired project performance targets. The SBSP Restoration Project Science Program has been the primary group responsible for these assessments, for the regional monitoring and adaptive management effort. The Lead Scientist for the SBSP Restoration Project will facilitate regular communication of assessment results from the Science Program to the AMT, who will make recommendations to the USACE. The USACE will be the decision maker for any adaptive management actions undertaken on projects that it is responsible for constructing.

This section defines the assessment process, acceptable variances between monitoring results and targets, the frequency and timing for comparison of monitoring results to the selected targets, and assessment documentation.

4.1 Assessment Process

The SBSP Restoration Project Science Program will identify methods for comparing the restoration targets/ triggers with monitoring data. These methods will include appropriate statistical comparisons (e.g., hypothesis testing, ANOVA, multivariate methods). The results of these assessments will be documented and stored in the data management system.

The SBSP Restoration Project Science Program members will collaborate with the AMT to define magnitudes of difference (statistical differences, significance levels) between measured and desired values that will constitute variances. These variances will be used to recommend adaptive management actions to the USACE.

Note that, while there are no assessments specific to sea level rise, any predictions of tidal habitat evolution will incorporate the most up-to-date sea level rise information and guidance at the time of assessments.

4.2 Frequency of Assessments

An annual meeting will be held between the AMT and the SBSP Restoration Project Science Team to discuss monitoring and research findings, management triggers, and implications for adaptive management. Assessments may be more frequent, depending on the relevant physical or ecological scale of each restoration target. Table 3 (Monitoring Cost Estimate) includes two columns describing the frequency and timing of monitoring. The temporal scale of the system responses was one of the main considerations in determining frequency and timing of monitoring. For example, inspections for levee erosion should be conducted monthly at first, then annually and after major rainfall and tidal events. In this case the frequency of assessments will be greatest during the first year, with decreasing frequency after the first year.

4.3 Documentation and Reporting

Project assessment documentation will be prepared following each annual meeting in the form of detailed meeting notes. The meeting notes will describe progress towards project objectives as

characterized by the restoration targets. The database manager will be responsible for storing the meeting notes and making them available on the SBSP Restoration Project website.

5. Decision Making

The AMT will receive input from the SBSP Restoration Project Science Team in an annual meeting that will focus on relevant monitoring findings, management triggers, and implications for future project phases. If the AMT believes that small management actions need to happen, they would recommend to the USACE that those actions be implemented immediately. If a larger change to the project approach or a substantial action is necessary, the AMT would vet this change or action publicly through the SBSP Restoration Project's PMT and its working groups such as the Stakeholder Forum, Alviso Regional Working Group, and/or the Regulatory Work Group, depending on the scale and type of issue. The AMT would report the results of the vetting process to the USACE, who will decide whether to take action.

For each management trigger there is a list of potential adaptive management actions the AMT and Science Team might recommend that the USACE take if a management trigger is reached. Table 4 (Adaptive Management Decision Matrix) describes the assessments and potential management actions associated with each restoration target category.

Table 4. Adaptive Management Decision Matrix

Restoration Target Category	Monitoring Metrics	Management Triggers/ Conditions Requiring Assessment	Assessments Prompted by Management Trigger	Potential Management Action
Sedimentation Inside the Ponds	• Water levels in ponds • Sedimentation rates in ponds • Suspended sediment concentrations in ponds	• Projections based on the rate of mudflat accretion suggest vegetation colonization elevations are not likely to be achieved within the planning time frame.	• Convene study session to review findings and assess whether colonization is compromised. [A] • If tidal marsh is not meeting projections, assess biological significance of slower tidal flat evolution. [A]	• If vegetation colonization is compromised and deemed biologically detrimental, widen breaches to encourage better tidal exchange [C] • Adjust to increase pond mudflat accretion. Potential management actions include adding wave breaks, placing fill, or in-bay material placement to "feed" the restored ponds. [C] • Implement management or adjust design (e.g., remove more levees to increase connectivity between ponds and adjacent sloughs) based on study results [C] • Reconsider movement up staircase. [P]
Restored Tidal Marsh Habitat (Inside the Ponds)	• Tidal marsh habitat acreage in ponds	• No vegetation within 10 years of monitoring	• Identify causes of slow vegetation establishment [A] • Review sediment dynamics [A]	• Remove impediment to vegetation establishment. [C] • See Potential Management Actions for Sedimentation Inside the Ponds.
Invasive and Nuisance Plants	• Abundance of non-native species	• Presence of other non-native plant species that is greater than 5% of vegetation cover. • Presence of new invasive plants with high potential to spread. • Presence of non-native *Spartina* or hybrids	• Continue to re-evaluate what is meant by "control" of invasive species and adjust monitoring and management triggers based on the latest scientific consensus [A] • If invasive species cannot be controlled, study biotic response to non-native vegetation [A]	No construction actions proposed. • Control invasive Spartina in future restored tidal marsh [I]
Transition zones	• Plant species composition in upland transition zones	• Dominant native plant species cover does not establish • Invasive species constitute >10% of habitat	No additional assessments proposed.	• Active seeding/planting to revegetated bare areas [C] • Control invasive *Lepidium* in transition zone [I] • Weed control [M]

* A = Assessment; C = Construction; I = Invasive and Nuisance Plants; P = Phasing (not cost shared); M = Operations & Maintenance (not cost shared)

Figure 7 (Adaptive Management Assessment and Decision Making: Sediment Dynamics Example) steps through the decision-making process for one of the Shoreline Study uncertainties: Sediment Dynamics. This example is used to illustrate adaptive management decision making throughout Section 7.

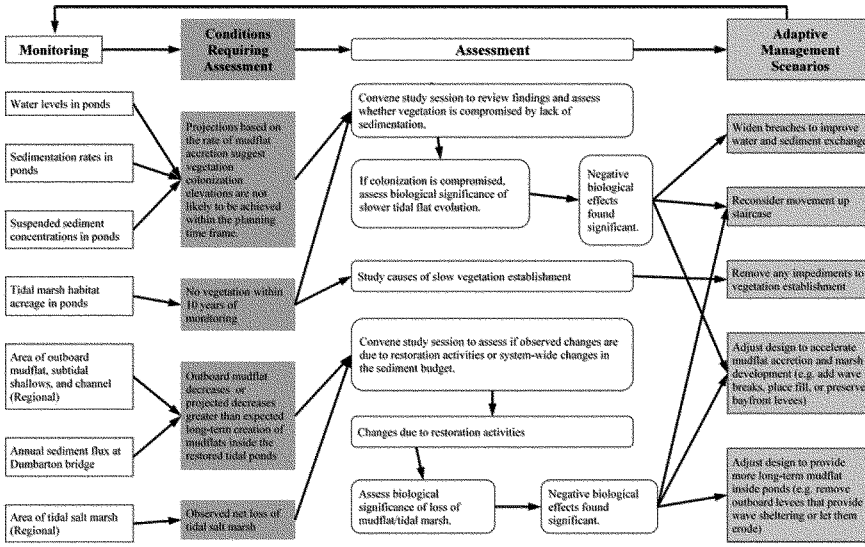

Figure 7. Adaptive Management Assessment and Decision Making: Sediment Dynamics Example

5.1 Triggers

Each restoration target has a management trigger for action if the system is not performing well. A trigger (also known as "Conditions Requiring Assessment") is a threshold that, when reached, indicates that the Shoreline Study may be diverging from a restoration target. The intent of the triggers is to anticipate problems before they cause significant impacts to the system. This advance notice would provide project managers with time to investigate the causes and take action, as necessary, to put the system back on track.

Each management trigger has a corresponding list of potential actions the project team may take if a trigger is reached (discussed in Section 7.2 Potential Adaptive Management Actions). Like the restoration targets, the triggers will be reviewed and updated regularly as additional information becomes available.

5.2 Potential Adaptive Management Actions

Potential management actions are taken when the project is not progressing towards restoration targets as planned and a management trigger has been reached. Typically, the first action would be to conduct an assessment of available monitoring data and consult with external and internal experts to inform subsequent management actions. For this plan, potential management actions are categorized as either (1) as-needed assessments, (2) construction (adjustments to design), or (3) changes to operations, and maintenance. Changes to restoration phasing (adaptive implementation) are also a potential outcome, but those actions are not included as cost-shared activities under the Shoreline Study MAMP.

5.2.1 As-Needed Assessments Triggered by Monitoring

When the cause for tripping a management trigger or the appropriate response is not immediately apparent, these additional assessments use available data (monitoring or other) to better understand what is causing the system to respond differently from target. These assessments typically occur prior to other adaptive management actions and involve convening an assessment team of experts and decision makers to advise the USACE on how to proceed (Table 5. As-needed assessments).

For example, if regular monitoring finds that there is no vegetation establishment within 10 years of monitoring the assessment team would assess whether vegetation establishment is, in fact, caused by sediment dynamics (lack of sedimentation) (Figure 7. Adaptive Management Assessment and Decision Making: Sediment Dynamics Example). If this is the case, the team would assess the biological significance of slower tidal flat evolution. If sediment dynamics is not the cause, the team would examine other potential reasons for slow vegetation establishment.

Table 5. As-needed assessments

Restoration Target Category	Potential Management Action	Type*	Shoreline Study Cost Estimate (unadjusted**)	Cost Estimate *	Notes
Sedimentation Inside the Ponds	• Convene study session to review findings and assess whether colonization is compromised.	A	$ 25,000	$ 4,500	All reviews @$25,000, adjusted by 18%*.
Sedimentation Inside the Ponds	• If tidal marsh is not meeting projections, assess biological significance of slower tidal flat evolution.	A		$ -	Already covered in applied studies
Restored Tidal Marsh Habitat (Inside the Ponds)	• Identify causes of slow vegetation establishment	A	$ 50,000	$ 9,000	
Restored Tidal Marsh Habitat (Inside the Ponds)	• Review sediment dynamics	A		$ -	Already covered in monitoring
California Clapper Rail	• Assess habitat suitability	A		$ -	Already covered in monitoring
Salt Marsh Harvest Mouse	• Assess habitat suitability	A		$ -	Already covered in monitoring
Invasive and Nuisance Plants	• Continue to re-evaluate what is meant by "control" of invasive species and adjust monitoring and management triggers based on the latest scientific consensus	A		$ -	Already covered in monitoring
Invasive and Nuisance Plants	• If invasive species cannot be controlled, study biotic response to non-native vegetation	A	$ 25,000	$ 4,500	All reviews @$25,000, adjusted by 18%*.
	SUBTOTAL			**$ 18,000**	
	27% Contingency			**$ 4,860**	
	TOTAL (First Cost Oct 2014)			**$ 22,860**	

5.2.2 Construction (Adjustments to Design)

Most construction actions involve adjusting the tidal restoration design (e.g. widening breaches or placing fill) when the project is not progressing towards the objectives as planned (Table 6. Adaptive Management Construction Activities). Design adjustments would be tailored to the specific problem as identified through the assessment. The majority of the proposed actions have been implemented elsewhere in San Francisco Bay for similar marsh habitat restoration projects.

For example, if the sediment dynamics study session (described above) finds that slower tidal flat evolution is biologically significant, the design could be adjusted to encourage faster tidal evolution. This might involve widening breaches, placing wave breaks or additional fill, or preserving bayfront levees (Figure 7. Adaptive Management Assessment and Decision Making: Sediment Dynamics Example).

Table 6. Adaptive Management Construction Activities

Restoration Target Category	Potential Management Action	Type*	Cost Est.	Basis for Cost Estimate
Sedimentation Inside the Ponds	• If vegetation colonization is compromised and deemed biologically detrimental, widen breaches to encourage better tidal exchange	C	$ 230,000	Assume 25% widening
Sedimentation Inside the Ponds	• Adjust to increase pond mudflat accretion. Potential management actions include adding wave breaks, placing fill, or in-bay material placement to "feed" the restored ponds.	C	$ 2,610,000	Assume sidecasts are 50% of 36,000 ft of starter channel at $145/LF
Sedimentation Inside the Ponds	• Implement management or adjust design (e.g., remove more levees to increase connectivity between ponds and adjacent sloughs) based on study results	C	$ 840,000	Assume lowering 7,500 ft of levee at $112/ft
Restored Tidal Marsh Habitat (Inside the Ponds)	• Remove impediment to vegetation establishment.	C		
California Clapper Rails	No construction actions proposed.			
Salt Marsh Harvest Mouse	No construction actions proposed.			
Invasive and Nuisance Plants	No construction actions proposed.			
Transition zones	• Active seeding/planting to revegetated bare areas	C	$ 25,000	Assume 20% replating @ $7,000/acre (no irrigation; grassland seeding; plug planting @ 400-500 plants/acre). Estimate does not include any soil amendments, maintenance, or irrigation costs.
	SUBTOTAL		$ 3,705,000	
	27% Contingency		$ 1,000,350	
	TOTAL (First Cost Oct 2014)		$ 4,705,350	

5.2.3 Invasive and Nuisance Plant Control

These adaptive management activities are for the removal of invasive species that may accidentally enter the future restored tidal marsh and transition zones and are beyond the normal operation and maintenance activities that will be performed by the USFWS or non-Federal sponsor. These activities will ensure the establishment of native species, which is a key component of the project's ecosystem restoration objectives.

Monitoring for invasive species will not be cost shared by the USACE, but will performed by existing efforts related to invasive plants and routine operation and maintenance activities.

Within the future tidal marsh areas, this category of proposed cost-shared adaptive management would involve spot control for *Spartina* hybrids whose propogules may enter the project area from the bay through the natural sedimentation that will establish this type of habitat. These spot-control activities will address the possibility that the proposed project will contribute to potential area of infestation of a bay-wide eradication effort (Invasive *Spartina* Project).

Within the future transition zones, the cost-shared adaptive management would address invasive *Lepidium*. The transition areas are more prone to invasion because *Lepidium* thrives in areas of physical disturbance. The transition areas would be a physically disturbed area because they would be constructed by moving large volumes of soil.

Table 7. Invasive and Nuisance Plants

Restoration Target Category	Potential Management Action	Type*	Cost Estimate
Invasive and Nuisance Plants	• Control invasive *Spartina* in future restored tidal marsh	M	$ 250,000
Invasive and Nuisance Plants	• Control invasive *Lepidium* in transition zone	M	$ 900,000
	SUBTOTAL Option		**$ 1,150,000**
	27% Contingency		**$ 310,500**
	TOTAL (First Cost Oct 2014)		**$ 1,460,500**

5.3 Project Close Out

Closeout of the project would occur after the period of cost-shared monitoring and adaptive management. Additional monitoring and adaptive management needed to determine when the project has successfully met its objectives will be conducted by the non-Federal sponsor as part of the operation and maintenance project phase. The project will be determined a success if the restoration targets (Table 2. Monitoring topics, targets, and metrics associated with ecosystem restoration objectives) have been met to the satisfaction of the USACE South Pacific Division Commander. The Division Commander will take into account the recommendations of the San Francisco District Commander and AMT, who will consult with the Executive Leadership Group, South Bay Salt Pond Restoration Project Stakeholder Forum and Science Program, Federal and State resource agencies, and others as appropriate.

Cost-shared monitoring is proposed for a period ten years following each phase of pond breaching. Monitoring beyond this ten-year period will be funded solely by the non-Federal sponsor. Conversely, if the restoration targets are met before the end of the ten-year period, monitoring may be discontinued.

6. Costs for Implementation of Monitoring and Adaptive Management

Cost-shared monitoring and adaptive management actions by the USACE will be limited to actions conducted within the project footprint that are associated with meeting the project's ecosystem restoration objectives, and will not extend beyond 10 years after construction.

The costs for cost-shared monitoring and adaptive management are summarized in Table 8 (Monitoring and Adaptive Management Cost Summary Table). Detailed cost estimates are described in the following sections. The total estimated cost for monitoring and adaptive management for the Shoreline Study, including a 27% contingency, is $8.7 million (First Cost October 2014 price level).

The individual cost elements are approximate and are intended to provide a reasonable basis for budgeting potential costs. Because uncertainties remain in the project elements, monitoring, and adaptive management actions, the cost estimates provided in this report will need to be refined before these actions are implemented.

6.1 Costs for Implementation of Monitoring

Table 3 reports the cost estimates for Shoreline Study monitoring. The costs are based on the frequency of monitoring and the amount of monitoring. All costs assume the monitoring plan is executed in full. The total estimated cost for Shoreline Study monitoring, including a 27% contingency, is $968,000 (First Cost October 2014 price level).

Many of the monitoring and assessment costs are estimated based on previously-estimated costs for the SBSP Restoration Project AMMP (Trulio et al 2007). The SBSP Restoration Project costs are scaled based on relative project areas. This assumes that costs can be estimated on a per-acre basis and reapplied for different regions in the South Bay.

The Shoreline Study's estimated share of monitoring and adaptive management costs is 18% of the combined Shoreline Study and SBSP Restoration Project costs. This calculation is based on the ratio of the Shoreline Study area to the combined Shoreline Study and South Bay Salt Pond area (2,891 acres/15,926 acres). Monitoring costs for the Shoreline Study would likely be higher if monitoring and adaptive management for the Shoreline Study were not coordinated with the SBSP Restoration Project.

6.2 Costs for Implementation of Adaptive Management

The costs for adaptive management are organized into the three adaptive management action categories. The costs of as-needed assessments, construction, and phasing, operations, and maintenance are reported in Table 5, Table 6, and Table 8, respectively. The construction cost estimates were provided in part by USACE. Many of the cost estimates were derived from other South Bay pond restoration projects. The total estimated cost for Shoreline Study adaptive management, including a 27% contingency, is $6,189,000 (First Cost October 2014 price level) for Ponds A9 - A15 and A18, with the potential construction actions contributing approximately three fourths of the costs. This total cost assumes that all adaptive management actions are implemented and likely overestimates total

costs. The relatively significant cost of adaptive management compared to initial construction of ecosystem restoration features is associated with the potential need to mobilize and demobilize for additional construction.

For management triggers where multiple adaptive management actions may be considered and only one implemented, we estimated costs for one representative action. The actual action selected during decision-making may not be the one assumed in the cost estimate and costs may differ. Total costs, however, are expected to be equal to or lower than the costs estimated here.

Table 8. Monitoring and Adaptive Management Cost Summary Table

		Adaptive Management				
Restoration Target Category	**Monitoring**	**Assessment**	**Construction**	**Invasive and Nuisance Plants**	**Adaptive Management Total**	**Total Cost**
Sedimentation Inside the Ponds	$600,000	$4,500	$3,680,000		$3,684,500	$4,284,500
Restored Tidal Marsh Habitat (Inside the Ponds)	$108,000	$9,000			$9,000	$117,000
CA Clapper Rail	$0				$0	$0
Salt Marsh Harvest Mouse	$0				$0	$0
Invasive and Nuisance Plants		$4,500		$1,150,000	$1,154,500	$1,154,500
Upland transition zones	$54,000		$25,000		$25,000	$79,000
Subtotal for Monitoring & Adaptive Management	$762,000	$18,000	$3,705,000	$1,150,000	$4,873,000	$5,635,000
Overhead for regular assessments, meetings, data management ($75K/year)						$1,500,000
TOTAL (Including 27% contingency) (First Cost Oct 2014)	**$967,740**	**$22,860**	**$4,705,350**	**$1,460,500**	**$6,188,710**	**$8,656,450**

Note: Adaptive Management column includes assessments triggered by monitoring results, construction, and invasive and nuisance plant costs.

References

EDAW, Philip Williams and Associates, Ltd., H.T. Harvey and Associates, Brown and Caldwell, and Geomatrix (2007). South Bay Salt Pond Restoration Project Final Environmental Impact Statement/Report. Prepared for U.S. Fish and Wildlife Service and California Department of Fish and Game.

Trulio, L., D. Clark, S. Ritchie, A. Hutzel, and the Science Team (2007). South Bay Salt Pond Restoration Project Administrative Draft Adaptive Management Plan. November 14, 2007.

U.S. Army Corps of Engineers (USACE) (2009). Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007(WRDA 2007) – Monitoring Ecosystem Restoration, CECW-PB. Washington D.C., August 31, 2009.

Appendix G

Geotechnical Engineering

September 2015
(revised December 2015)

GEOTECHNICAL APPENDIX

South San Francisco Bay Shoreline Study (SSFBS)

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1.0 PROJECT BACKGROUND AND PURPOSE

The South San Francisco Bay Shoreline (SSFBS) Study is evaluating the feasibility of a multipurpose project to provide flood risk management and ecosystem restoration benefits to the Shoreline of the South San Francisco Bay Area including addressing increased flood risk from future sea level rise. The project study was originally scoped in the 1980s and has since been reduced in scope to focus on the most acute life safety risk in the Alviso area.

The study can be divided into three distinct stages technical stages that are shown in Table 1-1. Multiple geotechnical reports were developed to support the Feasibility Scoping Meeting held in 2010. They discussed geotechnical baseline conditions and the estimated geotechnical performance of the outer and inner levees of the project area and provide the basis for most geotechnical recommendations related to design and construction. This work was compiled and presented in USACE (2009). Additionally, the USACE Engineering, Research and Development Center (ERDC) conducted a study to characterize erosion performance estimates for hydraulic simulation modeling of the existing outer and inner levees (USACE 2008, USACE 2009). The above referenced documents have undergone both District Quality Control (DQC) and Agency Technical Review (ATR) and should be referred to for technical details not provided in this appendix.

Table 1-1: Planning miletones and associated time periods.

Stage	Time Period	Planning Milestone
1	2004 to 2011	Feasibility Scoping Meeting [F3]
2	2011 to 2013	Alternative Formulation Briefing [F4]
3	2013 to 2014	Public Release of Study

The information presented in this geotechnical appendix is simplified to highlight key design and construction constraints most likely to impact the decision on the recommended plan, and summarizing critical elements governing the geotechnical performance of existing outboard and inboard dikes. Key constraints focus on geotechnical impacts to cost (e.g. fill requirements, staged construction) and calculation of project benefits (e.g. performance of the existing features).

1.1 Study Area and Recommended Alignment

The current project study area is shown on Figure 1-1. The recommended alignment and extent for the new flood control levee is coincident with the existing inboard dike. The recommended levee is approximately 19,500 ft long (3.7 miles). The alignment includes two closure structures; one mitre gate at the railroad and one tide gate at Artesian Slough. The ends of the alignment will tie into existing flood control levees along the Guadalupe River and Coyote Creek.

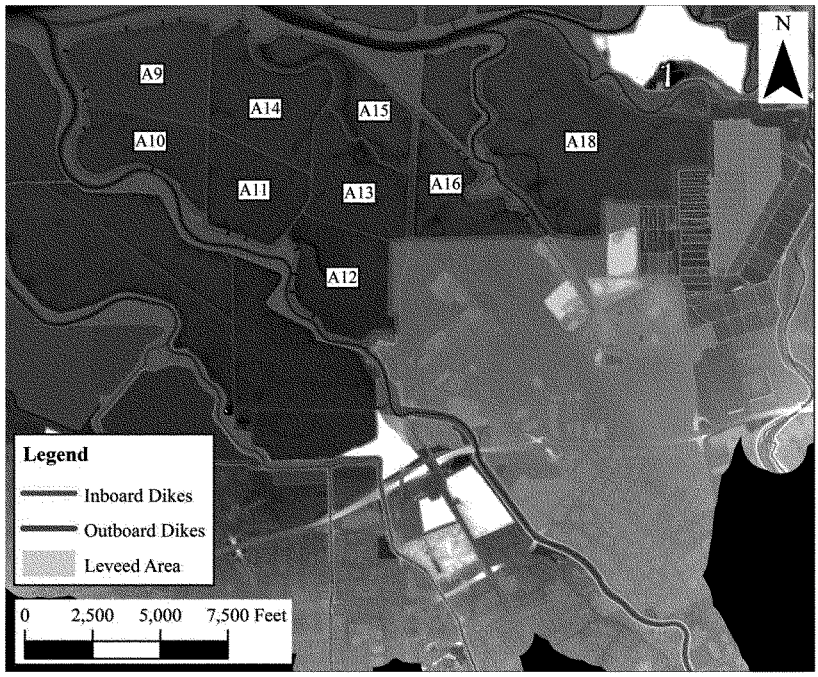

Figure 1-1: Study area vicinity map, pond locations, and existing berm features.

1.2 Geotechnical Investigations and Analysis Leading to the AFB

The primary source of geotechnical information for this summary is the 2009 F3 Milestone Appendix C: Geotechnical Investigation and Analysis for the South San Francisco Bay Shoreline Study in Study Area (USACE, 2009). The investigation included the review of 650 standard penetration test (SPT) borings and 43 cone penetrometer test (CPT) soundings performed by others. In addition, explorations were advanced on the existing outboard (14 SPT, 44 CPT) and inboard (20 SPT, 58 CPT) project levees for the study. Both laboratory testing and in-situ data was used to develop a statistical distribution of geotechnical properties for use in analyses.

Geomatrix (2008) developed fragility curves for six index points along outboard dikes in the project study area. The primary modes of failure considered were seepage and rapid drawdown. One fragility curve (i.e. Area 5) was used to model outboard dike performance for the with project condition at all index point locations prior to the AFB. This fragility curve was incorporated into a Monte Carlo simulation that studied the without project condition (Noble 2012).

Geotechnical recommendations for design and construction were developed for the Alternative Formulation Briefing (AFB). These recommendations focused on constraints most likely to impact a recommended plan (i.e. cost and constructability). Constraints were ubiquitous among all alternatives and used for screening and evaluating potential flood risk reduction measures against one another. The

constraints were considered in the recommended levee alignment (Figure 1-1) and the associated national economic development (NED) and locally preferred plan (LPP) described in the Civil Design Appendix of this integrated document.

1.3 Geotechnical Recommendations since the AFB

Recommendations that were developed for the Alternative Formulation Briefing (AFB) were revised during the current effort and are discussed in Section 3.0 of this appendix. Design and construction recommendations were revised to be more specific to the recommended levee alignment and to reflect additional technical recommendations (e.g. vegetation).

The project was analyzed under the "high" sea level rise rate for the with project condition at the time of the AFB. Following the AFB the existing condition was analyzed under the historical and intermediate sea level rise rates for the without project condition. The geotechnical basis for the fragility curve was modified from a seepage and drawdown governed performance to one governed by overtopping and erosion. The basis for the modified fragility is discussed in Section 4.0 of this appendix. The results of the analysis are discussed in detail in Tidal Flood Risk Analysis Appendix of this integrated document.

2.0 SUMMARY OF GEOTECHNICAL CONDITIONS

Details regarding the subsurface explorations are presented in USACE (2009). The level of subsurface information collected and evaluated to date is judged sufficient to support conceptual alternative comparisons in terms of design, cost, and construction differences. The recommendations provided are intended for conceptual feasibility level analysis for selection and comparison of different alternatives. The recommendations are based on engineering judgment, analysis, and subsurface exploration and laboratory testing. All recommendations will be reevaluated and finalized during preconstruction engineering and design (PED).

In general, the Alviso area of the project is mapped as Bay Mud, which is recently deposited fine-grained soil of marine origin. Bay Mud is relatively thin (< 5 feet) along the existing urban/salt pond boundary and becomes deeper (35 to 40 feet thick) along the outer pond levees adjacent to the bay. Bay Mud is occasionally underlain by thin (< 5 feet) granular marine deposits of loose to medium dense consistency. More typically the Bay Mud is underlain by alluvial flood plain deposits and Old Bay Mud that range in grain size from coarse to fine. The consistency of these deep foundation soils is medium dense to dense/stiff.

The existing inboard levees for the project area are constructed from excavated alluvial deposits in the vicinity of the alignment. The outboard levees are most likely constructed of Bay Mud borrow excavated from adjacent ponds and sloughs.

Bay Mud thickness is judged to be the most important geotechnical aspect affecting the cost of proposed alternatives. The thickness of the Bay Mud using cone penetrometer testing (CPT) and standard penetration testing (SPT) explorations along the inner and outer levees, regional/site geomorphology, and engineering judgment. The interpretation is shown on Figure 2-1.

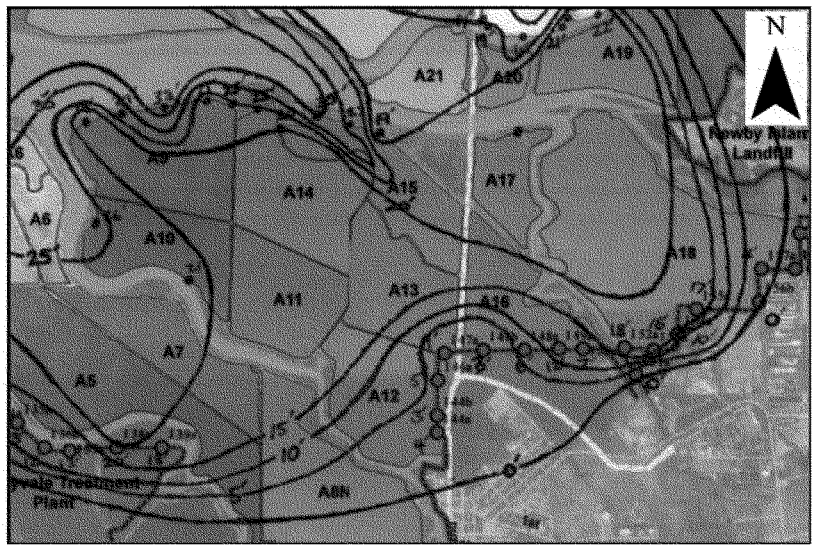

Figure 2-1: Interpreted bay mud thickness (ft) contours.

3.0 GEOTECHNICAL FINDINGS AND CONCEPTUAL DESIGN RECOMMENDATIONS

Several geotechnical explorations and analyses programs have been completed and are discussed in USACE (2009). The analyses considered multiple levee configurations for the project, the performance of existing features, and an anticipated three year period to complete all construction. The following sections summarize significant findings, geotechnical criteria, and recommendations used in the formulation of the levee alternatives.

3.1 Levee Design and Transitional Habitat Fills

The project alignment being considered includes the construction of a new levee along the existing inboard levee alignment. Various configurations of transitional habit fill are being considered along the waterside slope of the new levee. The fills range from large areal fills (> 300 ft wide) to a smaller fill bench (~ 50 ft wide) to provide an area for a variety of habitat and animal refugia to establish. The primary geotechnical constraint for fill design and construction are related to weak Bay Mud foundation soils that underlie the project area. These foundation soils may result in large magnitude settlement, bearing capacity/slope stability failures, and require special provisions for construction.

All levee and transitional habitat fill alternatives will encounter difficult conditions due to the soft surface and foundation soils, and static water elevations above work areas. Limited working/staging areas, operating on very soft soils, the use of specialized equipment (e.g. low ground pressure), and varying water management strategies are to be expected. The geotechnical site conditions most relevant to cost of a given alternative are those issues related to settlement and low strength soils. The following sections focus on these constraints which have significant cost impacts regardless of the details of the design decision (e.g. long-term staged construction, vertical wick drains, etc.). Additional analyses to identify

preferred construction methods that leverage value will be needed in PED. Similarly, construction field instrumentation (e.g. piezometers, settlement/survey monuments, etc.) will be evaluated to determine necessary monitoring during the construction and operation and maintenance phase of the project.

The construction will be sequenced to maintain control of pond water surface elevations and facilitate levee construction over a three year period. The new levee will be constructed in three reaches that are divided by the new closure structures discussed in paragraph 3.2. New structures and modifications to existing structures would be completed prior to the construction of the new levee reaches. Each reach has been identified primarily based on access to existing roads and can be subdivided during construction to better manage dewatering of the levee foundation and delivery of offsite fill for construction. Initial clearing and excavation of the existing inboard dike will create berms that will isolate the new levee foundation from the adjacent ponds. Temporary berms along the outboard of the new levee alignment can provide construction access/turn-outs and the base of new transitional habitat fills.

3.1.1 New Fill Settlement Estimates

The amount of primary consolidation settlement that would occur under new fill loads for various thicknesses of Bay Mud foundation soils and assuming 1-D loading conditions is shown in Figure 3-1. Magnitudes for settlement beneath large areal fills (e.g. transitional habitat) can be expected to be equivalent to those shown in Figure 3-1. Settlements beneath levees are likely to be approximately 5 to 10% less than those beneath large areal fills depending on the thickness of Bay Mud in the foundation. However, for planning purposes the magnitudes shown are judged to be reasonable for estimating earthwork/settlement along the levee alignment. The magnitude of, and impacts to structures resulting from, settlement will be more fully evaluated during PED.

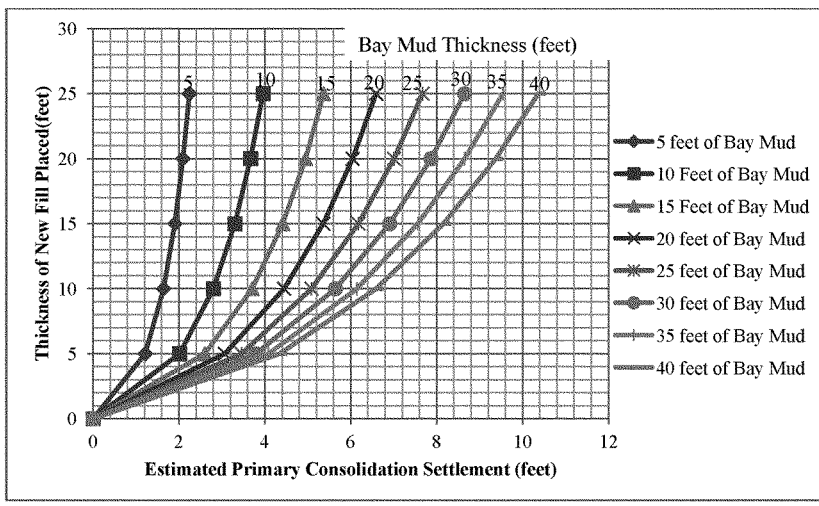

Figure 3-1: Estimated Bay Mud Consolidation Settlement for Large Areal Fills

The period to complete primary consolidation will be many years given the very low permeability of the Bay Mud. The estimated period to the completion of 50% and 90% consolidation is shown in Table 3-1.

The estimated periods assume no surcharging or subsurface drainage (i.e. wick drains) is implemented prior to or during levee fill placement. A uniform strain index of 0.32 and a new fill height of 16 ft were assumed. Double drainage is judged to prevail in the Alviso Area with the exception of a constrained area on the outboard pond berm roughly 0.5 mile east of Alviso Slough. For comparison purposes, the time to consolidation for single drainage conditions have been presented. The impact to the time required for consolidation is a factor of four.

Additional details regarding material properties and analyses assumptions are described in Attachment A. The impact of all assumptions on the large strain/settlement anticipated will be reevaluated in PED.

Table 3-1: Estimated Consolidation Rates for Bay Mud

	Double Drainage		Single Drainage	
Bay Mud Thickness (feet)	**Time for 50% consolidation (years)**	**Time for 90% consolidation (years)**	**Time for 50% consolidation (years)**	**Time for 90% consolidation (years)**
5	0.2	0.7	0.6	2.7
10	0.6	2.7	2.5	10.6
15	1.4	6.0	5.5	23.9
20	2.5	10.6	9.9	42.4
25	3.8	16.6	15.4	66.3
30	5.5	23.9	22.2	95.4
35	7.5	32.5	30.2	130
40	10.0	45.4	39.4	170

Secondary consolidation, impact of organic content, and initial distortion settlements will be analyzed in more detail during PED. Contribution from secondary consolidation is likely to be about 3% that of primary consolidation based on consolidation properties and estimates in USACE (2009). Contribution from organics is expected to be fairly uniform because the stratum with elevated organic content is typically 2 feet thick. Fills on "virgin ground" may induce localized elasto-plastic deformations typical to construction on soft soils.

More detailed analysis during PED will be needed to estimate and make recommendations to manage and accommodate elasto-plastic deformations and consolidation settlement. The use of geosynthetics (e.g. fabrics or grids) may be required for fills on virgin ground that serves as the foundation for levee fills. The use of wick drains spaced 5 to 7 feet may be used to expedite consolidation settlement of Bay Mud from many years to less than one year to accommodate a three year construction timeline for the new levee alignment. Existing strata beneath the current dikes is anticipated to be stiff enough to support against global failures and mud waves during the installation and initial wick drain service period. The need for expedited consolidation is driven by weak foundation soils and is discussed in paragraph 3.1.2.

3.1.2 Bearing Capacity and Slope Stability

New fill that is placed directly on normally consolidated Bay Mud is prone localized bearing capacity failures. Near surface Bay Mud is estimated to a cohesion of approximately 75 psf and a bearing capacity of approximately 430 psf (i.e. $q_{ult} = c*N_c = 75*5.7 = 430$) based on Terzaghi's bearing capacity equation. The use of low ground pressure equipment (i.e. 3 psi contact pressure) will be required to place the initial lifts of new fill. The use of geosynthetics to distribute the weight of new fill and construction techniques that monolithically advance the leading edge of construction are likely to be necessary to reduce "shoving" and mud waves on virgin ground.

Slope stability was analyzed using Morgenstern-Price methods for force and moment equilibrium for circular slip surfaces along the edges of large areal fills (e.g. planned habitat islands). Material properties for each stratum are shown in Table 3-2 and are based on typical values for the study area (USACE, 2009). Parameters directly measured during this study included compacted Bay Mud, Bay Mud crust, Stiff Clay (Old Bay Mud), and strength with depth (i.e. s_u/P) trends for normally consolidated Bay Mud.

Table 3-2: Soil properties used in stability analyses (Attachment A).

		Undrained (phi = 0)		Drained	
Material	**Unit Weight (pcf)**	**Cohesion (psf)**	**S_u/P (psf/ft)**	**Phi (degrees)**	**Cohesion (psf)**
Compacted Fill	125	800	--	32	100
Bay Mud Crust	100	500	--	32	500
Normally Consol. Bay Mud	97	75 [at ground surface]	12	31	0
Stiff Clay	125	1500	--	32	0

Low undrained shear strength of the underlying Bay Mud require that new fill thicknesses be carefully planned to avoid negative impacts (e.g. bearing capacity failures, mud waves, etc.). Slope stability analysis was performed for fill slopes of 5:1 to 3:1 (H:V) to estimate the maximum fill thickness that could be placed for various Bay Mud thickness while maintaining a factor of safety (FOS) of 1.3 or greater. The minimum FOS is based on the "end of construction" condition in EM 1110-2-1913. Table 3-3 summarizes the maximum fill thickness recommendations for respective fill configurations.

Table 3-3: Estimated Fill Thickness Placement Limits for first fill stage for 3:1 to 5:1 Slopes on 5 to 40 feet of Bay Mud (Attachment A)

Bay Mud	Side Slope of Fill (H:V)		
Thickness (ft)	**3:1**	**4:1**	**5:1**
5	20 feet	20 feet	20 feet
10	14 feet	15 feet	20 feet
15	11 feet	12 feet	15 feet
20	11 feet	12 feet	13 feet
40	11 feet	11 feet	13 feet

If fill thicknesses greater than recommended are required, the fill will need to be placed in stages after pore pressures have dissipated. Wick drains will allow more rapid drainage of pore pressures. Details are discussed more in Attachment A however, a quantitative value (i.e. time savings vs. cost of installation) for wick drains cannot be accurately specified before PED.

A number of additional stability analyses were conducted assuming a 4:1 side slope fill and 20 ft of Bay Mud to verify that short term (i.e. end-of-construction) loading is the critical case. The long-term (i.e. drained condition) condition showed a factory of safety of 2.41 and 2.27 for a piezometric surface at the ground surface (0 ft) and mean higher high tide (6 ft), respectively. The addition of a tension crack for the drained condition with water at 0 ft maintained the 2.27 factor of safety with a slightly shifted critical surface geometry. Stability analyses with be reevaluated in detail during PED and may include seismic deformation analyses.

3.1.3 Seismicity and Seismic Hazards

USACE (2009) discusses the seismic hazards that could impact the project area. The project is located in a highly seismic region between the San Andreas and Hayward faults. Fault rupture within the project

area is highly unlikely, however, strong ground shaking capable of inducing slope instability and liquefaction of coarse grain alluvial deposits is likely. Peak horizontal ground accelerations of around 0.5 to 0.6 g have a 10 percent chance of exceedance in 50 years. Explorations cataloged in USACE (2009) encountered discontinuous potentially liquefiable strata and sensitive clays within 50 ft of the ground surface. The effect on project levees is anticipated to be primarily related to settlement ranging from 0 to 18 inches. Due to the presences of these materials, a seismic site class F is assigned per ASCE/SEI 7-10, Chapter 20.

Detailed seismic analysis to estimate project performance should occur during PED. In general, it is anticipated that some levee distress may occur during a large seismic event, which will require repair and restoration of the levee section. Potential damage may include localized slumping, cracking, and/or seismically induced settlements at the crest. However, feasibility level analysis and past performance in the project area suggest that total loss of the levee section to significantly large liquefaction or lateral spreading it is not likely. Therefore, seismically induced damage is not anticipated to contribute significantly to an immediate post-earthquake flood risk. The compacted clay levee section is judged to be sufficiently resilient to seismic hazards with freeboard (approximately 3 feet above an event having 0.01 chance of exceedance in project year 50 which includes sea level rise), moderately flat slopes (3H:1V), and moderately wide crest (16 ft).

3.1.4 Project Fill Specifications

Levee fill shall meet the following criteria general criteria. Levee fill shall be sufficiently fine grained (e.g. CL, CH, or SC) and plastic (e.g. plasticity index of 10 to 50; liquid limit < 60) to produce a continuum of low hydraulic conductivity (i.e. $1x10^{-4}$ or less) fill. Levee fill shall be free of organic matter and particles larger than 4 inches in diameter. Past experiences of the sponsor has shown that materials meeting these specifications are commonly available from local quarries and construction projects. Levee fill specifications may be modified based on availability at the time the project enters construction.

Structural fills shall be used around new/existing structures and as a roadbase for the levee crest. Structural fills shall consist primarily of well graded sands and gravels. Fills around structures shall not free draining include 15 to 20 percent fines. Structural fills used to surface the levee crest may consist of crushed rock, quarry run, or other commercially available material capable of providing an all weather trafficable surface.

Transitional habitat fills can be constructed of materials not suitable for structural or levee fill. These materials include organic matter, material generated from clearing and grubbing, and oversize material encountered in project excavations. The top three feet of transitional habitat fill should be greater than 75% fines in order to provide the substrate necessary to support the anticipated project vegetation.

3.1.5 Potential Additional Fill Borrow Sources

The United States Fish and Wildlife Service (USFWLS) plans to import fill to the site for potential use as general fill for existing levee maintenance and for use in construction of new levees. SPN stated that if the fill material met the specifications noted in Section 3.1.4 it could be suitable for use as levee fill. An evaluation of the USFWLS proposed fill import and stockpile plan is included as Attachment B, and includes recommendations for sorting and testing of imported soil.

Additional sources of fill considered included the San Jose Wastewater treatment plant sludge pond solids and existing levees/berms. Laboratory testing of the sludge showed an organic content that precluded

their use as structural fills. The sludge is geotechnical suitable for transitional habitat fills; however, additional testing to determine the environmental suitability is required. Existing inboard levee fill may be able to be reused if it meets the specifications noted or blended with suitable levee fill to improve its suitability. In all cases, levee fill should be homogeneous to provide a consistent impermeable continuum with low risk for seepage related failure or distress.

3.1.6 Vegetation and Erosion Protection

Marsh vegetation that is maintained to a height compliant with ETL 1110-2-583 is considered the only feasible vegetation at the project. Saline conditions along the alignment for the recommended levee will not support significant sod/turf. Vegetation that can be successfully installed and maintained will be a mix of native marsh vegetation. The combination of vegetation, buried stone, and/or transitional habitat fills (i.e. planting berms) are proposed to balance requirements for levee safety and regulatory limits on traditional maintenance activity (e.g. regular mowing, equipment in/near environmentally sensitive areas).

The configuration of proposed vegetation, and alternatives for maintaining vegetation, are shown and summarized in Attachment D. This vegetation will include 12 to 18 inch pickleweed from elevation 0 ft to 3 ft above the typical high water elevation. The high water elevation corresponds to approximately elevation 6 ft and 10 ft on the land and water side slope, respectively. Upland grasses will occupy the side slopes between the levee crest and the pickleweed. Combinations of buried stone protection and buried gravel may be necessary to stunt the growth of native vegetation in lieu of regular mowing in an environmentally sensitive area, or to provide erosion protection where vegetation cannot be supported. It is anticipated that a reduced need for regular mowing will still include annual mowing of the levee side slopes within 10 to 12 feet of the levee crest and above elevation 9 ft. The establishment of woody vegetation (e.g. coyote bush) on the levee prism is unlikely, but would be cleared and grubbed by hand as needed.

The recommended levee design includes vegetation as erosion protection on the water and land side slopes. Vegetation likely to establish on the project levees is described above. Vegetation is anticipated to be continuous and able to provide erosion protection from overtopping of the levee. Overtopping would be of short duration (i.e. minutes to hours) for events exceeding the design levee height. Erosion protection from 0.5 to 1 ft waves generated during frequent events will be provided by the transitional habitat fills (e.g. 50 foot bench at EL 9 feet or ecotone), buried stone protection, and existing wave break berms between the railroad and Artesian Slough.

3.2 Levee Crossings

For the feasibility design the structures recommended at levee crossings are gate closure systems. Recommendations were based on the subsurface stratigraphy shown in CPTs 47a and 48b, and boring 52a. Additional borings and design analyses will be necessary during PED to validate and finalize the feasibility dataset and assumptions.

3.2.1 Rail Road Flood Gate Closure

The recommended levee alignment will require a mitre gate closure structure across the existing railroad track near Station 34+75. The miter gate is shown in the Civil Design Appendix. The feasibility level design, construction, and operations of the proposed gate structure considered:

- Use of deep foundation system (i.e. concrete piles) to support the structure. The piles will be 20 feet long concrete piles extending to stiff soils beneath the soft Bay Mud. The pile section is 24 inches square and sufficiently oversized to bear potential down drag and seismic loads.
- Differential settlement and lateral loading between the closure structure and proposed levees.
- Availability of materials and trained personnel to respond to flood events.
- The construction of the closure structure should not require sustained interruptions in the railroad operations or modification to the railroad grade/alignment.
- A concrete cutoff through the railroad bed beneath the mitre gate to prevent seepage.

3.2.2 Tide Gate at Artesian Slough

The recommended levee alignment will require a tide gate at Artesian Slough near Station 94+75. The design and construction of the proposed tide gate considered:

- Use of deep foundation system (i.e. concrete piles) to support the structure. The piles will be 20 feet long concrete piles extending to stiff soils beneath the soft Bay Mud. The pile section is 24 inches square and sufficiently oversized to bear potential down drag and seismic loads.
- Differential settlement and lateral loading between the tide gate and proposed levees.
- The new levee should provide access for regular maintenance and operation of the tide gate. Additional width, surfacing requirements, or other provisions may be required to support equipment and light duty vehicle traffic.

3.2.3 Utilities

Four utility crossings are identified along the recommended levee alignment. An action at each crossing is described where applicable.

- A siphon near Station 76+00. The siphon was installed in 2012 and maintains flow through the existing inboard dike to New Chicago Marsh.
- Underground electric lines leading to the SCWD weir near Station 95+00. The utility will be reconfigured to an overhead configuration.
- Culverts near Station 96+00 that maintain flow from Artesian Slough to the area south of Pond A18.
- Overheard PG&E electric and appurtenant towers near Station 130+00. Overhead clearance is substantial enough to not impact levee construction. Tower bases in Pond A18 may require added erosion protection after the pond is breached to tidal action.

The siphon and culvert provide water to environmentally sensitive areas. Neither crossing has a means of positive closure and will likely need to be replaced. The design and construction of the new siphon and culvert should consider settlements induced by new levee fill. Critical components such as valves, weir board structures, etc. may require support from a deep foundation or be sized to be resilient to differential settlement.

4.0 ECONOMICS AND HYDRAULICS MODELING SUPPORT

The following section discusses geotechnical performance (i.e. fragility curve) of the existing dike-pond system that was used in hydraulic modeling of flooding in the project area. The fragility curve provides the likely performance of the outboard dike as a function of water surface elevation. Performance is characterized as the "probability of unsatisfactory performance" and is more plainly the "probability of breach". The resultant fragility curve that was input in the Flood Damage Reduction Analysis (HEC-

FDA) software to model the without project condition and identify economic benefits captured for different levels of flood protection. The effects of erosion and overtopping on geotechnical performance and breach development are also discussed.

4.1 Performance of Existing Dike-Pond System

The existing dikes in the project area are not engineered structures. The most likely source of initial flooding under more frequent flood events is through the dike-pond system that is west of Artesian Slough (Figure 4-1). By comparison, the existing condition of the west side of the project is consistently at lower elevations (i.e. > 2 ft) on both inboard and outboard dikes.

The following sections summarize geotechnical performance in the context of the dike-pond system west of Artesian Slough. Overtopping and erosion based failures are critical to the performance of the dike-pond system. Seepage and drawdown based failures were determined to be non-credible due to the short duration (i.e. hours) loading of flood events.

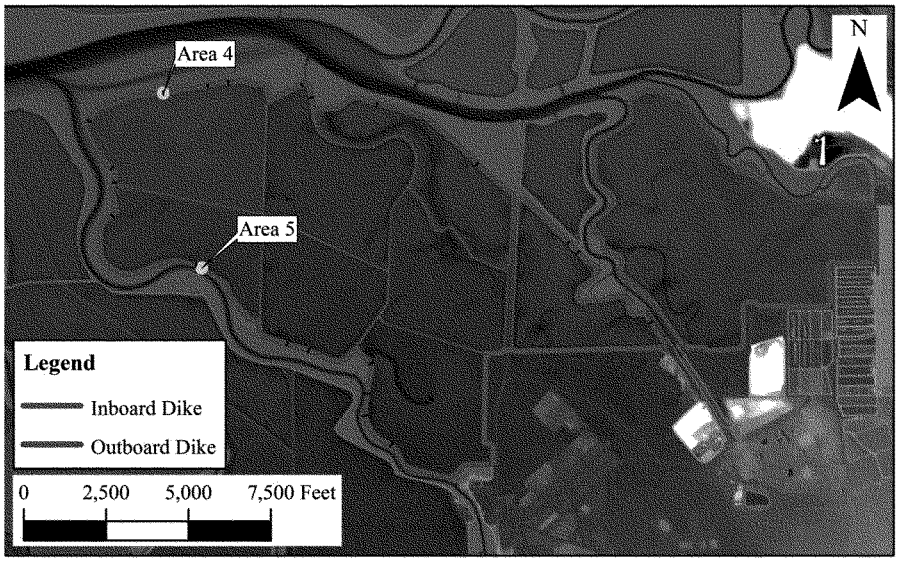

Figure 4-1: Project map of existing dikes and berms.

4.2 Outboard Dike Performance

4.2.1 Fragility Curves Prior to Alternative Formulation Briefing

Geotechnical fragility curves for the entire SSBS project were developed in USACE (2009) to characterize the condition of the existing outboard dikes. This effort leveraged data from existing (650 SPT and 43 CPT soundings), as well as new (34 SPT and 102 CPT soundings), geotechnical exploration locations along the existing inboard and outboard dikes and historical operation and maintenance efforts.

This data was used to create a total of 14 index points; six on the outboard dikes (Geomatrix, 2008) and eight on the inboard dikes (USACE 2009).

Two of the index points developed in Geomatrix (2008) are along the outboard dike that is west of Artesian Slough (Figure 4-1). A "most critical" geometry was estimated from six cross sections within 500 feet of each index point. Fragility curves were developed by varying outboard water surface elevations and reporting the minimum factor of safety under steady state seepage and rapid drawdown conditions. Probability of unsatisfactory performance (P_u), also referred to as probability of failure, was reported as a function of water surface elevation from the crest (i.e., crest elevation minus water surface elevation).

4.2.2 Fragility Curve post-Alternative Formulation Briefing

The fragility curve used prior to the AFB was based upon seepage and rapid drawdown and judged incompatible with the short duration (hours) loading of flood events. Erosion and overtopping erosion were identified as the mechanisms critical to determining the likelihood of failure/breach of the outboard dike. In addition, newer and higher resolution survey information in the study area had been collected. An additional fragility curve was developed to more accurately represent loading (i.e. erosion and overtopping) and updated dike dimensions (i.e. elevation and crest width) known to exist in the study area.

No new geotechnical analysis was performed to quantitatively support the additional curve. However, existing analysis for erosion and overtopping, as well as empirical observations of dike performance, were leveraged to support the justification for the revised fragility curve. The primary factors supporting the revised fragility curve were (i.) typical conditions along the outboard dike, (ii.) hydraulic and breach modeling already performed for the without project condition in the study area, and (iii.) observed performance relative to maintenance performed.

A 2010 USGS LiDAR survey of the study area was used to identify the typical configuration of the outboard dike. The cross-section geometry was sampled at 21 representative locations (Figure 4-2) and plotted (Figure 4-3). Cross sections were purposely concentrated in areas where overtopping is likely to occur first (i.e., saddles) and/or erosion is more likely (i.e., proximity to sloughs). Crest widths were estimated by measuring the section width 1 ft below the peak crest elevation. This method was used to avoid underestimating crest widths due to irregular topography. Factors that contribute to functionally narrower crests, such as rodent holes, irregularities from erosion, and very loose erodible soils, were not considered in the estimate of the crest width. The average crest elevation and width of the sampled cross sections was 10.8 ft NAVD88 and 18 ft, respectively.

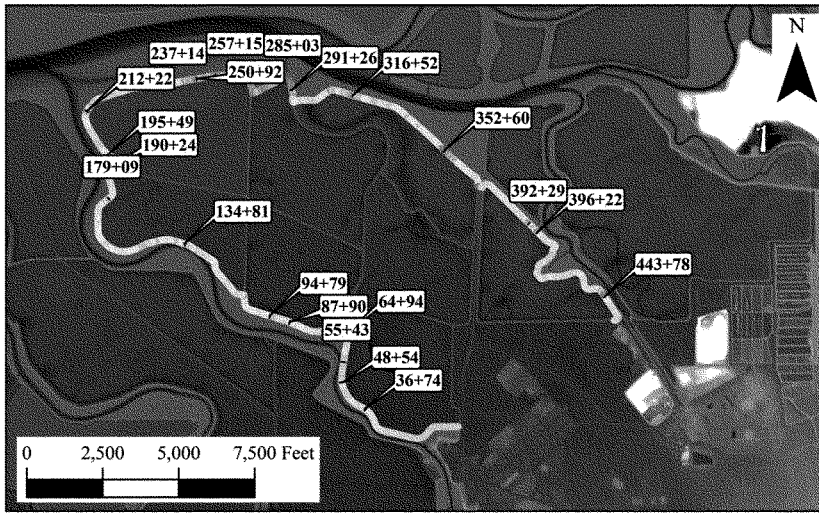

Figure 4-2: Locations of select cross-sections along the ouboard dike.

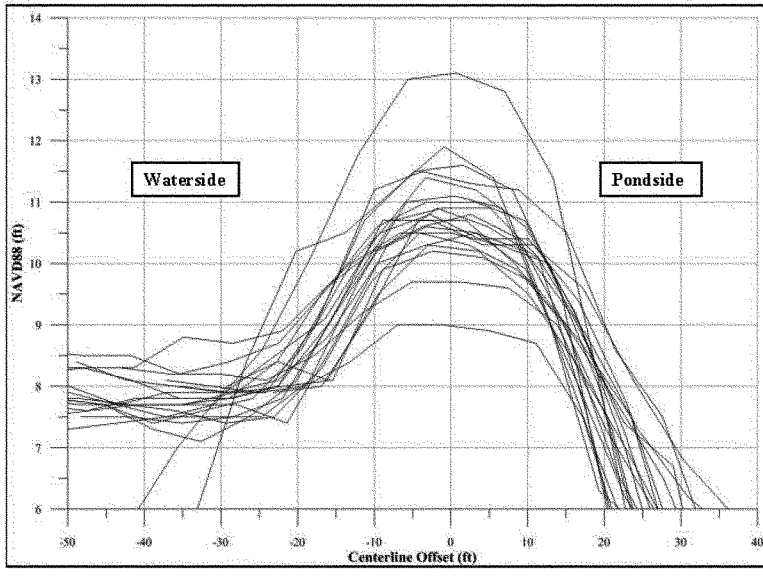

Figure 4-3: Cross-sections along the outboard dike.

4.2.3 Overtopping and Erosion Induced Breaching

Overtopping and erosion are critical to the performance of the outboard dike. Existing information duration of tidal flood events and the results of breach modeling efforts in the study area were used to estimate the thresholds at which the likelihood of breach along the outboard dike will occur. The following section discusses the basis for estimated loading duration and respective performance impacts to the outboard dike with respect to the peak water surface elevation (WSE) experience during a flood event.

The duration of flood loading was estimated using the tidal signal (i.e., shape) from the San Francisco Golden Gate tide gauge. The peak of the signal was set equal to a given WSE and the duration above lower elevations was recorded. Table 4-1 shows the approximate durations of loading above elevations incrementally lower than the peak WSE.

Table 4-1: Summary of durations exceeding elevations lower than the peak WSE.

Peak Water Level (NAVD88, ft)	WSE above (NAVD88, ft)	Duration Above WSE (hr)
12	11	4.5
	10	7
	9	9
	8	> 10
11	10	4.5
	9	7
	8	9
10	9	4.5
	8	7

USACE (2008) details the investigation and modeling effort to establish likely times to breach from wave attack, overtopping erosion, or both. Table 4-2 summarizes the overtopping scenarios likely to induce a breach at the outboard dike between Alviso and the ponds west of Artesian Slough. The table was adapted from USACE (2008) and shows the expected time to breach for overtopping scour only.

Table 4-2: Estimated time to breach versus dike crest width.

		Expected critical time to breach (hr) for respective crest width (ft)					
Height (ft) of overtopping	q (ft^3/s) per foot of dike	W = 25*	W = 20*	W = 15	W = 11	W = 7	W = 5
0.30	0.5	--	--	42.86	31.43	19.43	14.04
0.47	1	--	--	9.19	6.7	4.33	2.98
0.75	2	--	--	4.46	3.32	2.08	1.49
0.98	3	5.50	4.40	3.29	2.42	1.53	1.09
1.19	4	4.60	3.70	2.75	2.02	1.27	0.91

1. Overtopping height determined from broad crested weir equation (Henderson, 1966).
2. Overtopping flow rate from the Feasibility Scoping Meeting Geotechnical Appendix (USACE, 2009).
3. (*) Indicates time to breach interpolated from linear fit of data for dikes with W from 5 to 15 ft.

The cross-section geometry, anticipated loading duration, loading required for overtopping breach, and past performance were considered to identify possible breach locations. Figure 4-4 shows potential overtopping breaches that can be expected to occur from a given peak WSE. Point labels represent crest elevation and width at respective outboard dike station (Figure 4-2). Lines draw indicate the approximate

threshold (i.e. overtopping duration vs. crest width) to which overtopping breaches are likely to occur. Of the 21 cross sections evaluated, three locations are at risk of an overtopping breach for a peak WSE of 11 ft. The number of potential overtopping breaches increases to 12 for a peak WSE of 12 ft.

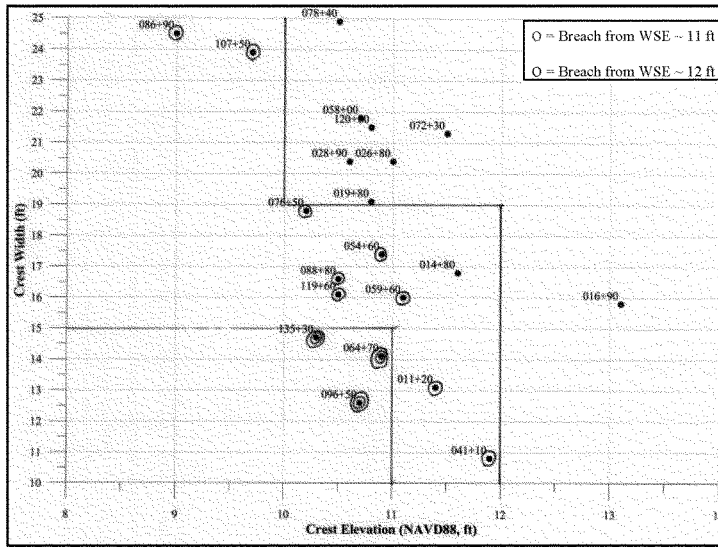

Figure 4-4: Potential overtopping breach locations for given peak WSE (Geomatrix, 2006).

The impact of wave attack and erosion on the waterside of the outboard contribute to the performance of the outboard dike. USACE (2008) modeled wave attack, however, wave height (i.e. 3 ft height or greater) was judged to be overestimated by at least 2 ft in the study area. Past performance along the outboard dike during frequent (i.e. non-overtopping) events was inferred from maintenance records for the period 1995 to 2005 (Geomatrix, 2006). These records provide a generally coarse interpretation of distress along the outboard dike. Figure 4-5 shows the number of repair episodes along the outboard dike in the period of record. Figure 4-6 shows the summed extent of repairs in the period of record when such records were available. The extent of repairs was typically described in terms of linear feet and/or cubic yards. A review of the storm frequency and annual maximum water levels showed a positive correlation between "stormier years" and increased maintenance (i.e. 1997 and 2003).

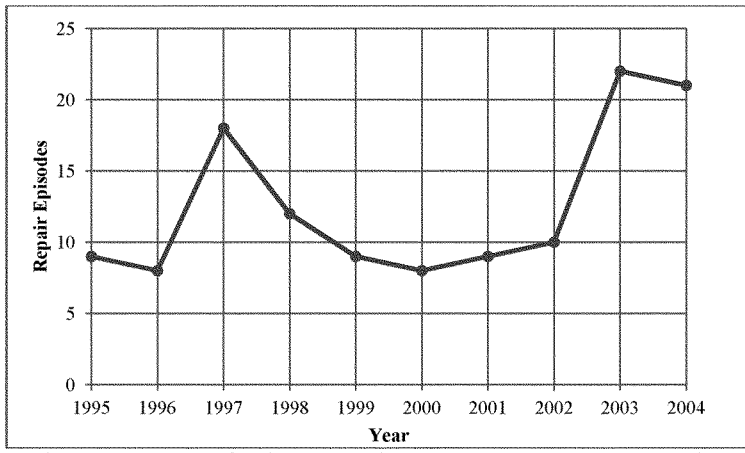

Figure 4-5: Number of maintenance episodes by year along the outboard dike.

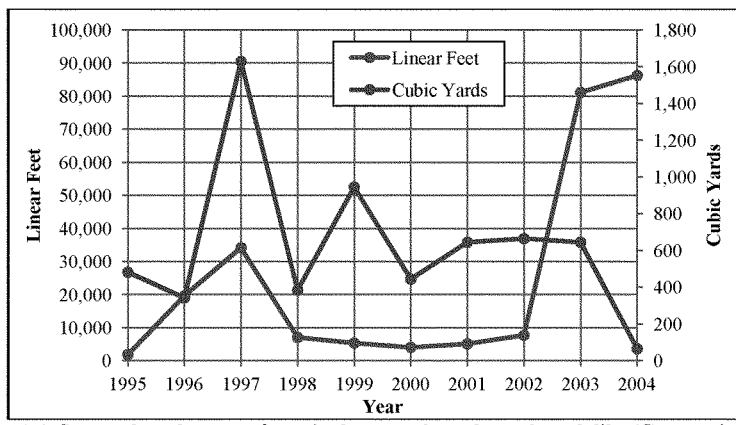

Figure 4-6: Summed total extent of repairs by year along the outboard dike (Geomatrix, 2006).

The fragility curve for outboard dike combined geotechnical investigation, numerical modeling, and maintenance record datasets to capture the primary mechanisms critical to performance along the outboard dike; overtopping and erosion. The key assumptions used to construct the fragility curve are as follows:

- Time to overtopping breach is quantitatively supported in the geotechnical analyses performed in USACE (2009a).
- Maintenance records demonstrate distress and/or damage occurring in "stormier years" with presumably higher than typical water surface elevations. Maintenance was generally ad-hoc

when the ponds and associated dikes were owned by Cargill, Inc.; however, the U.S. Fish and Wildlife Service (FWS) performs maintenance annually in the period following the wet season.

- Wave height in the project area is limited to 0.5 to 1 ft above the static WSE and does not increase with increasing static WSE. The outboard dike is assumed partially exposed to wave attack above elevation 8 ft and fully exposed above elevation 9 ft (Figure 4-3).
- The extent of resources (e.g., funding and staff) for FWS to maintain the outboard dike into the future is uncertain. To date, repairs have been prioritized to the areas of highest need and is not comprehensive to all needs (USACE, 2014a).

Figure 4-7 shows the fragility curves developed during the study for analysis pre- and post-AFB. Table 4-3 shows the estimated probability of unsatisfactory performance for the two mechanisms considered since the AFB and the combined probabilities for respective elevations. Justifications and support to the engineering judgment applied while estimating performance at each elevation are described in Table 4-3.

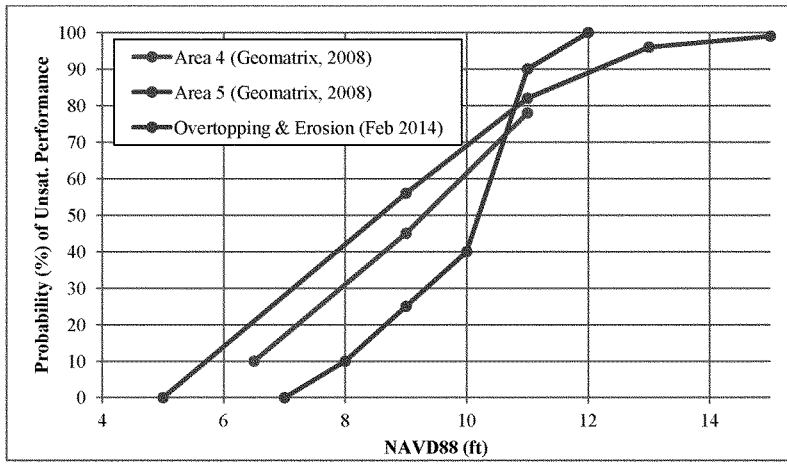

Figure 4-7: Comparison of outboard dike fragility curves

A sensitivity analysis was conducted to determine impact of the geotechnical fragility curve on calculated damages for the current and future without project condition. The analysis evaluated two additional fragility curves; (i) failure due to overtopping only, and (ii) no failure below elevation 10 feet. The additional fragility curves are discussed in detail in Tidal Flood Risk Analysis Appendix of this report.

Table 4-3: Updated probability of unsatisfactory performance (breach) based on erosion and overtopping mechanisms only.

Static WSE (NAVD88, ft)	Probability of Failure (P_u)			Comments
	Erosion	Overtopping	Combined[1]	
12	0.3	1.0	1.0	1. 32,000 ft of outboard dike (70% of length) overtops. About 21,000 ft overtops over elevation 11 ft for 4hrs, possibly inducing up to 3 overtopping breaches. 2. Overtopping of crest elevations at 10 ft for 6.5 hours, possibly inducing 9 additional overtopping breaches (Figure 4-4).
11	0.3	0.85	0.90	1. 9,250 ft of outboard dike (25% of length) overtops above elevation 10 ft for 4 hrs. Potential overtopping breaches at three locations. 2. Overtopping height is transient and the duration required to induce breaching may not occur. 3. Breach from combined erosion and overtopping increases the likelihood of breach at the three locations (Figure 4-4).
10	0.25	0.20	0.40	1. Overtopping at a limited number of locations. These locations have wide sections and sustain overtopping erosion for proportionally longer durations than narrow (< 15 feet) sections. 2. The dike crest in several reaches is composed of loose highly erodible silt with organics (USACE, 2014a). Time to overtopping breach may be substantially shorter in these reaches. 3. Rodent activity in the uppermost 1 to 3 feet of the dike section may contribute to internal erosion (USACE, 2014a) or effectively narrower crest width available during overtopping. 4. Very loose silts and organics in localized reaches of the dike crest may be substantially more erodible than assumed in USACE (2008). 5. Increased size and frequency of maintenance can be expected based on maintenance records (Geomatrix 2006). 6. The difference between the 2010 site survey and current conditions in 2014 is uncertain (e.g. potential for lower and thinner than measured crest elevations). 7. Repairs/Action to restore crest elevation from subsidence is recognized only after overtopping occurs (i.e., no periodic surveys/measurements of dikes). 8. Dike vulnerability to combined erosion and overtopping in low spots is very minor or incipient overtopping.
9	0.2	0.05	0.25	1. WSE in the range observed to have increased frequency and scope of repairs. 2. Lower WSE more frequent in a single wet season with maintenance performed annually and not ad-hoc. 3. Prioritization of repairs/maintenance relative to available resources can allow "semi-vulnerable" locations to become increasing vulnerable to loading. 4. Loss of section height and width due to normal coastal processes.
8	0.1	0	0.10	
7	0	0	0.0	1. Water levels experienced frequently (daily to weekly) with no noteworthy distress.

Notes:
1. Calculated per ETL 1110-2-547; (1 - Erosion) * (1 - Overtopping) = 1 - Combined.

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4.3 Inboard Dike Performance

The inboard dike was assumed to fail due to overtopping. The inboard dike crest width is variable in the reach west of Artesian Slough. Crest widths are typically between 10 and 15 ft wide but can be as little as 8 ft along the alignment. Crest elevations vary from 6 to 11 feet suggesting substantial overtopping length (i.e. 1,000 ft) if the dike was exposed to normal high tides (i.e MHHW = 7 ft NAVD88) or greater than one mile of overtopping length for WSEs that cause an overtopping breach of the outboard dike. It can be inferred from Table 4-2 that an overtopping height of 1 ft for the duration of 3 to 4 hrs is likely to induce a breach through the inboard dike. An accumulation of overtopping high tide cycles in the days following a non-overtopping outboard dike breach, or an overtopping induced breach of the outboard dike would result in subsequent failure of the inboard dike.

Static failures prior to overtopping were not considered credible during the current effort. Water levels have been sustained for significant periods near mean tide elevation (i.e., 3.5 ft) without failure. If the outboard dike experienced a breach, normal high tide water levels (i.e., MHHW ~ 7 ft) would overtop the lowest reaches (elevation 6 to 6.5 ft) of the inboard dike. Therefore, sustained water levels that are appreciably above elevation 3 ft and do not overtop the inboard dike are highly unlikely.

4.4 Failure Mode Sequence

The geotechnical performance of the outboard dike is critical to the performance of the entire dike-pond system. The failure at the outboard dike will result in overtopping and subsequent failure at the inboard dike. Overtopping is likely to occur at as low as elevation 6.5 ft for the inboard dike. Overtopping, or a breach before overtopping, of the outboard dike will likely result in at least 2 feet of overtopping at the inboard dike. In addition, a breach of the inboard dike is assumed to occur shortly after breach of the outboard.

4.5 Breach Development

Levee failure logic requires estimates for breach dimensions that are likely to develop under variable hydraulic loading conditions. Breach dimensions were estimated using Nagy (2006) equations, which have correlated levee breach dimensions to retained water height, based on a review of 1000+ breaches. These dimensions were consistent with the more physical process breach modeling completed by USACE (2008). Table 4-4 summarizes these estimates. A memorandum summarizing the breach dimension analysis assumptions is included as Attachment C.

Table 4-4: Estimated Breach Lengths using Nagy (2006)

Approximate Water Height above Landside Toe (ft)	Estimated Fully Developed Breach Length (ft)
6.5	75
10	160
13	340
16	725
20	1530

5.0 REFERENCES

AMEC Geomatrix (2008), "Summary Report, Geotechnical Reliability Evaluation of Outboard Levees South San Francisco Bay Shoreline Study, Alameda and Santa Clara Counties, California", Oakland, CA.

Geomatrix (2006), "South Bay Salt Pond Restoration Project Levee Assessment", Oakland, CA.

Henderson, F. M. (1966), Open channel flow. MacMillian Publishing Co., New York, NY.

Nagy, L. (2006), "Estimating Dike Breach Length from Historical Data," Periodica Polytechnica, Serial Civil Engineering, Vol. 50, No. 2, pp. 125-139.

Noble (2012), "Monte Carlo Simulation Under With Project Conditions for South San Francisco Bay Shoreline Study", Noble Consultants, pgs. 23.

USACE (2008), "Erosion-induced Breaching: Reliability Assessment of San Francisco South Bay Salt Pond Levees", *Geotechnical and Structures Laboratory*.

USACE (2009), "Appendix C: Geotechnical Investigation and Analysis South San Francisco Bay Shoreline Study F3 Milestone Without Project", San Francisco District, San Francisco, CA.

USACE (2009a), "Reliability Assessment of San Francisco South Bay Salt Pond Inboard Levees", Landris T. Lee Jr., Geotechnical and Structures Laboratory. Vicksburg, MS.

USACE (2014), "Memorandum for Record: South San Francisco Bay Shoreline Study Supplemental Analyses on Sea Level Change and flood risk associated with US Fish & Wildlife Service's (FWS) Refuge Lands", dated 12 Mar 2014.

USACE (2014a), "Geotechnical field assessment of the San Francisco South Bay dike system", *Trip Report*, Richard Olsen, pgs. 14.

Attachment A

CESPN –ET –EG

5 AUGUST 2011

(minor revisions 15 June 2012)

PROJECT: South San Francisco Bay Shoreline Study

SUBJECT: Geotechnical Support for Alternatives Evaluation and Plan Formulation

Background

The Geo-Sciences Section of the San Francisco District of the Army Corps of Engineers (SPN) has been tasked with providing geotechnical input that will be used to develop cost estimates for various project alternatives as part of the plan formulation process. This memorandum is intended as an interim document that provides general guidance in schematic plan an alternative development. It is anticipated that additional geotechnical consultation may be required at various times during the alternative formulation process to support alternative designs and evaluation. This memo is intended to provide consolidation magnitude and time-rate settlements for various foundation Bay Mud and fill configurations.

Documents that have been relied upon in preparation of this memorandum are:

- Geotechnical Engineering Appendix in support of the Feasibility Scoping Meeting (2010). This document includes geotechnical investigation, laboratory testing and engineering analysis of the outboard levees performed by Geomatrix (under contract to the California Coastal Conservancy) and by SPN Geo-Sciences, geotechnical investigation and laboratory testing of the inboard levees performed by Geomatrix(under contract to the California Coastal Conservancy, 2010) and engineering analysis performed by the SPN Geo-Sciences Section.
- Conceptual Design information provided by the Santa Clara Valley Water District, in a June 28, 2011 email.

Scope of Work of Memorandum

A brief discussion of geotechnical needs for the current conceptual feasibility analysis was provided in a June 17, 2001 email. Six (6) items were proposed by Geosciences as tasks that would assist in the development of better project cost estimates for feasibility level planning and design. The tasks are summarized below:

1) Estimate settlement vs. fill height for various levee fill and foundation conditions
2) Estimates settlement rate for various fill and foundation conditions, including discussion of ways to increase rate of settlement, as appropriate.
3) Estimate maximum fill heights that could be placed at one time without overstressing the foundation soil for various fill height and slope configurations.
4) Typical fill specifications for levee fill.
5) Narrative discussion of geotechnical construction concerns for the proposed alternatives.

6) Narrative discussion of geotechnical concerns/considerations for proposed environmental earthwork.

This memorandum is intended to address items 1-6, above. This discussion is prepared in a DRAFT and INTERIM format and is provided to the PDT team (USACE and non-federal sponsors) for review and comment. After comments, this document will be submitted for District Quality Assurance review. The analysis, recommendations and other conclusions presented in interim technical memoranda are intended to be compiled in a geotechnical report appendix for the next major planning milestone (Alternatives Formulation Briefing).

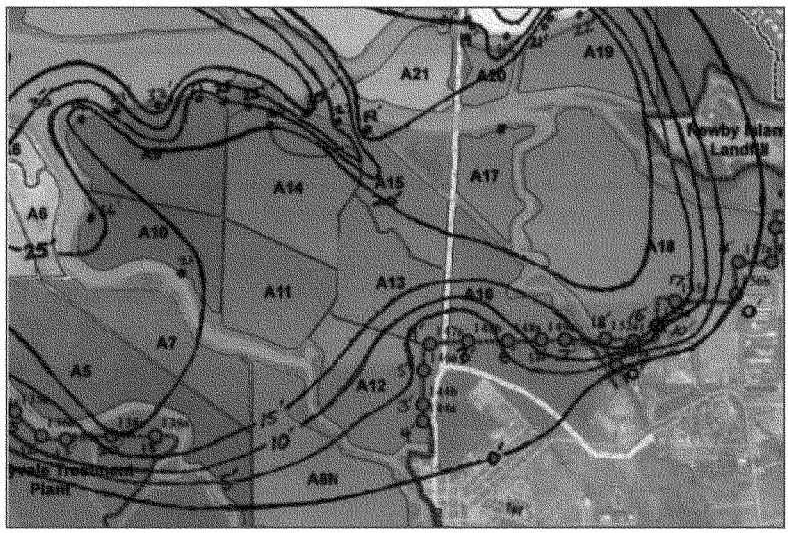


Figure 5-1 - Contours of Bay Mud Thickness

Task 1. Settlement Estimates

The project area is underlain by approximately 0 to 40 feet of marine soil deposits, locally known as Bay Mud. Bay Mud is generally normally consolidated, highly compressible and very weak clayey/silty soil. Bay Mud is commonly classified as CL/CH/ML/MH or OH depending on the location in the bay. Bay Mud was deposited underwater. Figure 1 shows the Corps' interpretation of the Bay Mud thickness for the project area. Along the edges of the deposit, the upper few feet (1-3 feet) has been observed to have slightly less compressibility, higher strength and higher over consolidation ratios, due to some desiccation drying of the soil during tidal cycles. This upper layer is commonly identified as Bay Mud "crust".

It is anticipated that the primary settlement concern for the project will be Bay Mud primary consolidation due to construction of earth or other structures on the Bay Mud. Consolidation settlement has complex soil mechanics that depends on the soil permeability, stress history, applied

loads, existing loads, load geometry and other factors. The discussion below is intended to be general and detailed enough in nature to have suitable confidence in consolidation estimation for feasibility level design and cost comparisons, however more detailed settlement calculations are likely to be required once more refined designs are developed.

Three graphs estimating earthwork settlement are presented below. Several key assumptions were made in the analysis, as follows.

- Bay Mud is normally consolidated under the existing loads, and that all settlement due to existing loads is complete.
- The upper 2 feet of Bay Mud is over consolidated, with an over consolidation ratio (OCR) of 2.
- Bay Mud will generally remain in-place beneath new construction
- Bay Mud has a virgin compression index (strain based) of 0.32
- Bay Mud has a recompression index (strain based) of 0.03.
- New levees will have a crest width of 16 feet and 3:1 (H:V) side slopes on both landside and waterside of the levees (note that this may be different based on additional stability and seepage analysis).
- New fill will have a total unit weight of 125 pounds per cubic foot
- Existing levee fills are assumed to have a total unit weight of 115 pounds per cubic foot.
- Bay Mud crust has a total unit weight of 100 pounds per cubic foot
- Normally consolidated Bay Mud has a total unit weight of 97 pounds per cubic foot
- Bay Mud is 100 percent saturated at all depths

Graph 1 shows the estimated Bay Mud consolidation settlement for a large mass fill area, such as may be required for very wide environmental island construction, unusually large levees, and other large fill areas.

Graph 2 shows the estimated Bay Mud consolidation settlement for levees constructed directly on Bay Mud (no existing fills present). Settlements will be reduced if new levees can be constructed along the same alignment as existing levee fill alignments. Conceptual sketches provided by the SCVWD have indicated that some of the alternatives are proposed along the same alignment as existing levee fills. On an initial estimating basis, the design grade change should be the difference between levee crest elevations (new – existing) to estimate settlement, if the center lines of the levee crest are collinear.

To use Charts 1 and 2 below an iterative process is required, such that;

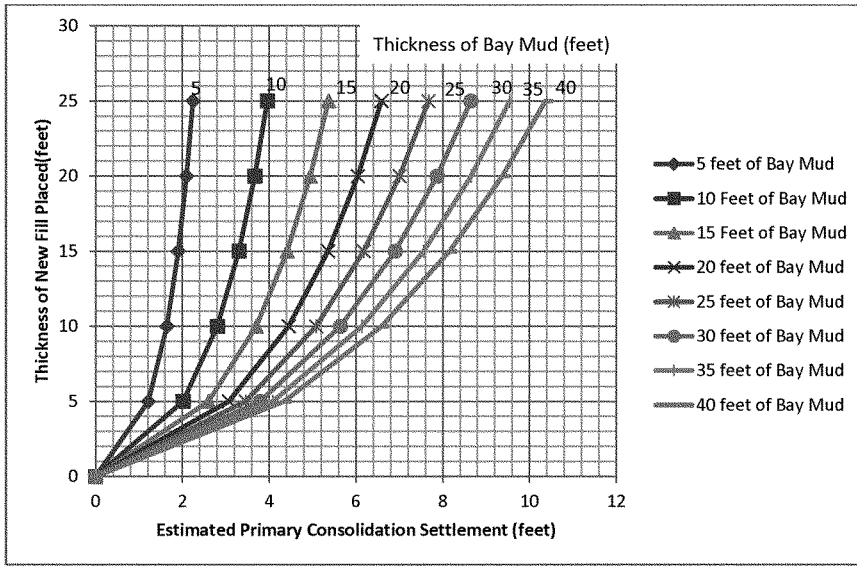
Fill thickness – settlement = design change in grade

For example: if the existing elevation = 0 feet

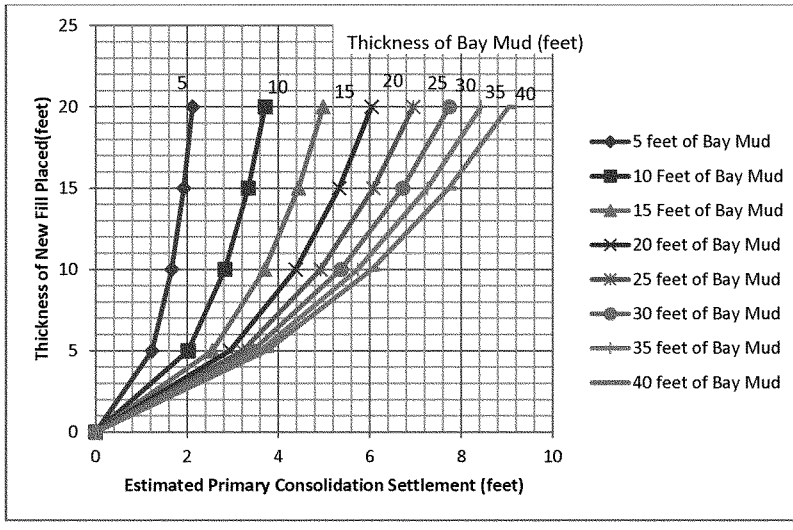
Design elevation = 10 feet

From Chart 1 , for a Bay Mud thickness of 20 feet the solution would be about 15 feet of fill

15 feet of fill - ~ 5 feet of settlement = design elevation of 10 feet.



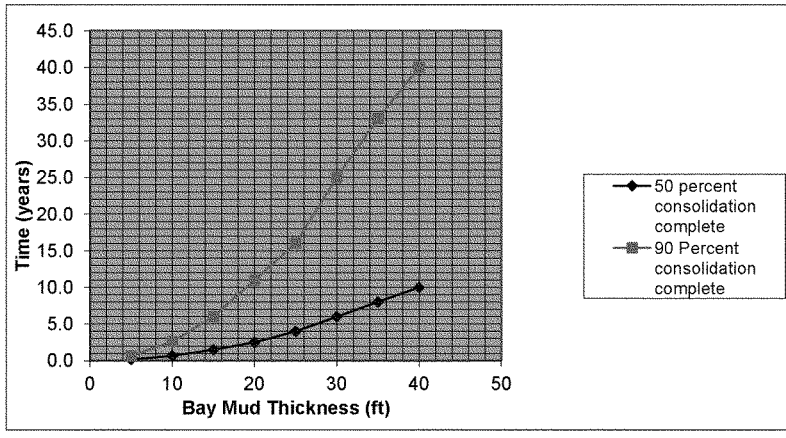
Graph 1. Estimated Bay Mud Consolidation Settlement for Large Areal Fills



Graph 2. Estimated Bay Mud Consolidation Settlement at Center of Crest for Levees with 3:1 (H:V) Slopes

Task 2. Consolidation Rates

Graph 3 and Table 1, present the estimated time for 50 percent and 90 percent consolidation for various Bay Mud thicknesses. Assumptions in the time rate consolidation include the assumption that double drainage will occur and that the coefficient of consolidation for the Bay Mud is 8 ft^2/yr. The time for consolidation is relatively short (less that 1 year for 90 percent consolidation) for thin Bay Mud thicknesses (5 feet or less). If it is desired to reduce the time for consolidation, which may be especially important if the required fill cannot be place at one time due to foundation and bearing capacity limitations of the Bay Mud, vertical drains can be installed. Typically vertical drains extend the entire thickness of the Bay Mud and are spaced on 2 to 6 foot centers depending on the drain material, and the project settlement time constraints. Additionally, surcharge fills can be placed to further reduce the time line in some situations. Vertical drains will allow the dissipation of construction pore pressures over months instead of years, which will allow additional fill stages to be placed in months rather than waiting years.



Graph 3. Estimated Consolidation Rates for Bay Mud

Table 1. Estimated Consolidation Rates for Bay Mud

Bay Mud Thickness (feet)	Time for 50% consolidation (years)	Time for 90% consolidation (years)
5	0.2	0.7
10	0.7	2.6
15	1.5	6.0
20	2.5	11.0
25	4.0	16.0
30	6.0	25.0
35	8.0	33.0
40	10.0	40.0

Task 3. Estimated Maximum Fill Thickness that Can Be Placed at One Time

Because the underlying Bay Mud for the project area is weak and slowly draining the weak Bay Mud will only support limited fill thicknesses without being overstressed. Overfilling Bay Mud will cause slope instability and bearing failures. Filling to design grades may be required in stages to allow for pore pressure dissipation before each new stress is applied. Overfilling on Bay Mud is a well documented phenomenon and should be carefully considered in design and construction activities. In addition to new structures, construction activities that may include stockpiles, heavy equipment, or excavations should be carefully planned do avoid overstressing the Bay Mud. Piezometric monitoring Bay Mud pore pressures in fill areas during construction is recommended, to determine when pore pressures have

dissipated enough to allow additional filling. Table 2, below includes estimated allowable first filling thicknesses for various fill side slopes, of 3:1(H:V) to 5:1 (H:V). In areas where fills are planned where previously placed fills were/are located, allowable fill heights will be somewhat higher. The recommendations below are based on allowable end-of-construction (undrained loading) factors of safety of 1.3. Bay Mud was assumed to have an undrained strength ratio of 0.32 (S_u/σ') for the normally consolidated Bay Mud and 500 psf for the upper 2 feet (Bay Mud "crust"). Fill was assumed to have a unit weight of 125 pounds per cubic foot and an undrained shear strength of 800 psf.

From the analysis it appears that where Bay Mud is shallow (about 5 feet or less) such that all of the required fill can be placed in one stage. However, for areas of the project with more than 5 feet of Bay Mud, fill will need to be placed in stages for significant grade changes. It is assumed that undrained (end-of-construction) conditions will control slope designs, and that rapid drawdown and seepage loading will be satisfactory if end-of-construction factors of safety exceed 1.3. Additional fill stages may not be able to include as much fill thickness as the first stage, and will require careful planning.

Table 2. Estimated Fill Thickness Placement Limits for first fill stage for 3:1 to 5:1 Slopes on 5 to 40 feet of Bay Mud

Bay Mud Thickness (ft)	Side Slope of Fill (H:V)		
	3:1	4:1	5:1
5	20 feet	20 feet	20 feet
10	11 feet	11 feet	16 feet
15	9 feet	10 feet	14 feet
20	9 feet	10 feet	12 feet
40	8 feet	10 feet	12 feet

Task 4. Levee Material Specifications

Almost any soil can be used in the construction of levees, if the levee is properly designed for the fill used. In general, it is anticipated that the only on-site available borrow would be Bay Mud. Bay Mud would require significant processing (aeration, mixing, and possible chemical treatment) before it would be practical to use as a levee fill, additionally it may not meet levee fill specifications that reflect local engineering practice. In general levee fill that meet the following specifications is preferred. It is anticipated that fill materials meeting the following specifications will be available at a number of nearby quarries or construction sites. If material meeting the following specifications is not available, revisions to specifications is likely to be possible to avoid excessively long haul distances, although levee designs may require some revision to accommodate different specifications.

1) USCS soil types: CL, SC, or GC

2) At least 70 percent passing the No.4 sieve
3) 100 percent less than 4 inches in greatest dimension
4) No more than 15 percent larger than 2 ½ inches.
5) Plasticity Index of 10 to 20
6) Liquid Limit less than 40
7) Free of organic content
8) Non-dispersive clay minerals
9) Low hydraulic conductivity (less that 10^{-6} cm/sec)
10) Minimum undrained shear strength of 800 psf
11) Minimum effective friction angle of 32 degrees
12) Fill should be clean of environmental contaminants

Task 5. Discussion of Geotechnical Aspects of Proposed Cross Sections

The Santa Clara Valley Water District has performed some initial design in order to estimate costs of various levee alternatives. Figures 2 and 3 show several possible levee alignments and a typical levee cross section that the SCVWD has provided in alternative planning and discussion. USACE understands that detailed refined design has not occurred, and the provided designs are a starting point for discussion.

A brief discussion of the geotechnical considerations for each proposed alignment is presented below.

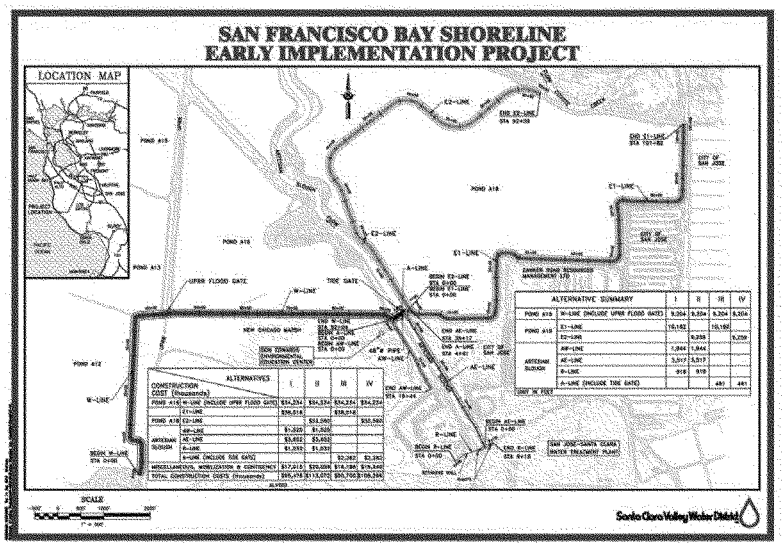


Figure 2. Alignments of Possible Flood Damage Reduction alternatives

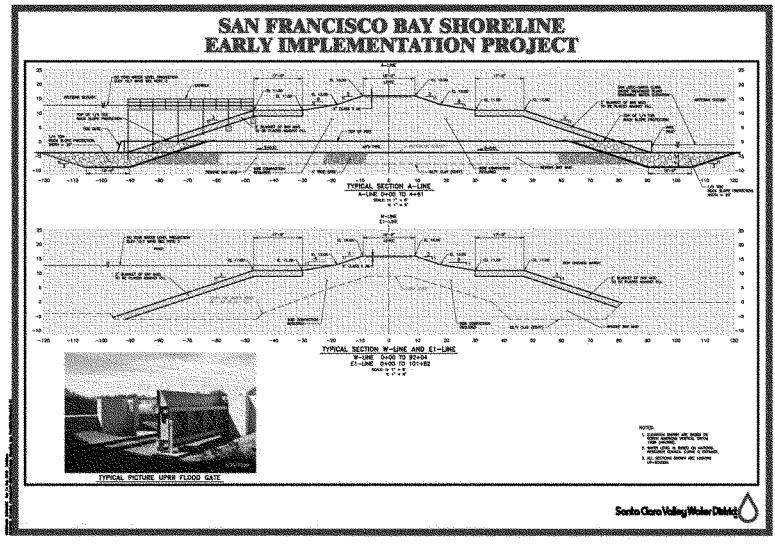


Figure 2. Typical Cross Sections

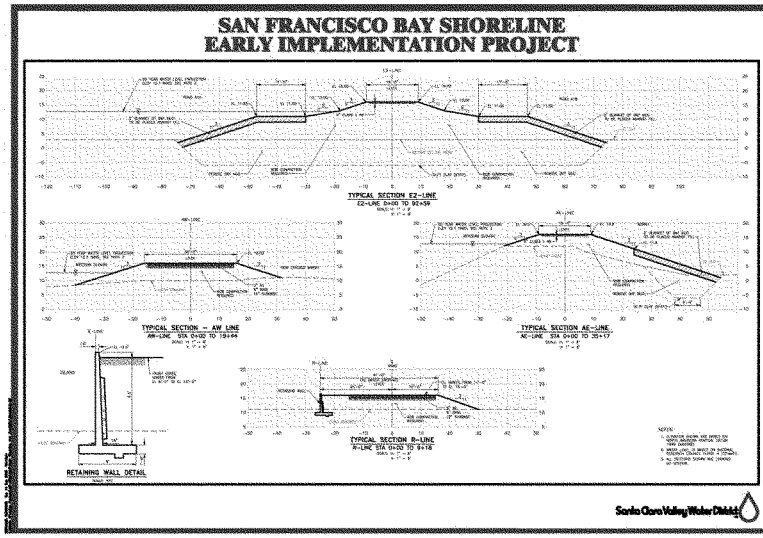


Figure 3. Typical Cross Sections

Proposed alignment Line E-2

- Bay Mud thickness is anticipated to be on the order of 20 feet. Excavation to deeper stiff soil would be very expensive and require very significant dewatering and soil disposal costs. Ground water is anticipated to be encountered near the ground surface (within 2 feet). Excavating to deep soil would reduce settlement and stability problem potential.
- It is anticipated that construction directly on Bay Mud with vertical drains and staged construction would be more practical.
- Total fill grade change would be about 13 feet, which would require a fill thickness on the order of 19 feet. This would require at least two fill stages to construct.
- There does not appear to be significant geotechnical value (perhaps there is a vegetation benefit to a Bay Mud levee surface?) to the 2-foot Bay Mud blanket on either side of the levee. This detail would add a construction difficulty due to handling and controlling the placement and compaction of different materials in a levee cross section.
- The slope designs appear to have included some thought that the relatively flat configuration, with slope benches would allow construction in a single stage, however it is not anticipated that in the current alignments single stage fill placement would be possible. However, if two stages of earthwork are performed steeper slopes may be practical.

- If low permeability fills are used seepage concerns are not anticipated. In order to add seepage performance reliability, a landside toe drain would add both stability and seepage performance reliability.
- Drainage features (conduits crossing from landside to bay) would need to have appropriate pipe bedding, joint flexibility and camber.

Proposed tide gate alignment Line A-2

- Bay Mud thickness is anticipated to be on the order of 20 feet. Excavation to deeper stiff soil would be very expensive and require very significant dewatering and soil disposal costs. Excavating to deep soil would reduce settlement and stability problem potential.
- It is anticipated that construction directly on Bay Mud with vertical drains and staged construction would be more practical.
- Total fill grade change would be about 13 feet, which would require a fill thickness on the order of 19 feet. This would require at least two fill stages to construct.
- There does not appear to be significant geotechnical value (perhaps there is a vegetation benefit to a Bay Mud levee surface?) to the 2-foot Bay Mud blanket on either side of the levee. This detail would add a construction difficulty due to handling and controlling the placement and compaction of different materials in a levee cross section.
- The slope designs appear to have included some thought that the relatively flat configuration, with slope benches would allow construction in a single stage, however it is not anticipated that in the current alignments single stage fill placement would be possible. However, if two stages of earthwork are performed steeper slopes may be practical.
- If low permeability fills are used seepage concerns are not anticipated. In order to add seepage performance reliability, a landside toe drain would add both stability and seepage performance reliability.
- Conduits would need to have appropriate pipe bedding, joint flexibility and camber. Possibly filling would be required first, with construction of gates, post levee settlement.
- Recommend consideration of concrete structure supported on deep foundations.
- Differential settlement will need to be considered at gate/levee joint due to differing stress histories.

Proposed AE and AW alignments

- Differing foundations will lead to differential settlement along each alignment. Design should account for this.
- There does not appear to be significant geotechnical value (perhaps there is a vegetation benefit to a Bay Mud levee surface?) to the 2-foot Bay Mud blanket on either side of the levee. This detail would add a construction difficulty due to handling and controlling the placement and compaction of different materials in a levee cross section.
- Practically, construction of thin slope wedges is very difficult. Consider how the construction benching and compaction into the existing levee will be performed in earthwork estimates.

Line R

- Retaining wall supported road appears feasible. Preliminary designs have not been checked.

Proposed alignment Line E-1 and Line W

- Bay Mud thickness is anticipated to range from less than 4 feet to about 20 feet.
- There does not appear to be significant geotechnical value (perhaps there is a vegetation benefit to a Bay Mud levee surface?) to the 2-foot Bay Mud blanket on either side of the levee. This detail would add a construction difficulty.
- The alignments share the same center line as existing levee alignments. This is anticipated to reduce the settlement potential for new levees and provide some slope stability benefit.
- The proposed levees are shown to be constructed on top of existing levees. Geotechnical analysis of the existing levees indicates that differing soil conditions are present along the existing alignment with both clayey and sandy fill soils. It is suggested that in order to improve reliability and certainty the existing levee should be removed, soils mixed to the specifications and re-built. The new levee should be located in the same alignment.
- Differential settlement will need to be considered due to differing Bay Mud thicknesses along alignments.
- Sections include excavation to stiff soil below Bay Mud. This will not be practical due to thicker Bay Mud at many locations. Designs should account for appropriate settlement and stability recommendations as discussed above. It is likely staging may be required for thicker Bay Mud deposits.
- Toe drains or other drainage features may improve seepage reliability.

Proposed RR Gate

- The closure gate across the RR lines will likely need to be supported on deep foundations.
- Differential settlement and lateral loading on tracks and foundation will need to be accounted for due to adjacent levee filling
- Reliability of gate including maintenance and operations considerations should be considered carefully in the alternatives analysis.

Geotechnical Considerations for Environmental Restoration Alternatives

The primary geotechnical considerations for environmental restoration alternatives are earthwork settlement and stability. Estimates of settlement and maximum fill thickness for various Bay Mud conditions are included above in the discussion. Fills not only cause settlement under the filled area, but also can cause settlement of nearby adjacent features. Environmental fills should be properly designed and constructed to minimize these effects on utilities, infrastructure, and flood damage reduction features.

In addition, alternatives should not impact the ability to inspect, maintain, or emergency flood fight around flood damage reduction projects.

Sample Calculation for Large Aereal Fills in the Alviso Area

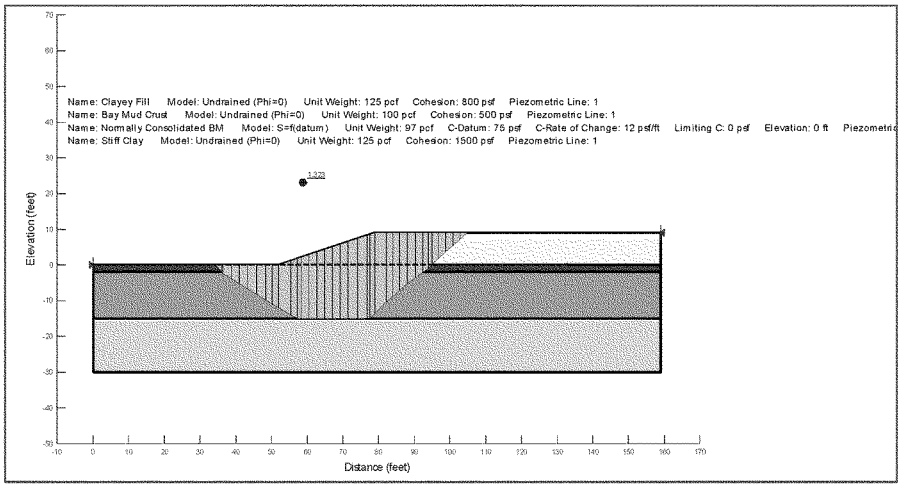
depth below existing mud line (ft)	depth below GW	u (psf)	Total unit weight	Total Stress	Initial Effective Stress (psf)	Layer thicknes	Cc (strain index)	Cr (strain index)	delta p (psf)	OCR	Pp	Primary Consolidation (ft)	Cumulative Consolidation (ft)
0	0	0	100	0	0	0	0.32	0.03	600	2	0	#DIV/0!	0
1	1	62.4	100	100	37.6	1	0.32	0.03	600	2	75.2	0.3061	0.3061
2	2	124.8	100	200	75.2	1	0.32	0.03	600	2	150.4	0.2177	0.5238
3	3	187.2	97	297	109.8	1	0.32	0.03	600	1	109.8	0.2594	0.7832
4	4	249.6	97	394	144.4	1	0.32	0.03	600	1	144.4	0.2279	1.0111
5	**5**	**312**	**97**	**491**	**179**	**1**	**0.32**	**0.03**	**600**	**1**	**179**	**0.2044**	**1.2155**
6	6	374.4	97	588	213.6	1	0.32	0.03	600	1	213.6	0.1859	1.4014
7	7	436.8	97	685	248.2	1	0.32	0.03	600	1	248.2	0.1708	1.5721
8	8	499.2	97	782	282.8	1	0.32	0.03	600	1	282.8	0.1582	1.7303
9	9	561.6	97	879	317.4	1	0.32	0.03	600	1	317.4	0.1475	1.8778
10	**10**	**624**	**97**	**976**	**352**	**1**	**0.32**	**0.03**	**600**	**1**	**352**	**0.1383**	**2.0161**
11	11	686.4	97	1073	386.6	1	0.32	0.03	600	1	386.6	0.1302	2.1463
12	12	748.8	97	1170	421.2	1	0.32	0.03	600	1	421.2	0.1231	2.2694
13	13	811.2	97	1267	455.8	1	0.32	0.03	600	1	455.8	0.1167	2.3861
14	14	873.6	97	1364	490.4	1	0.32	0.03	600	1	490.4	0.1111	2.4972
15	**15**	**936**	**97**	**1461**	**525**	**1**	**0.32**	**0.03**	**600**	**1**	**525**	**0.1059**	**2.6031**
16	16	998.4	97	1558	559.6	1	0.32	0.03	600	1	559.6	0.1013	2.7044
17	17	1060.8	97	1655	594.2	1	0.32	0.03	600	1	594.2	0.0970	2.8014
18	18	1123.2	97	1752	628.8	1	0.32	0.03	600	1	628.8	0.0931	2.8945
19	19	1185.6	97	1849	663.4	1	0.32	0.03	600	1	663.4	0.0895	2.9840
20	**20**	**1248**	**97**	**1946**	**698**	**1**	**0.32**	**0.03**	**600**	**1**	**698**	**0.0862**	**3.0702**
21	21	1310.4	97	2043	732.6	1	0.32	0.03	600	1	732.6	0.0831	3.1534
22	22	1372.8	97	2140	767.2	1	0.32	0.03	600	1	767.2	0.0803	3.2337
23	23	1435.2	97	2237	801.8	1	0.32	0.03	600	1	801.8	0.0776	3.3113
24	24	1497.6	97	2334	836.4	1	0.32	0.03	600	1	836.4	0.0752	3.3864
25	**25**	**1560**	**97**	**2431**	**871**	**1**	**0.32**	**0.03**	**600**	**1**	**871**	**0.0728**	**3.4593**
26	26	1622.4	97	2528	905.6	1	0.32	0.03	600	1	905.6	0.0706	3.5299
27	27	1684.8	97	2625	940.2	1	0.32	0.03	600	1	940.2	0.0686	3.5985
28	28	1747.2	97	2722	974.8	1	0.32	0.03	600	1	974.8	0.0667	3.6652
29	29	1809.6	97	2819	1009.4	1	0.32	0.03	600	1	1009.4	0.0648	3.7300
30	**30**	**1872**	**97**	**2916**	**1044**	**1**	**0.32**	**0.03**	**600**	**1**	**1044**	**0.0631**	**3.7931**
31	31	1934.4	97	3013	1078.6	1	0.32	0.03	600	1	1078.6	0.0615	3.8546
32	32	1996.8	97	3110	1113.2	1	0.32	0.03	600	1	1113.2	0.0599	3.9145
33	33	2059.2	97	3207	1147.8	1	0.32	0.03	600	1	1147.8	0.0584	3.9729
34	34	2121.6	97	3304	1182.4	1	0.32	0.03	600	1	1182.4	0.0570	4.0300
35	**35**	**2184**	**97**	**3401**	**1217**	**1**	**0.32**	**0.03**	**600**	**1**	**1217**	**0.0557**	**4.0857**
36	36	2246.4	97	3498	1251.6	1	0.32	0.03	600	1	1251.6	0.0544	4.1401
37	37	2308.8	97	3595	1286.2	1	0.32	0.03	600	1	1286.2	0.0532	4.1933
38	38	2371.2	97	3692	1320.8	1	0.32	0.03	600	1	1320.8	0.0520	4.2454
39	39	2433.6	97	3789	1355.4	1	0.32	0.03	600	1	1355.4	0.0509	4.2963
40	**40**	**2496**	**97**	**3886**	**1390**	**1**	**0.32**	**0.03**	**600**	**1**	**1390**	**0.0499**	**4.3462**

depth below existing mud line (ft)	depth below GW	u (psf)	Total unit weight	Total Stress	Initial Effective Stress (psf)	Layer thicknes	Cc (strain index)	Cr (strain index)	delta p (psf)	OCR	Pp	Primary Consolidation (ft)	Cumulative Consolidation (ft)
0	0	0	100	0	0	0	0.32	0.03	1200	2	0	#DIV/0!	0
1	1	62.4	100	100	37.6	1	0.32	0.03	1200	2	75.2	0.3983	0.3983
2	2	124.8	100	200	75.2	1	0.32	0.03	1200	2	150.4	0.3061	0.7044
3	3	187.2	97	297	109.8	1	0.32	0.03	1200	1	109.8	0.3445	1.0489
4	4	249.6	97	394	144.4	1	0.32	0.03	1200	1	144.4	0.3101	1.3589
5	**5**	**312**	**97**	**491**	**179**	**1**	**0.32**	**0.03**	**1200**	**1**	**179**	**0.2837**	**1.6427**
6	6	374.4	97	588	213.6	1	0.32	0.03	1200	1	213.6	0.2626	1.9053
7	7	436.8	97	685	248.2	1	0.32	0.03	1200	1	248.2	0.2451	2.1505
8	8	499.2	97	782	282.8	1	0.32	0.03	1200	1	282.8	0.2303	2.3807
9	9	561.6	97	879	317.4	1	0.32	0.03	1200	1	317.4	0.2174	2.5982
10	**10**	**624**	**97**	**976**	**352**	**1**	**0.32**	**0.03**	**1200**	**1**	**352**	**0.2062**	**2.8044**
11	11	686.4	97	1073	386.6	1	0.32	0.03	1200	1	386.6	0.1962	3.0006
12	12	748.8	97	1170	421.2	1	0.32	0.03	1200	1	421.2	0.1873	3.1879
13	13	811.2	97	1267	455.8	1	0.32	0.03	1200	1	455.8	0.1793	3.3672
14	14	873.6	97	1364	490.4	1	0.32	0.03	1200	1	490.4	0.1720	3.5391
15	**15**	**936**	**97**	**1461**	**525**	**1**	**0.32**	**0.03**	**1200**	**1**	**525**	**0.1653**	**3.7045**
16	16	998.4	97	1558	559.6	1	0.32	0.03	1200	1	559.6	0.1592	3.8637
17	17	1060.8	97	1655	594.2	1	0.32	0.03	1200	1	594.2	0.1536	4.0173
18	18	1123.2	97	1752	628.8	1	0.32	0.03	1200	1	628.8	0.1484	4.1656
19	19	1185.6	97	1849	663.4	1	0.32	0.03	1200	1	663.4	0.1435	4.3092
20	**20**	**1248**	**97**	**1946**	**698**	**1**	**0.32**	**0.03**	**1200**	**1**	**698**	**0.1390**	**4.4482**
21	21	1310.4	97	2043	732.6	1	0.32	0.03	1200	1	732.6	0.1348	4.5830
22	22	1372.8	97	2140	767.2	1	0.32	0.03	1200	1	767.2	0.1309	4.7138
23	23	1435.2	97	2237	801.8	1	0.32	0.03	1200	1	801.8	0.1272	4.8410
24	24	1497.6	97	2334	836.4	1	0.32	0.03	1200	1	836.4	0.1237	4.9647
25	**25**	**1560**	**97**	**2431**	**871**	**1**	**0.32**	**0.03**	**1200**	**1**	**871**	**0.1204**	**5.0850**
26	26	1622.4	97	2528	905.6	1	0.32	0.03	1200	1	905.6	0.1173	5.2023
27	27	1684.8	97	2625	940.2	1	0.32	0.03	1200	1	940.2	0.1143	5.3166
28	28	1747.2	97	2722	974.8	1	0.32	0.03	1200	1	974.8	0.1115	5.4281
29	29	1809.6	97	2819	1009.4	1	0.32	0.03	1200	1	1009.4	0.1089	5.5370
30	**30**	**1872**	**97**	**2916**	**1044**	**1**	**0.32**	**0.03**	**1200**	**1**	**1044**	**0.1063**	**5.6433**
31	31	1934.4	97	3013	1078.6	1	0.32	0.03	1200	1	1078.6	0.1039	5.7473
32	32	1996.8	97	3110	1113.2	1	0.32	0.03	1200	1	1113.2	0.1016	5.8489
33	33	2059.2	97	3207	1147.8	1	0.32	0.03	1200	1	1147.8	0.0995	5.9484
34	34	2121.6	97	3304	1182.4	1	0.32	0.03	1200	1	1182.4	0.0974	6.0457
35	**35**	**2184**	**97**	**3401**	**1217**	**1**	**0.32**	**0.03**	**1200**	**1**	**1217**	**0.0954**	**6.1411**
36	36	2246.4	97	3498	1251.6	1	0.32	0.03	1200	1	1251.6	0.0934	6.2345
37	37	2308.8	97	3595	1286.2	1	0.32	0.03	1200	1	1286.2	0.0916	6.3261
38	38	2371.2	97	3692	1320.8	1	0.32	0.03	1200	1	1320.8	0.0898	6.4160
39	39	2433.6	97	3789	1355.4	1	0.32	0.03	1200	1	1355.4	0.0881	6.5041
40	**40**	**2496**	**97**	**3886**	**1390**	**1**	**0.32**	**0.03**	**1200**	**1**	**1390**	**0.0865**	**6.5906**

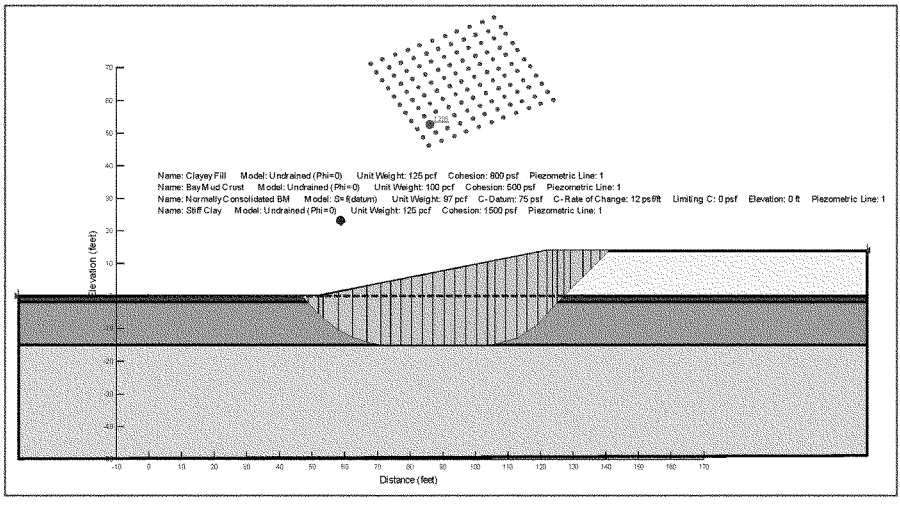
depth below existing mud line (ft)	depth below GW	u (psf)	Total unit weight	Total Stress	Initial Effective Stress (psf)	Layer thicknes	Cc (strain index)	Cr (strain index)	delta p (psf)	OCR	Pp	Primary Consolidation (ft)	Cumulative Consolidation (ft)
0	0	0	100	0	0	0	0.32	0.03	1800	2	0	#DIV/0!	0
1	1	62.4	100	100	37.6	1	0.32	0.03	1800	2	75.2	0.4532	0.4532
2	2	124.8	100	200	75.2	1	0.32	0.03	1800	2	150.4	0.3597	0.8129
3	3	187.2	97	297	109.8	1	0.32	0.03	1800	1	109.8	0.3969	1.2098
4	4	249.6	97	394	144.4	1	0.32	0.03	1800	1	144.4	0.3613	1.5712
5	**5**	**312**	**97**	**491**	**179**	**1**	**0.32**	**0.03**	**1800**	**1**	**179**	**0.3339**	**1.9051**
6	6	374.4	97	588	213.6	1	0.32	0.03	1800	1	213.6	0.3118	2.2169
7	7	436.8	97	685	248.2	1	0.32	0.03	1800	1	248.2	0.2933	2.5102
8	8	499.2	97	782	282.8	1	0.32	0.03	1800	1	282.8	0.2775	2.7877
9	9	561.6	97	879	317.4	1	0.32	0.03	1800	1	317.4	0.2637	3.0514
10	**10**	**624**	**97**	**976**	**352**	**1**	**0.32**	**0.03**	**1800**	**1**	**352**	**0.2516**	**3.3031**
11	11	686.4	97	1073	386.6	1	0.32	0.03	1800	1	386.6	0.2408	3.5439
12	12	748.8	97	1170	421.2	1	0.32	0.03	1800	1	421.2	0.2311	3.7749
13	13	811.2	97	1267	455.8	1	0.32	0.03	1800	1	455.8	0.2222	3.9972
14	14	873.6	97	1364	490.4	1	0.32	0.03	1800	1	490.4	0.2142	4.2114
15	**15**	**936**	**97**	**1461**	**525**	**1**	**0.32**	**0.03**	**1800**	**1**	**525**	**0.2068**	**4.4182**
16	16	998.4	97	1558	559.6	1	0.32	0.03	1800	1	559.6	0.2000	4.6182
17	17	1060.8	97	1655	594.2	1	0.32	0.03	1800	1	594.2	0.1937	4.8118
18	18	1123.2	97	1752	628.8	1	0.32	0.03	1800	1	628.8	0.1878	4.9996
19	19	1185.6	97	1849	663.4	1	0.32	0.03	1800	1	663.4	0.1823	5.1820
20	**20**	**1248**	**97**	**1946**	**698**	**1**	**0.32**	**0.03**	**1800**	**1**	**698**	**0.1772**	**5.3592**
21	21	1310.4	97	2043	732.6	1	0.32	0.03	1800	1	732.6	0.1724	5.5316
22	22	1372.8	97	2140	767.2	1	0.32	0.03	1800	1	767.2	0.1679	5.6994
23	23	1435.2	97	2237	801.8	1	0.32	0.03	1800	1	801.8	0.1636	5.8630
24	24	1497.6	97	2334	836.4	1	0.32	0.03	1800	1	836.4	0.1596	6.0225
25	**25**	**1560**	**97**	**2431**	**871**	**1**	**0.32**	**0.03**	**1800**	**1**	**871**	**0.1557**	**6.1783**
26	26	1622.4	97	2528	905.6	1	0.32	0.03	1800	1	905.6	0.1521	6.3304
27	27	1684.8	97	2625	940.2	1	0.32	0.03	1800	1	940.2	0.1487	6.4790
28	28	1747.2	97	2722	974.8	1	0.32	0.03	1800	1	974.8	0.1454	6.6244
29	29	1809.6	97	2819	1009.4	1	0.32	0.03	1800	1	1009.4	0.1423	6.7667
30	**30**	**1872**	**97**	**2916**	**1044**	**1**	**0.32**	**0.03**	**1800**	**1**	**1044**	**0.1393**	**6.9060**
31	31	1934.4	97	3013	1078.6	1	0.32	0.03	1800	1	1078.6	0.1364	7.0424
32	32	1996.8	97	3110	1113.2	1	0.32	0.03	1800	1	1113.2	0.1337	7.1761
33	33	2059.2	97	3207	1147.8	1	0.32	0.03	1800	1	1147.8	0.1311	7.3072
34	34	2121.6	97	3304	1182.4	1	0.32	0.03	1800	1	1182.4	0.1286	7.4357
35	**35**	**2184**	**97**	**3401**	**1217**	**1**	**0.32**	**0.03**	**1800**	**1**	**1217**	**0.1262**	**7.5619**
36	36	2246.4	97	3498	1251.6	1	0.32	0.03	1800	1	1251.6	0.1239	7.6858
37	37	2308.8	97	3595	1286.2	1	0.32	0.03	1800	1	1286.2	0.1216	7.8074
38	38	2371.2	97	3692	1320.8	1	0.32	0.03	1800	1	1320.8	0.1195	7.9269
39	39	2433.6	97	3789	1355.4	1	0.32	0.03	1800	1	1355.4	0.1174	8.0443
40	**40**	**2496**	**97**	**3886**	**1390**	**1**	**0.32**	**0.03**	**1800**	**1**	**1390**	**0.1154**	**8.1598**

depth below existing mud line (ft)	depth below GW	u (psf)	Total unit weight	Total Stress	Initial Effective Stress (psf)	Layer thicknes	Cc (strain index)	Cr (strain index)	delta p (psf)	OCR	Pp	Primary Consolidation (ft)	Cumulative Consolidation (ft)
0	0	0	100	0	0	0	0.32	0.03	2400	2	0	#DIV/0!	0
1	1	62.4	100	100	37.6	1	0.32	0.03	2400	2	75.2	0.4925	0.4925
2	2	124.8	100	200	75.2	1	0.32	0.03	2400	2	150.4	0.3983	0.8907
3	3	187.2	97	297	109.8	1	0.32	0.03	2400	1	109.8	0.4349	1.3256
4	4	249.6	97	394	144.4	1	0.32	0.03	2400	1	144.4	0.3987	1.7244
5	**5**	**312**	**97**	**491**	**179**	**1**	**0.32**	**0.03**	**2400**	**1**	**179**	**0.3708**	**2.0951**
6	6	374.4	97	588	213.6	1	0.32	0.03	2400	1	213.6	0.3480	2.4431
7	7	436.8	97	685	248.2	1	0.32	0.03	2400	1	248.2	0.3290	2.7722
8	8	499.2	97	782	282.8	1	0.32	0.03	2400	1	282.8	0.3127	3.0848
9	9	561.6	97	879	317.4	1	0.32	0.03	2400	1	317.4	0.2984	3.3832
10	**10**	**624**	**97**	**976**	**352**	**1**	**0.32**	**0.03**	**2400**	**1**	**352**	**0.2858**	**3.6690**
11	11	686.4	97	1073	386.6	1	0.32	0.03	2400	1	386.6	0.2745	3.9435
12	12	748.8	97	1170	421.2	1	0.32	0.03	2400	1	421.2	0.2643	4.2078
13	13	811.2	97	1267	455.8	1	0.32	0.03	2400	1	455.8	0.2550	4.4629
14	14	873.6	97	1364	490.4	1	0.32	0.03	2400	1	490.4	0.2465	4.7094
15	**15**	**936**	**97**	**1461**	**525**	**1**	**0.32**	**0.03**	**2400**	**1**	**525**	**0.2387**	**4.9481**
16	16	998.4	97	1558	559.6	1	0.32	0.03	2400	1	559.6	0.2315	5.1796
17	17	1060.8	97	1655	594.2	1	0.32	0.03	2400	1	594.2	0.2248	5.4043
18	18	1123.2	97	1752	628.8	1	0.32	0.03	2400	1	628.8	0.2185	5.6228
19	19	1185.6	97	1849	663.4	1	0.32	0.03	2400	1	663.4	0.2126	5.8354
20	**20**	**1248**	**97**	**1946**	**698**	**1**	**0.32**	**0.03**	**2400**	**1**	**698**	**0.2071**	**6.0425**
21	21	1310.4	97	2043	732.6	1	0.32	0.03	2400	1	732.6	0.2019	6.2445
22	22	1372.8	97	2140	767.2	1	0.32	0.03	2400	1	767.2	0.1970	6.4415
23	23	1435.2	97	2237	801.8	1	0.32	0.03	2400	1	801.8	0.1924	6.6339
24	24	1497.6	97	2334	836.4	1	0.32	0.03	2400	1	836.4	0.1880	6.8220
25	**25**	**1560**	**97**	**2431**	**871**	**1**	**0.32**	**0.03**	**2400**	**1**	**871**	**0.1839**	**7.0059**
26	26	1622.4	97	2528	905.6	1	0.32	0.03	2400	1	905.6	0.1799	7.1858
27	27	1684.8	97	2625	940.2	1	0.32	0.03	2400	1	940.2	0.1762	7.3620
28	28	1747.2	97	2722	974.8	1	0.32	0.03	2400	1	974.8	0.1726	7.5346
29	29	1809.6	97	2819	1009.4	1	0.32	0.03	2400	1	1009.4	0.1692	7.7037
30	**30**	**1872**	**97**	**2916**	**1044**	**1**	**0.32**	**0.03**	**2400**	**1**	**1044**	**0.1659**	**7.8696**
31	31	1934.4	97	3013	1078.6	1	0.32	0.03	2400	1	1078.6	0.1627	8.0324
32	32	1996.8	97	3110	1113.2	1	0.32	0.03	2400	1	1113.2	0.1597	8.1921
33	33	2059.2	97	3207	1147.8	1	0.32	0.03	2400	1	1147.8	0.1568	8.3489
34	34	2121.6	97	3304	1182.4	1	0.32	0.03	2400	1	1182.4	0.1541	8.5030
35	**35**	**2184**	**97**	**3401**	**1217**	**1**	**0.32**	**0.03**	**2400**	**1**	**1217**	**0.1514**	**8.6543**
36	36	2246.4	97	3498	1251.6	1	0.32	0.03	2400	1	1251.6	0.1488	8.8031
37	37	2308.8	97	3595	1286.2	1	0.32	0.03	2400	1	1286.2	0.1463	8.9495
38	38	2371.2	97	3692	1320.8	1	0.32	0.03	2400	1	1320.8	0.1439	9.0934
39	39	2433.6	97	3789	1355.4	1	0.32	0.03	2400	1	1355.4	0.1416	9.2350
40	**40**	**2496**	**97**	**3886**	**1390**	**1**	**0.32**	**0.03**	**2400**	**1**	**1390**	**0.1394**	**9.3744**

depth below existing mud line (ft)	depth below GW	u (psf)	Total unit weight	Total Stress	Initial Effective Stress (psf)	Layer thicknes	Cc (strain index)	Cr (strain index)	delta p (psf)	OCR	Pp	Primary Consolidation (ft)	Cumulative Consolidation (ft)
0	0	0	100	0	0	0	0.32	0.03	3000	2	0	#DIV/0!	0
1	1	62.4	100	100	37.6	1	0.32	0.03	3000	2	75.2	0.5231	0.5231
2	2	124.8	100	200	75.2	1	0.32	0.03	3000	2	150.4	0.4284	0.9515
3	3	187.2	97	297	109.8	1	0.32	0.03	3000	1	109.8	0.4647	1.4162
4	4	249.6	97	394	144.4	1	0.32	0.03	3000	1	144.4	0.4282	1.8443
5	**5**	**312**	**97**	**491**	**179**	**1**	**0.32**	**0.03**	**3000**	**1**	**179**	**0.3998**	**2.2441**
6	6	374.4	97	588	213.6	1	0.32	0.03	3000	1	213.6	0.3768	2.6209
7	7	436.8	97	685	248.2	1	0.32	0.03	3000	1	248.2	0.3574	2.9783
8	8	499.2	97	782	282.8	1	0.32	0.03	3000	1	282.8	0.3407	3.3190
9	9	561.6	97	879	317.4	1	0.32	0.03	3000	1	317.4	0.3261	3.6452



15 feet of BM, 3:1 Slope, 9 feet of fill



15 feet of BM, 5:1 slope, 14 feet of fill

Attachment A

CESPN-ET-EG

Date: 7 May 2012

Project: South San Francisco Bay Shoreline Feasibility Study

Subject: Geotechnical Review of Proposed Import Project by FWLS in Relation to Shoreline Feasibility Study Conceptual Alternatives

Summary:

We understand the United States Fish and Wildlife Service (FWLS) will be provided free import soil to Shoreline Ponds for use in pond levee maintenance and possibly for use as levee fill for future levee construction that may occur as part of the Army Corps of Engineer's Southbay Shoreline project and is planning a project to stockpile this material on-site.

The Geo-Sciences Section of the Army Corps of Engineers San Francisco District (SPN) was provided with the following documents for review:

- An April 6, 2012 technical memorandum prepared by Cornerstone Earth Group, with the subject "Ravenswood, Mountain View, and Alviso Fill Evaluation."
- 6 Plan Sheets dated April 2012, prepared by MacKay and Somps titled "Stock Pile Plan Dirt Import Project – Phase 1, Mountain View, California."
- 4 Plan Sheets dated April2002 prepared by MacKay and Somps titled "Stockpile Plan Dirt Import Project – Phase 1, Menlo Park, California."
- 4 Plan Sheets dated April2002 prepared by MacKay and Somps titled "Stockpile Plan Dirt Import Project – Phase 1, Alviso, California."

Based on review of these documents, SPN has the following comments regarding the proposed stockpile plan as described in the documents above.

Comment 1: In general, the recommendations provided by the geotechnical consultant for the project are labeled as "conceptual". Typically construction drawings are not developed using conceptual recommendations as there are often many details and uncertainties in conceptual design that are not fully developed for construction drawings. It is recommended that the geotechnical engineer provide additional exploration, lab testing and engineering analysis as necessary to support construction documents. Of particular consideration should be effects of new fill on existing infrastructure due to settlement, changes in levee crest elevation, and other factors. The Corps has provided the FWLS copies of subsurface exploration used in the feasibility analysis, this should be available to the geotechnical consultant for review. A particular discrepancy noted in the consultant geotechnical recommendations and our subsurface interpretation, is that the Corps has interpreted thicker Bay Mud deposits near Alviso as the proposed temporary fill extends toward the bay. This could impact the consultant's stability and settlement estimates.

Comment 2: The proposed fill specifications in the geotechnical recommendations appear suitable for general fill, however to be used for levee fill, we have proposed more stringent fill specifications, although there may be some room for flexibility as Corps alternative designs are in concept only at this time. In general, to date, the Corps has proposed levee fill having a PI of 10 to 20, with non-dispersive behavior, generally clayey soil (CL, SC, GC), with low permeability ($<10^{-6}$ cm/sec). Of particular

concern are the performance of fill with high plasticity and liquid limits for new levee construction. It appears that the proposed fill specifications allow for MH, CH and ML soils for import, that may not meet final design specifications for levee fill. For general use to construct environmental ecology features, the environmental designers should verify that the proposed import fill will support the required habitat species.

Comment 3: Fill imported to the site should be tested and placed so that material properties of the import fill are generally geographically known (i.e. if the project needs levee fill where can we find it?).

Comment 4: Because the fill will settle, some fill imported may not be practical to reclaim for new project purposes (i.e. it settles too much below the water level). Therefore the best fill material (meeting Corps proposed levee fill specifications) should be placed on shallower Bay Mud areas to minimize loss to settlement.

Comment 5: The proposed fill elevations in some locations are higher than existing levee crest elevations. The H&H team should review proposed fill geometry and effects the proposed filling may have on the project hydraulic performance. Note that fill settlement time-rate estimates may be required such that appropriate engineering judgments can be made.

Comment 6: FWLS should note that the Southbay Shoreline Feasibility Study has not finalized or recommended design alternatives at this point, and that all, some or none of the imported fill may be useful to the project. By thoroughly testing engineering properties and documenting fill placement locations, the potential for project beneficial re-use will be maximized.

This review does not constitute Corps approval or responsibility of performance of the proposed temporary fill stockpiles, which are the responsibility of the USFWLS and their retained consultants and contractors. If the USFWLS requires technical assistance from the Corps, Corps technical assistance can be provided under our Memorandum of Understanding with the USFWLS.

This discussion has been prepared by:

Brian Hubel, P.E., G.E.

Geotechnical Engineer

Corps of Engineers

San Francisco District Geo-Sciences Section

415-503-922

Attachment C

CESPN-ET-EG

18 April 2012

Project: San Francisco South Bay Shoreline Study

Subject: Levee Breach Dimensions

Background:

Previous levee failure and flooding analysis, performed by the Corps of Engineers Engineering Research and Development Center (ERDC) had determined levee breach dimensions based on the shear stress the water applies to the soil. The breach is extended until the shear stress applied is balanced by the bulk erosive strength of the soil which was assumed to be about 36 Pa (0.7psf). This methodology is discussed in Section 3 of the draft report titled, "Coastal Flooding Uncertainty Analysis for South San Francisco Bay Shoreline Study: without Project Conditions," dated 24 January 2011 *(1)*. Currently, the previous modeling performed by ERDC is undergoing validation by retained engineering contractors who will also be performing with-project modeling. SPN-Geosciences has been requested to provide estimates of breach dimensions for this modeling effort.

The estimates presented in this memo should be considered coarse approximations, as breach development and resulting dimensions is a complex process. Most predictive methods rely heavily on empirical observations and relationships. The modeling presented in the ERDC report has basis in more physical principals. The resulting dimensions of the breaches are not reported or easily checked in the referenced document. The recommendations presented in this memo are based on empirical observations.

Methodology:

Estimating breach dimensions is difficult and depends on a number of factors including the water head over the "weir"(bar), geotechnical properties of the levee soil, dimensions of the levee, hydraulic loading type (river, coastal, etc.), protected side topographic conditions, flood fight activities, and time. Our assumptions are based on a maximum breach developing (unlimited time) without flood fight, for water at the top of the levee, and that the entire levee cross section is washed away with the exception of a small bar at the water side toe of the levee. Figure 1. shows the typical shape of a levee breach.

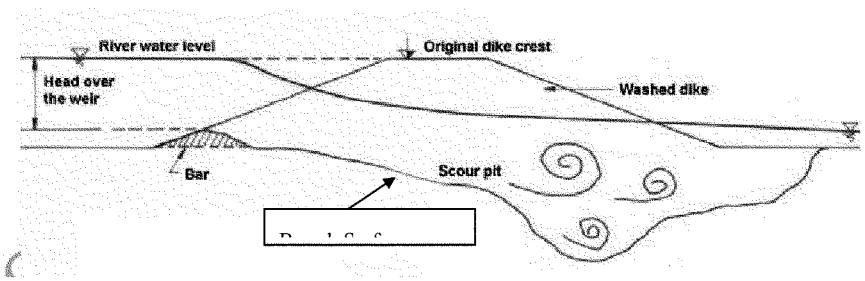


Figure 5-2. Typical Cross Section of a Dike Failure *(2)*

For most failures the "bar" on the water side could be on the order of 40cm *(2)*. For this analysis we assumed that the top of the bar would be the same elevation as the toe of the protected side of the levee. Numerous research papers have been published regarding the development of dam breaches, which although have some similarities to levees, some important differences are also present. These differences include a water supply limited by the reservoir storage, and that embankments are generally constructed at narrow canyon constrictions rather than as long continuous structures.

Table 1 summarizes some recent levee breach dimensions reported in a 2009 report published by the Southeast Region Research Initiative (SERRI) Project *(3)*. As can be seen in the table geometries are quite variable, as should be expected for various geometry, load, and geotechnical conditions.

Table 1. Summary of Recent US Levee Breach Geometry *(3)*

Levee Breach	Load Type	Water side Slopes (H:V)	Crest Width (ft)	Protected Side Slopes (H:V)	Levee Height (ft)	Water Height (ft)	Breach Length (ft)	Scour Depth (ft)
Feather River near Arboga, CA (1997)	River	2:1	20	3:1	29	25	623	56
Pin Oak Levee on Mississippi River near Winfield, MO (2008)	River	3:1	10	3:1	12	11	150	--
Truckee Irrigation Canal Levee, near Fearnly, NV (2008)	River	2:1	15	1.5:1	9.5	6.5	50	11
Jones Tract Levee on Middle River near Stockton, CA (2004)	River	3:1	28	3:1	16	9	344	--
Russell-Allison Levee on Wabash River near Westport, IL (2008)	River	3:1	10	3:1	8	5	173	--
Cap au Gris Levee on Mississippi River near Windfield, MO (2008)	River	3:1	10	3:1	9	11	351	15
Floodwall on Metairie Outfall Canal, New Orleans, LA (2005)	Hurricane	3:1	10	3:1	19	17	449	21
Floodwall on London Avenue Canal, New Orleans, LA (2005)	Hurricane	3:1	10	3:1	17	13	125	5

Floodwall on Inner Harbor Navigation Canal, New Orleans, LA (2005)	Hurricane	3:1	10	3:1	20	22	919	--

Several breaches have been purposely constructed in the area for restoration of Pond A6 and at Redwood Creek. The stabilized breach lengths at A6 are 106, 82,138, and 74 feet and at Redwood Creek lengths are measured from air photos at 184, 215, 85, and 147 feet. It is presumed that constructed widths were smaller and allowed to progress to these widths. These dimensions are relatively consistent with dimensions lengths that would be calculated using Nagy(2006) relationships for 7 to 12 feet of water height.

Nagy (2006) reported on over 2200 dike failures in the Carpathian-Basin (Hungary) from about 1800 to present. Of those case histories more than 1000 failures have known levee breach lengths. Although the statistical fit is loose (R^2=.39), Nagy correlated the fully developed breach length to the water height above the water side "bar" by the equation:

$$y=5.1899e^{0.7498x}$$

where:

x=water height in meters

y=breach length in meters

Recommendations:

Using the equation above, Table 2 presents estimates of fully developed breach lengths water heights of 6.5 to 20 feet. Once a breach begins it is anticipated that the entire levee section will be quickly lost, with the "bar" weir crest elevation likely similar to the elevation of the protected side toe of the levee. The water height can be taken as the difference between the water loading elevation and the toe elevation on the protected side of the levee. The depth of the scour channel is quite difficult to estimate, and varies widely in case histories. Initially we recommend a scour depth(depth of erosion below bottom of levee) of about 2 times the water height. If there is high sensitivity to this parameter, additional research may be warranted. The slopes of the levee breach may be taken as vertical for the purposes of this modeling. Breach geometry is highly uncertain and could contribute significantly to modeling uncertainty.

Table 2. Estimated Breach Lengths using Nagy (2006)

Approximate Water Height (ft)	Estimated Fully Developed Breach Length (ft)
6.5	75
10	160
13	340
16	725
20	1530

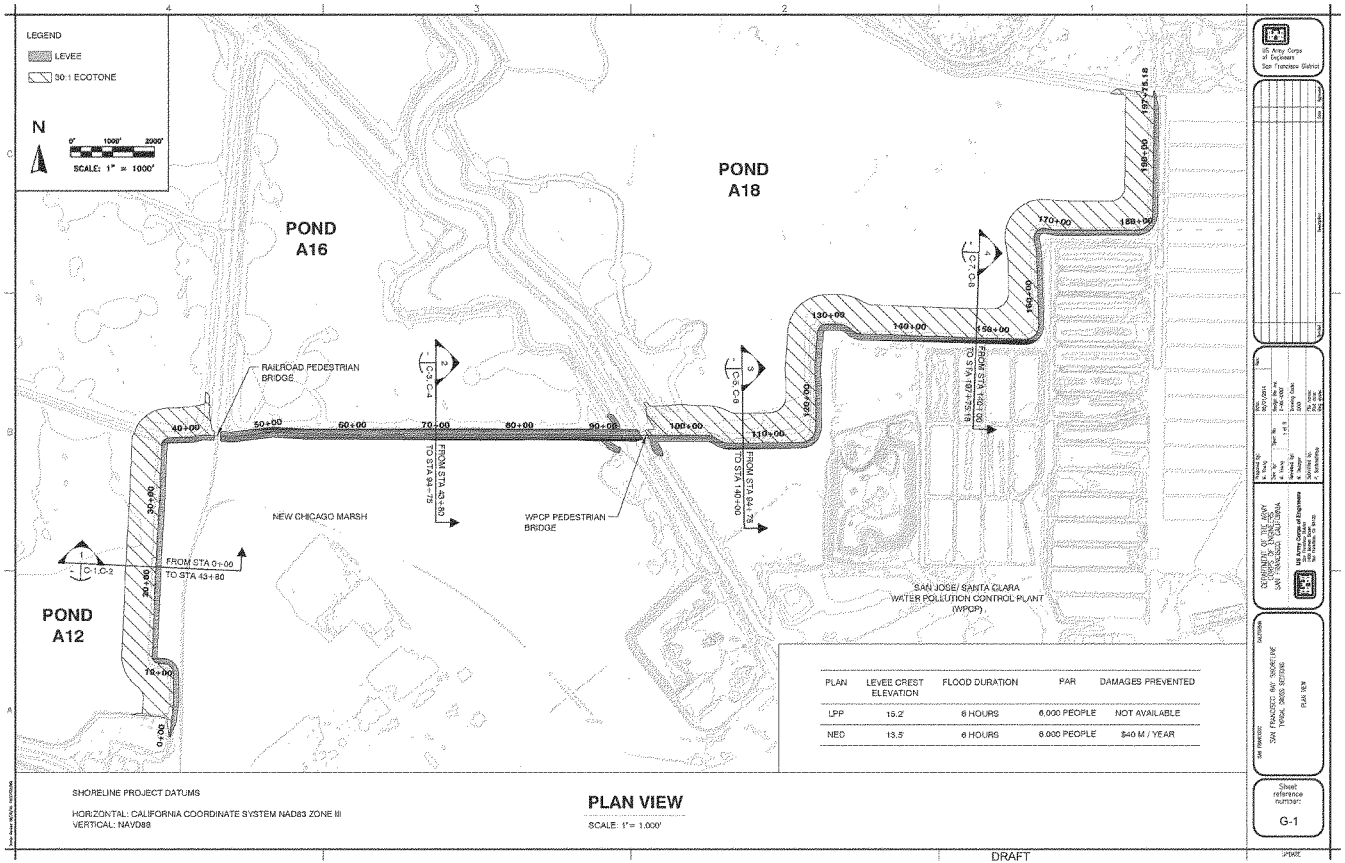
References:

(1) Letter, J.V., (2011). Draft report, "Coastal Flooding Uncertainty Analysis for South San Francsico Bay Shoreline Study: without Project Conditions," ERDC/CHL US Army Corps of Engineers.

(2) Nagy, L. (2006). "Estimating Dike Breach Length from Historical Data," Periodica Polytechnica, Serial Civil Engineering, Vol. 50, No. 2, pp. 125-139.

(3) Saucuer, C. L.; Howard, I.L.; and Tom, J. G., (2009) SERRI Report 70015-001, "Levee Breach Geometries and Algorithms to Simulate Breach Closure" prepared for US Department of Homeland Security under Department of Energy Interagency Agreement 43WT10301.

Attachment D



PLAN	LEVEE CREST ELEVATION	FLOOD DURATION	PAR	DAMAGES PREVENTED
LPP	15.2'	6 HOURS	6,000 PEOPLE	NOT AVAILABLE
NED	13.5'	6 HOURS	6,000 PEOPLE	$40 M / YEAR

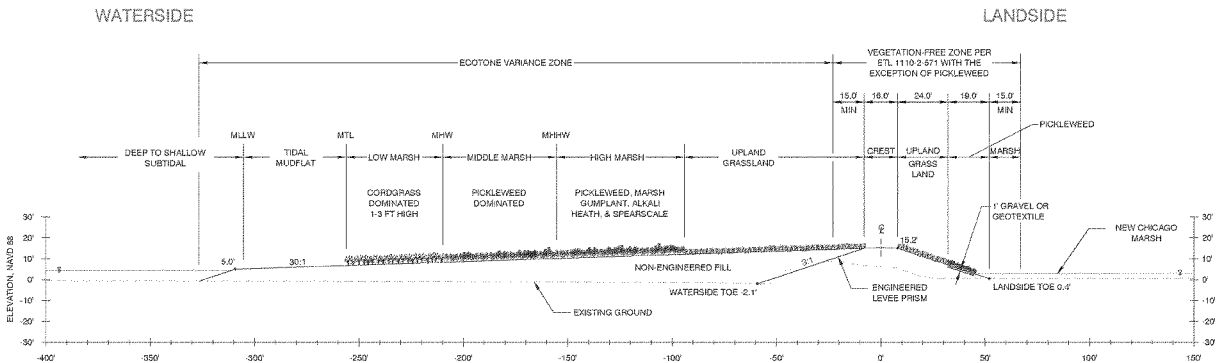
SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

PLAN VIEW

SCALE: 1" = 1,000'

DRAFT



GRAVEL OR GEOTEXTILE ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 0+00 TO STA 43+80

1 C1

SCALE: 1" = 40' (H), 1" = 40' (V)

WATERSIDE NOTES:

1. PLANTS IN THE LOW MARSH AND MIDDLE MARSH AREAS WILL ESTABLISH ON THEIR OWN. LOW MARSH WILL CONSIST OF CORDGRASS (A TALL SPECIES OF GRASS) WHILE THE MIDDLE MARSH WILL PRIMARILY CONSIST OF PERENNIAL PICKLEWEED. A LOW SUCCULENT AND SLIGHTLY WOODY PLANT THAT GROWS TO AN AVERAGE HEIGHT OF 1 FOOT. THE LOW AND MIDDLE MARSH AREAS WOULD BE LARGELY UNMANAGED WITH NO MOWING.
2. THE HIGH MARSH AND UPLAND GRASSLAND WILL BE PLANTED. HIGH MARSH PLANTS ARE MOSTLY 1-2 FEET TALL WITH OCCASIONAL STEMS REACHING UP TO 5 FEET TALL. PLANTS IN THESE AREAS ARE SOFT TO SEMI WOODY. THE HIGH MARSH AND UPLAND GRASSLAND AREAS WOULD ALSO BE LARGELY UNMANAGED WITH NO MOWING.
3. THE 15 FEET OF ECOTONE CLOSEST TO THE FLOOD RISK MANAGEMENT LEVEE, ALONG WITH THE REST OF THE FRM LEVEE CROSS-SECTION, WOULD BE MANAGED AS A VEGETATION-FREE ZONE PER ETL 1110-2-571. SEE SECTION FOR DETAILS.

SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

LANDSIDE NOTES:

1. THE LANDSIDE OF THE LEVEE AND THE ADJACENT 15 FOOT OFFSET ARE INTENDED TO BE MANAGED AS PART OF THE VEGETATION-FREE ZONE. HOWEVER, THE LOWER LANDSIDE SLOPE CAN BE EXPECTED TO DEVELOP GROWTH OF PICKLEWEED AND OTHER HIGH MARSH PLANTS DUE TO THE PRESENCE OF SALT AND SEASONAL WATER IN THE AREA. THE GROWTH OF HIGH MARSH PLANTS CAN BE EXPECTED THROUGHOUT THE ENTIRE LENGTH OF THE LEVEE. PICKLEWEED WILL NOT USUALLY GROW BEYOND THE TOE OF THE LEVEE DUE TO PERMANENT AND SEASONAL PONDED WATER. THERE WILL BE VERY MINOR LOCATIONS WHERE PICKLEWEED DOES GROW NEXT TO THE LEVEE DUE TO HIGHER GROUND.
2. ACCESS ALONG THE LAND SIDE TOE WILL NOT BE EASY DUE TO THE MARSH. THERE WILL BE VERY MINOR LOCATIONS WHERE PICKLEWEED DOES GROW NEXT TO THE LEVEE DUE TO HIGHER GROUND.
3. WE WILL GENERALLY ONLY NEED TO ADDRESS THE EXISTENCE OF PICKLEWEED ON THE LAND SIDE SLOPE DUE TO THE ECOTONE
4. NATURAL PICKLEWEED IN TIDAL AREAS TYPICALLY GROW TO A MAXIMUM HEIGHT OF 12 TO 18 INCHES (OCCASIONALLY UP TO 24 INCHES) BETWEEN 0.0 AND 3.0 FT ABOVE THE WATER SURFACE ELEVATION. OUTSIDE OF TIDAL AREAS, CONDITIONS AT THE SHORELINE SITE ARE USUALLY NOT IDEAL. HEIGHTS WILL RANGE FROM 6 INCHES TO 24 INCHES DEPENDING ON SOIL SALINITY AND WATER AVAILABILITY. THE PICKLEWEED COULD BE STUNTED BY EXTREME SALINITY CONDITIONS (HIGH OR LOW), PROLONGED INUNDATION, OR SEVER LACK OF WATER. THE MOST RELIABLE METHOD WOULD BE TO APPLY A LAYER OF BAY MUD TO THE SURFACE OF THE LEVEE TO CREATE A COMBINATION OF HIGH SALINITY AND DRY CONDITIONS. THE ABILITY OF OTHER METHODS TO STUNT PICKLEWEED IS UNCERTAIN.
5. THE PROJECT DELIVERY TEAM (PDT) RECOMMENDS A MINIMUM LEVEE PRISM WHICH WOULD BE CONSTRUCTED PRIMARILY OF BAY MUD AS SHOWN. HOWEVER, IF THE PICKLEWEED HEIGHT NEEDS TO BE FURTHER REDUCED FOR LEVEE SAFETY ON THE LANDSIDE, AN UNDERLYING LAYER OF GRAVEL OR AN UNDERLYING GEOTEXTILE COULD BE ADDED, AS ALSO SHOWN. THE PDT DOES NOT RECOMMEND ADDING A PLANTING BERM WITH NATURAL PICKLEWEED, AS SHOWN ON SHEET C 2. BECAUSE IT WILL REDUCE THE AREA OF THE MARSH, POSSIBLY RAISE ADDITIONAL ENVIRONMENTAL ISSUES, AND IS JUDGED TO BE THE MOST EXPENSIVE SOLUTION.
6. ELEVATION OF PICKLEWEED ABOVE THE LEVEE BASE IN NON-TIDAL AREAS WILL DEPEND ON THE SOIL SOURCE USED FOR THE LEVEE FACE. REUSED BAY MUD WILL ENCOURAGE PICKLEWEED AND DISCOURAGE GRASS. UPLAND SOIL WILL GENERALLY GROW GRASS UNLESS SOIL SALINIZATION OCCURS FROM ADJACENT WATERS.

US Army Corps of Engineers San Francisco District

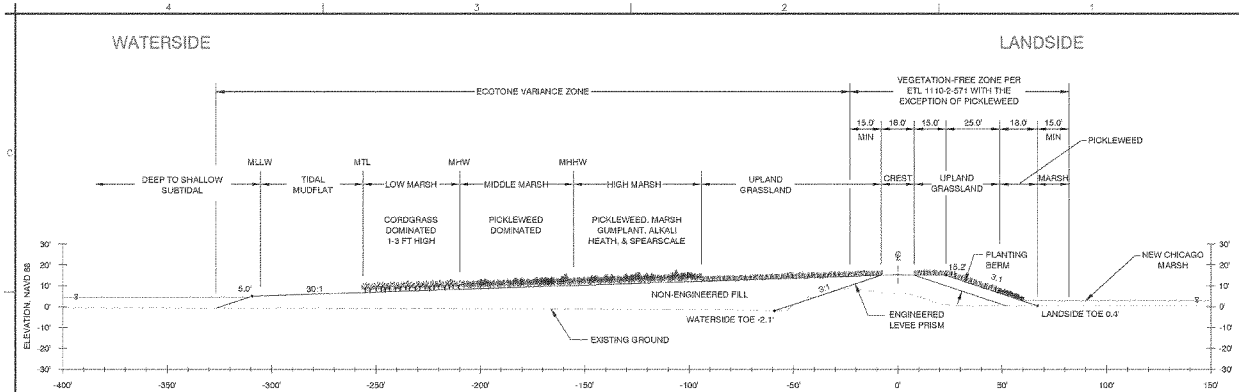
DEPARTMENT OF THE ARMY SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS SAN FRANCISCO, CALIFORNIA

SAN FRANCISCO BAY SHORELINE TYPICAL CROSS SECTIONS GRAVEL OR GEOTEXTILE ALTERNATIVE 39 0.00 TO STA 43.80

Sheet reference number: C-1

DRAFT

1306



PLANTING BERM ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 0+00 TO STA 43+80

1 / C-2

SCALE: 1" =40' (H), 1" = 40' (V)

WATERSIDE NOTES:

1. PLANTS IN THE LOW MARSH AND MIDDLE MARSH AREAS WILL ESTABLISH ON THEIR OWN. LOW MARSH WILL CONSIST OF CORDGRASS (A TALL SPECIES OF GRASS) WHILE THE MIDDLE MARSH WILL PRIMARILY CONSIST OF PERENNIAL PICKLEWEED. A LOW SUCCULENT AND SLIGHTLY WOODY PLANT THAT GROWS TO AN AVERAGE HEIGHT OF 1 FOOT. THE LOW AND MIDDLE MARSH AREAS WOULD BE LARGELY UNMANAGED WITH NO MOWING.

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SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

LANDSIDE NOTES:

1. THE LANDSIDE OF THE LEVEE AND THE ADJACENT 15 FOOT OFFSET ARE INTENDED TO BE MANAGED AS PART OF THE VEGETATION-FREE ZONE. HOWEVER, THE LOWER LANDSIDE SLOPE CAN BE EXPECTED TO DEVELOP GROWTH OF PICKLEWEED AND OTHER HIGH MARSH PLANTS DUE TO THE PRESENCE OF SALT AND SEASONAL WATER IN THE AREA. THE GROWTH OF HIGH MARSH PLANTS CAN BE EXPECTED THROUGHOUT THE ENTIRE LENGTH OF THE LEVEE. PICKLEWEED WILL NOT USUALLY GROW BEYOND THE TOE OF THE LEVEE DUE TO PERMANENT AND SEASONAL PONDED WATER. THERE WILL BE VERY MINOR LOCATIONS WHERE PICKLEWEED DOES GROW NEXT TO THE LEVEE DUE TO HIGHER GROUND.

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4. NATURAL PICKLEWEED IN TIDAL AREAS TYPICALLY GROW TO A MAXIMUM HEIGHT OF 12 TO 18 INCHES (OCCASIONALLY UP TO 34 INCHES) BETWEEN 0.0 AND 3.0 FT ABOVE THE WATER SURFACE ELEVATION. OUTSIDE OF TIDAL AREAS, CONDITIONS AT THE SHORELINE SITE ARE USUALLY NOT IDEAL, HEIGHTS WILL RANGE FROM 6 INCHES TO 24 INCHES DEPENDING ON SOIL SALINITY AND WATER AVAILABILITY. THE PICKLEWEED COULD BE STUNTED BY EXTREME SALINITY CONDITIONS (HIGH OR LOW), PROLONGED INUNDATION, OR SEVER LACK OF WATER. THE MOST RELIABLE METHOD WOULD BE TO APPLY A LAYER OF BAY MUD TO THE SURFACE OF THE LEVEE TO CREATE A COMBINATION OF HIGH SALINITY AND DRY CONDITIONS. THE ABILITY OF OTHER METHODS TO STUNT PICKLEWEED IS UNCERTAIN.

5. THE PROJECT DELIVERY TEAM (PDT) RECOMMENDS A MINIMUM LEVEE PRISM WHICH WOULD BE CONSTRUCTED PRIMARILY OF BAY MUD AS SHOWN ON SHEET C-1. HOWEVER, IF THE PICKLEWEED HEIGHT NEEDS TO BE FURTHER REDUCED FOR LEVEE SAFETY ON THE LANDSIDE, AN UNDERLYING LAYER OF GRAVEL OR AN UNDERLYING GEOTEXTILE COULD BE ADDED, AS ALSO SHOWN ON SHEET C-1. THE PDT DOES NOT RECOMMEND ADDING A PLANTING BERM WITH NATURAL PICKLEWEED, AS SHOWN, BECAUSE IT WILL REDUCE THE AREA OF THE MARSH, POSSIBLY RAISE ADDITIONAL ENVIRONMENTAL ISSUES, AND IS JUDGED TO BE THE MOST EXPENSIVE SOLUTION.

6. ELEVATION OF PICKLEWEED ABOVE THE LEVEE BASE IN NON-TIDAL AREAS WILL DEPEND ON THE SOIL SOURCE USED FOR THE LEVEE FACE. REUSED BAY MUD WILL ENCOURAGE PICKLEWEED AND DISCOURAGE GRASS. UPLAND SOIL WILL GENERALLY GROW GRASS UNLESS SOIL SALINIZATION OCCURS FROM ADJACENT WATERS.

US Army Corps of Engineers San Francisco District

Revision	Date	Description	Approved
3			
2			
1			

Prepared by: Sur. by: Dr. by: Ck. by: Spec. No.: Date: Sheet No. of Sheets: Scale: Project No.: Contract No.: Solicitation No.: Date: Contract Award: Date: Completion: Sheet Size: 22" x 34"

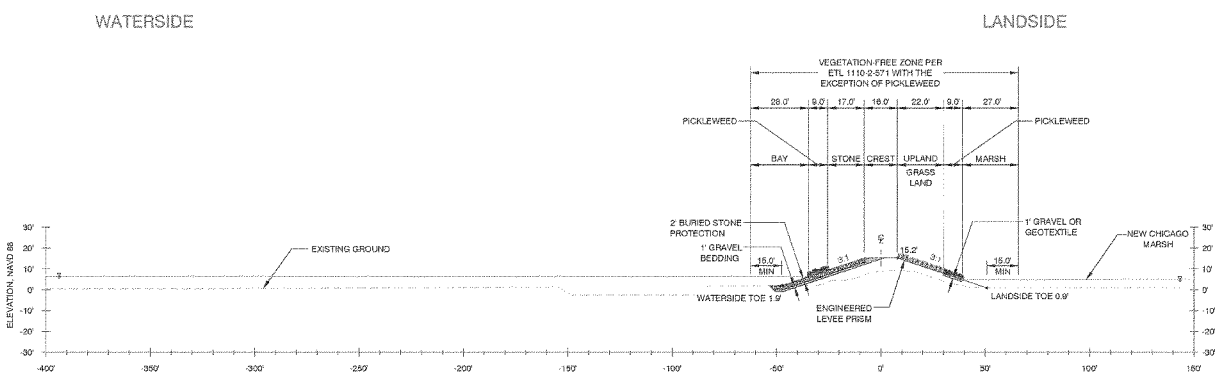
DEPARTMENT OF THE ARMY
SAN FRANCISCO, CALIFORNIA
US Army Corps of Engineers
San Francisco District

SAN FRANCISCO BAY SHORELINE
TYPICAL CROSS SECTIONS
PLANTING BERM ALTERNATIVE
STA 0+00 TO STA 43+80

Sheet reference number: C-2

DRAFT

USACE – San Francisco District
South San Francisco Bay Shoreline Phase I Study
September 2015



GRAVEL OR GEOTEXTILE ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 43+80 TO STA 94+75

B / C-3

SCALE: 1" = 40' (H), 1" = 40' (V)

WATERSIDE NOTES:

1. THE BURIED STONE IS NEEDED TO PROTECT AGAINST EROSION. THE SOIL PLACED IN THE INTERSTICES WILL ALLOW SMALLER ANIMALS TO TRAVEL UP AND DOWN THE SLOPES. PICKLEWEED WILL ESTABLISH ITSELF IN THE LOWER PORTION OF THE BURIED STONE. AN ADDITIONAL ECOTONE COULD ALSO BE CONSIDERED IN THIS REACH.

LANDSIDE NOTES:

1. THE LANDSIDE OF THE LEVEE AND THE ADJACENT 15 FOOT OFFSET ARE INTENDED TO BE MANAGED AS PART OF THE VEGETATION-FREE ZONE. HOWEVER, THE LOWER LANDSIDE SLOPE CAN BE EXPECTED TO DEVELOP GROWTH OF PICKLEWEED AND OTHER HIGH MARSH PLANTS DUE TO THE PRESENCE OF SALT AND SEASONAL WATER IN THE AREA. THE GROWTH OF HIGH MARSH PLANTS CAN BE EXPECTED THROUGHOUT THE ENTIRE LENGTH OF THE LEVEE. PICKLEWEED WILL NOT USUALLY GROW BEYOND THE TOE OF THE LEVEE DUE TO PERMANENT AND SEASONAL PONDED WATER. THERE WILL BE VERY MINOR LOCATIONS WHERE PICKLEWEED DOES GROW NEXT TO THE LEVEE DUE TO HIGHER GROUND.

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6. ELEVATION OF PICKLEWEED ABOVE THE LEVEE BASE IN NON-TIDAL AREAS WILL DEPEND ON THE SOIL SOURCE USED FOR THE LEVEE FACE. REUSED BAY MUD WILL ENCOURAGE PICKLEWEED AND DISCOURAGE GRASS. UPLAND SOIL WILL GENERALLY GROW GRASS UNLESS SOIL SALINIZATION OCCURS FROM ADJACENT WATERS.

SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

US Army Corps of Engineers San Francisco District

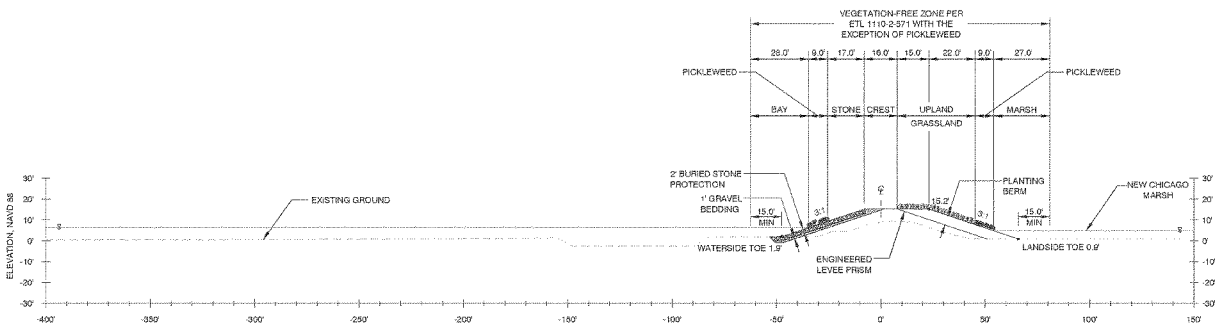
DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

SAN FRANCISCO BAY SHORELINE
TYPICAL CROSS SECTIONS
GRAVEL OR GEOTEXTILE ALTERNATIVE
STA 43+80 TO STA 94+75

Sheet reference number: C-3

DRAFT

1308



PLANTING BERM ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 43+80 TO STA 94+75

2 / C-4

SCALE: 1"=40' (H), 1"= 40' (V)

WATERSIDE NOTES:

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SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

LANDSIDE NOTES:

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US Army Corps of Engineers San Francisco District

Revisions: No. | Description | Date | Approved

Scale: 1:40 | Date: 2/8/2013 | Drawn by: Jim Hall | Checked by: Jim Hall | Approved by: Jim Hall | Sheet No. 1 of 1 | Project No. 2008-0000

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CALIFORNIA
US Army Corps of Engineers
333 Market Street
San Francisco, CA 94105-2197

Subject: SAN FRANCISCO BAY SHORELINE
TYPICAL CROSS SECTIONS
PLANTING BERM ALTERNATIVE
STA 43+80 TO STA 94+75

San Francisco

Sheet reference number: C-4

DRAFT

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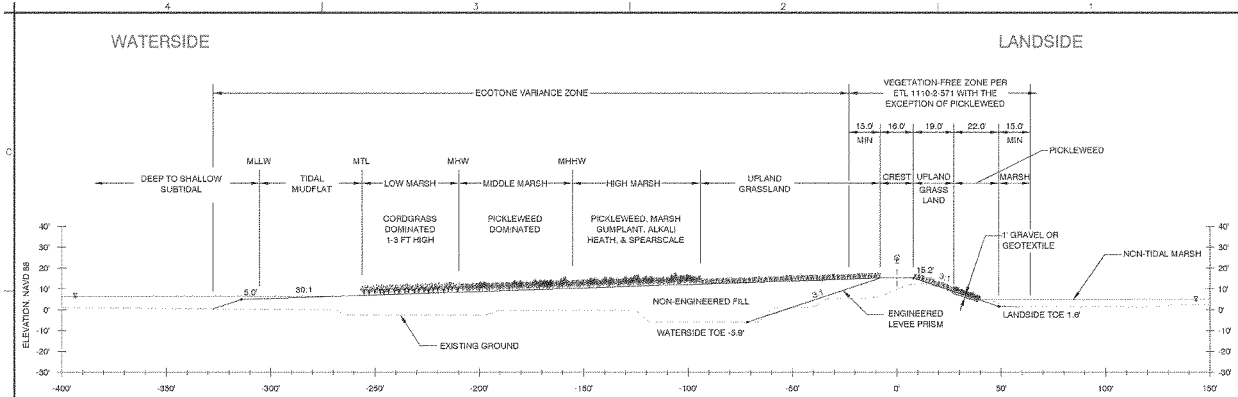

GRAVEL OR GEOTEXTILE ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 94+75 TO STA 140+00

3 / C-3

SCALE: 1"=40' (H), 1"= 40' (V)

WATERSIDE NOTES:

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3. THE 15 FEET OF ECOTONE CLOSEST TO THE FLOOD RISK MANAGEMENT LEVEE, ALONG WITH THE REST OF THE FRM LEVEE CROSS-SECTION, WOULD BE MANAGED AS A VEGETATION-FREE ZONE PER ETL 1110-2-571. SEE SECTION FOR DETAILS.

SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

LANDSIDE NOTES:

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US Army Corps of Engineers
San Francisco District

Symbol	Description	Date	Approved

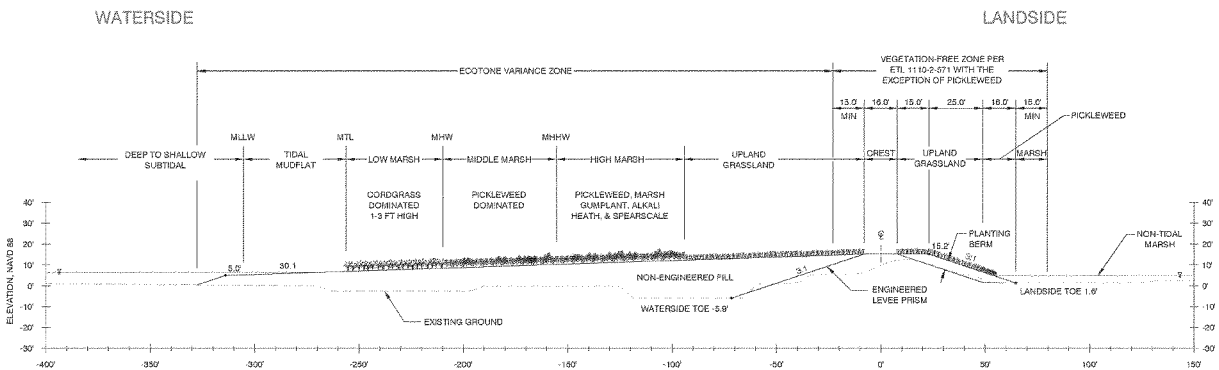
No.	Revision

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

SAN FRANCISCO BAY SHORELINE
TYPICAL CROSS SECTIONS
GRAVEL OR GEOTEXTILE ALTERNATIVE
STA 94+75 TO STA 140+00

Sheet reference number:
C-5

DRAFT



PLANTING BERM ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 94+75 TO STA 140+00

3 / C-6

SCALE: 1"=40' (H), 1"=40' (V)

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SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD85 ZONE III
VERTICAL: NAVD88

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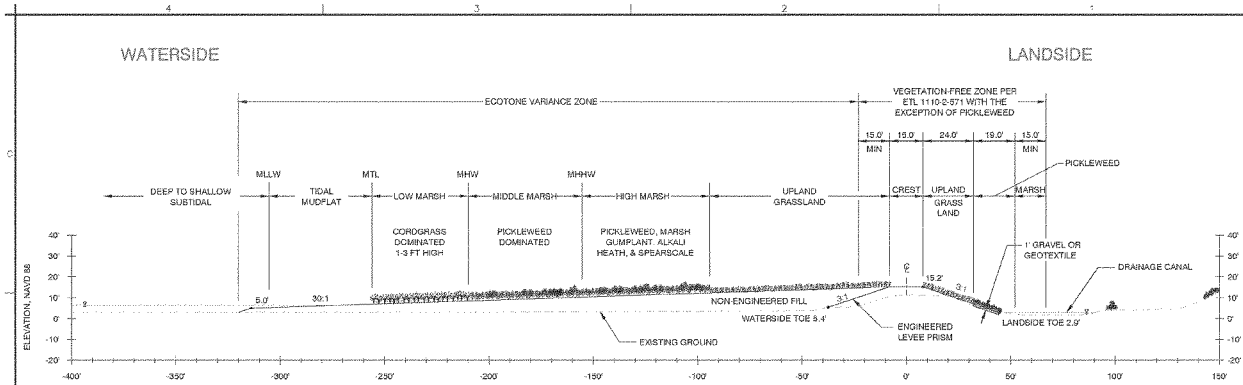
US Army Corps of Engineers
San Francisco District

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
1455 Market Street, San Francisco, CA 94103-1398

SAN FRANCISCO BAY SHORELINE
TIDAL CROSS SECTIONS
PLANTING BERM ALTERNATIVE
STA 94+75 TO STA 140+00

Sheet reference number: C-6

DRAFT



GRAVEL OR GEOTEXTILE ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 140+00 TO STA 197+75

4 / C-7

SCALE: 1"=40' (H), 1"= 40' (V)

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SHORELINE PROJECT DATUMS

HORIZONTAL: CALIFORNIA COORDINATE SYSTEM NAD83 ZONE III
VERTICAL: NAVD88

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US Army Corps of Engineers San Francisco District

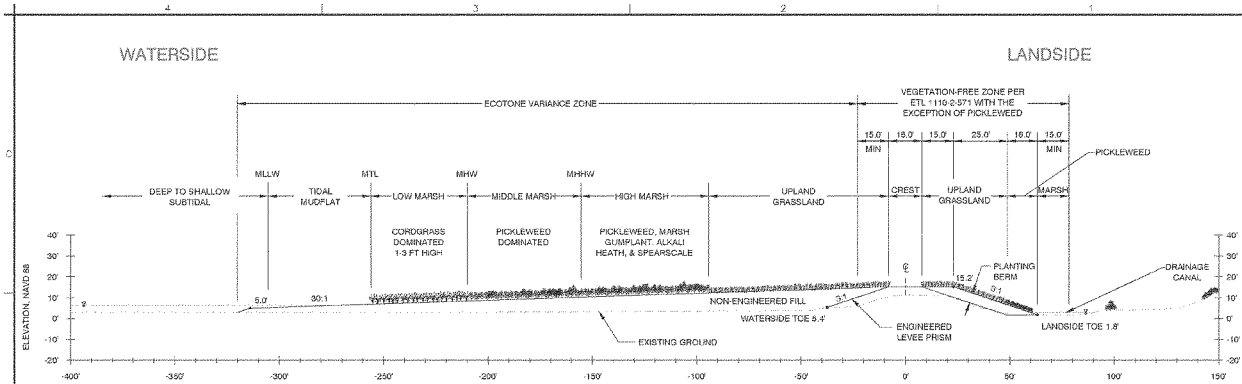
DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

SAN FRANCISCO BAY SHORELINE
TYPICAL CROSS SECTIONS
GRAVEL OR GEOTEXTILE ALTERNATIVE
STA 140+00 TO STA 197+75

Sheet reference number: C-7

DRAFT

1312



PLANTING BERM ALTERNATIVE
TYPICAL CROSS SECTION FROM STA 140+00 TO STA 197+75

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US Army Corps of Engineers San Francisco District

DEPARTMENT OF THE ARMY CORPS OF ENGINEERS SAN FRANCISCO, CALIFORNIA

SAN FRANCISCO BAY SHORELINE TIDAL DIKES SECTIONS PLANTING BERM ALTERNATIVE STA 140+00 TO STA 197+75

Sheet reference number: C-8

DRAFT

Attachment E

Geotechnical field assessment of the San Francisco South Bay Dike system

Geotechnical Memo – Version 0.8 (File: Report SFSB Site14+0813--v5o.docx)
Project center: 37.447°, -121.987° Field inspection date: 13 August 2014
Richard S. Olsen, PhD, PE, Sr. Geotechnical Engineer for USACE, HQ USACE E&C, Washington DC

Summary

The geotechnical means for potential failure of the South bay dike is crest erosion during overtopping. The 6-mile dike has a crest composed of a wide range of soil types from erodible silts to stiff clays (having low erodiblity). There is high likelihood that if overtopping occurs than some portion of the dike system will experience deep erosion of the crest.

This dike system has not experienced failure for 30+ years because of aggressive on-site efforts to maintain a marginally satisfactory crest elevation. These historic efforts have produced a system with a low margin of safety for overtopping and crest erosion. Potential for failure in the future is high for water levels of historic level as well as for lower levels.

The dike system is composed of many over geotechnical issues; settlement, rodent tunneling, drainage structures, wave erosion of exposed silt, and near surface (above pool level) sliding of the dike face. All of these issues can be addressed by properly maintaining the system.

Reason for Field Assessment

The purpose of the field visit was to observe condition of the dike to;
a) verify information from numerous project geotechnical reports,
b) observe the condition of the dike in terms of geotechnical engineering and failure modes, and
c) report on near surface conditions of the dike system (because erosion potential of the dike crest is critical).

The highest failure potential mode in terms of geotechnical engineering is erosion of the crest soils during overtopping. This memo will describe all geotechnical failure modes and related information will be examined.

Approach

Special field observation procedures as well as new reporting techniques were used for this effort and are described in Appendix A - Geotechnical field observation procedures, Appendix B – Taking photos in the field, Appendix C - Google Earth, and Appendix D – Geotechnical visualization in a report.

Observations

A visit to the levee reach was conducted by U.S. Army Corps of Engineers (USACE) personnel from HQ and SPN on 13 August 2014 by Dr. Rick Olsen (HQ USACE CW EC), Mr. Scott Nicholson (HQ USACE CW PC), Mr. Caleb Conn (USACE SPN), and Mr. Nicholas Malasavage (USACE SPN). The inspection involved driving the total dike length with frequent walking inspections at important locations.

Field observations were performed using new methods (see Appendix A and B) and displayed in this report using numerous new visualization methods (see Appendix C and D). The vehicle track and photo locations shown in Figure 1, a Google Earth visualization map (a KMZ file) which can be downloaded from http://geostaff.net//USACE/SPN/SFSB/2014aug/GE-track-photos.kmz (allow it to open in Google Earth - 6MB file will take some time to load). The photo icon groups in Figure 1 indicate the locations of vehicle stops for inspections. All project figures having site photographs will have a small map in an upper corner showing the approximate location (see right side of Figure 1).

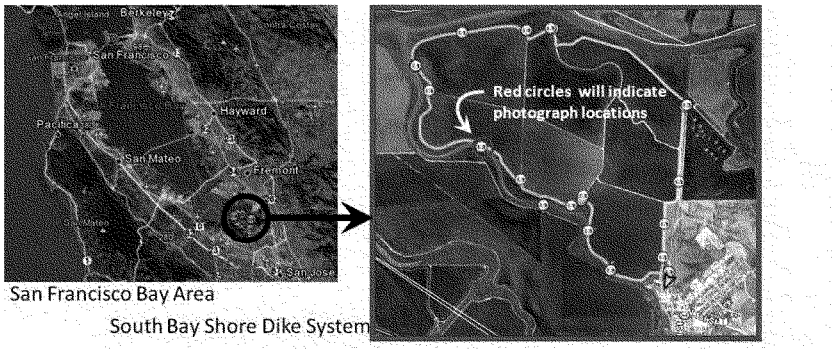

Figure 1 - Site map

There are two methods for displaying site obtained photos using Google Earth. The first is a typical method which allows user to interact with Google Earth to see location specific photos, an example is shown in Figure 2 (see Appendix C on how to use Google Earth). A new alternative visualization method is to use Vpics (also described in Appendix C)) with an example shown in Figure 3, the Vpics Google Earth KMZ data file can be downloaded from http://geostaff.net//USACE/SPN/SFSB/2014aug/GE-Vpics.kmz (allow it to open in Google Earth – 4MB file will take some time to load).

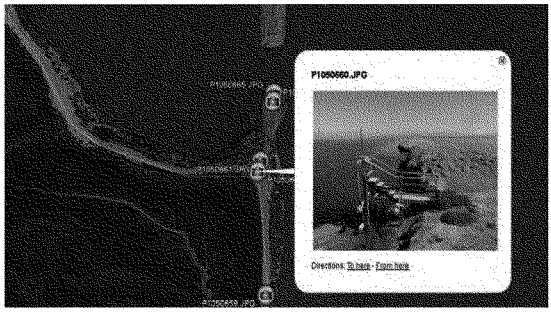

Figure 2 - Photo view from Google Earth

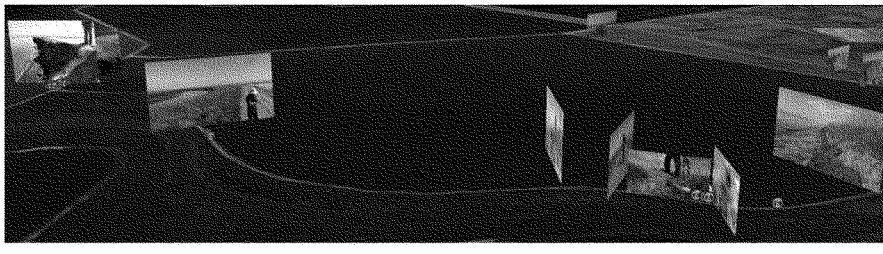

Figure 3 - Vertical pictures (Vpics) using Google Earth

Dike crest soil composition

The highest potential for dike failure is erosion of the crest soils during overtopping. There are two generalized soil locations for this dike system; soils inside the dike and the underlying soft bay mud; this section only deals with the dike soil composition.

During the field assessment most of the dike length had an observed crest soil composition ranging from loose silt behavior with high organic fiber content (termed moon dust in the field) to loose soil mixtures as shown in Figure 4. The left photo shows a silt behavior soil and the right photo shows darker high organic fiber content silt. This loose silt like behaving soil has a thickness of at least a foot in several locations (see Figure 5). These silt behaving soils have secondary influences, unfortunately generating an optimum condition for rodents to dig holes but allowing specific vegetation types to grow.

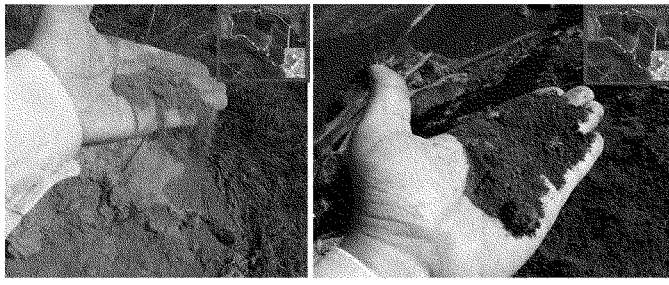

Figure 4 - Crest loose silt behavior with some to high organic fiber content

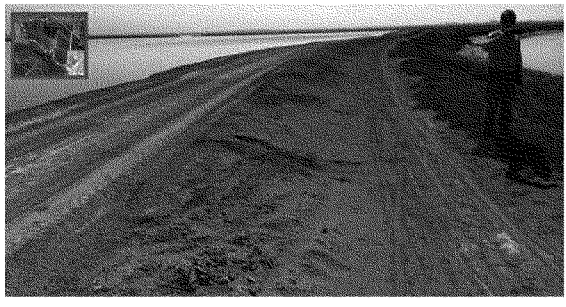

Figure 5 - Loose silt like behavior on dike crest

Characterizing crest soil types is critical for this dike system. However, none of the geotechnical engineering efforts focused on assessing the character of the dike soil types. A majority of boring effort concentrated on collection of bay mud samples. Very limited geotechnical soil sampling of the dike crest does indicate soil types ranging from silt to sandy clay, generally using only one or two soil samples in the upper 7 feet for each boring. During the CPT based exploration it's likely that a light weight CPT truck was used because a large number of the soundings were predrilled through the stronger upper dike soils before CPT probing operations started. This pre-drilling could have been a great opportunity for retrieving soil samples from the upper portion of the dike.

The following is a summary of the boring soil classification information from the upper 7 feet for borings in dike area 2 (project area);

Clay, stiff day – Boring P8
Clay, fill – Boring P12
Silt , medium stiff to stiff dry - boring P1
Clay, very soft – Boring P13

The following information is from borings outside of area 2;

Silty clay, stiff dry to moist– boring P3
Clay, soft to medium dry – Boring P4
Clay, stiff moist – Boring P6
Clay, stiff to very stiff – Boring P7
Clay, medium stiff fill – Boring P9 area 4
Clay, medium stiff fill – Boring P11
Silt (MH), medium stiff fill – Boring A6
Sandy Clay, very loose fill – Boring A7
Sandy Clay, medium stiff fill – Boring B9

No index tests other than water content were performed. A better approach would have been to perform almost continuous soil sampling in the upper 10 feet. At a minimum, performing passing #200 sieve testing should have been performed for all soil samples. Also, no samples were obtained from the upper 2 feet of the dike crest. Only a limited number of soil samples were retrieved, and stored, therefore the potential for future index testing is impossible.

During the field inspection there is evidence that Cargel field operations would scarify or blade crest soil to the bay side of the crest as shown in Figure 6. The apparent purpose of blading was to generate a small temporary raised crest section as illustrated in Figure 7.

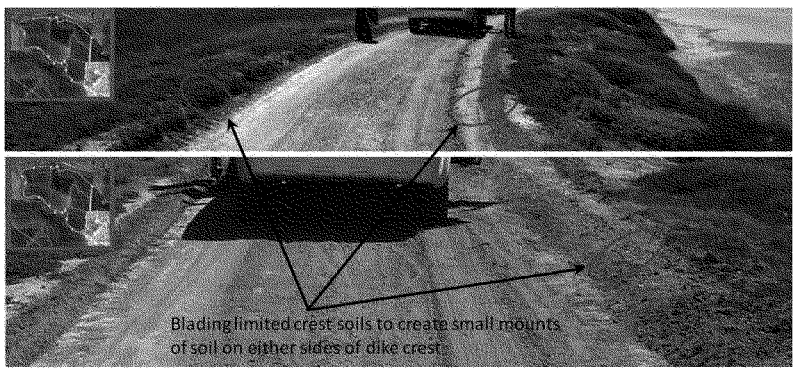

Figure 6 – Blading and scarifying dike crest silt to either side of the crest – to create limited crest elevation rise.

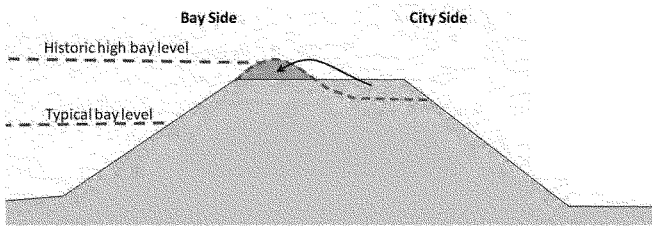

Figure 7 – Blading to create small localized mounds on the side of the crest to temporary raise the effective crest height

Crest erosion during overtopping

The crest soil type ranges from erodible silts to stiff clays (with low erodiblity). We really don't know the true range of soil types, the locations for erodible soils, or the thickness of erodible soils because there is so little information from the field. We don't know, for example, if there is only one location along the total dike length with high erosion potential. We know that at least one location along this dike system (based on borings) and likely many others (based on field observations) has significant depth of erodible silt at the crest. A high water event causing water flow over the dike crest will cause quick erosion of the crest for at least one location.

The ERDC report (2008) summarized the above geotechnical soil type data, predicted average soils (and thickness) for the levee crest, and than predicted erosion rates. It really is not possible to generalize erosion rates with so little information, specifically for soil types arranging from erodible silt to stiff clay. The most that can be predicted, with limited information, is that overtopping erosion will occur at one location having a depth that is unknown (likely as deep as 2 or 3 feet).

It is possible that only a single point along the total dike will fail due to marginal overtopping and that the depth of crest erosion will only be a few feet. We don't know the volume of breached water that could go through a shallow breach (say 2 feet) if the high water event only has a short duration.

Strength of Dike soils

Soil strength of the dike is highly variable as are most historically constructed levees and dikes around the world. Very few of the soil samples retrieved from inside the dike were laboratory tested for soil strength. A majority of the field exploration were performed using CPT soundings because it's about 3 times less expensive per foot compared to borings, but it does not provide soil samples.

Geotechnical consultants used a very simple method for estimating soil strength using CPT data. To calculate soil strength (S_u or S) the measured CPT end bearing stress required to push the tip through the ground (termed the cone resistance, q_c) was divided by N_k of 16 as shown in the equation below.

$$S_u = \frac{q_c}{N_k}$$

This method is only for clays with low silt content and is inappropriate for soil mixtures. For sandy soil mixtures the measured cone resistance will be exponentially higher and consequently an N factor higher than 16 must be used. Therefore, using N_k of 16 will generate predicted soil strength too high, and is therefore unconservative for soil mixtures in the dike.

Above waterline wave erosion of exposed silt and sliding of dike slope face soils

On the South segment of this dike system, when the dike height is high, the exposed soils on the slopes become dry and brittle. Erosion due to wave action erodes away the dike toe resulting in steeper slopes (see Figure 8). These steep sections slowly experience multipoint failures (as shown in Figure 9). The resulting debris flows into the ponds create a bench of flow material just beyond the dike toe, as illustrated in Figure 10.

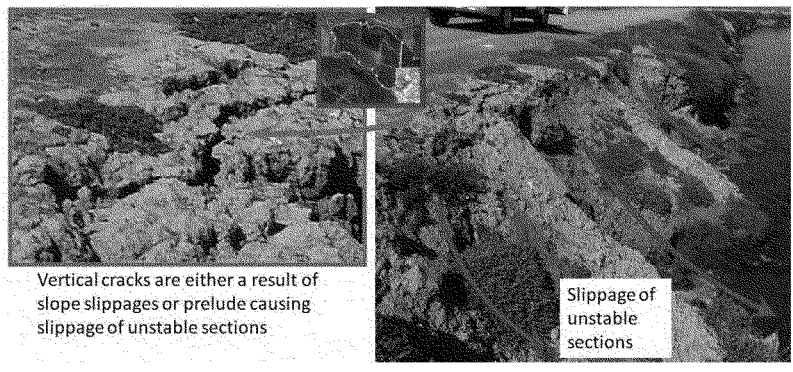

Figure 8 - toe erosion resulting in near surface failure of dike dry material

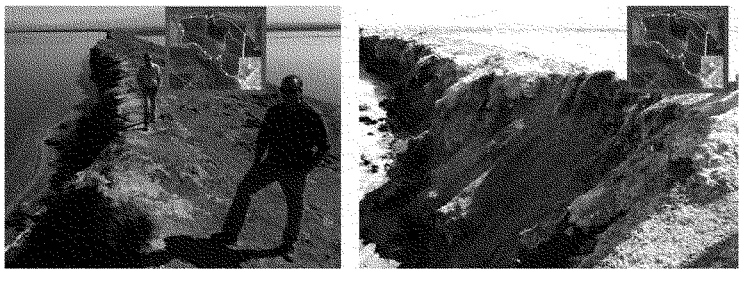

Figure 9 - Steepen dry silts and resulting sliding

Figure 10 - runout of flow material just beyond the dike toe

Rodent dug holes

Rodent holes where observed throughout the dike system - during high water events these holes can cause internal erosion based failure of the dike. The rodent holes were observed at a depth of 1 to 3 feet below the crest elevation and generally on the pool side of the dike (see Figure 11). Along an access road next to the railroad (see Figure 12) a large number of rodent holes were observed as close as one every foot. The railroad utility a few decades ago placed a large volume of small rip rap rock along the rail embankment on the south side of the road crossing, possibly because of the large number of rodent holes in this small area.

These rodent holes are important because levees have historically failed when water has risen to within 3 feet of levee crest. Figure 13 shows a levee failure in Romania likely due to rodent tunnels at a depth of 3 feet below the levee crest.

The combination of rodent holes and dry highly erodible silt soils together provide a dangerous condition because either or both in combination can cause erosion failure along an upper section of the dike (as illustrated in Figure 14).

Figure 11 - Rodent dug tunnels are throughout the dike system

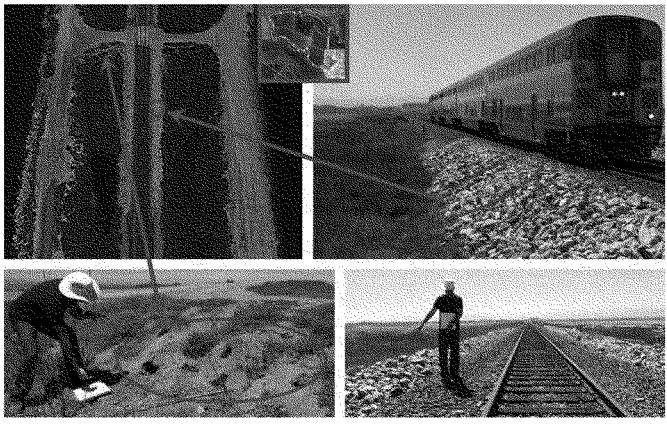

Figure 12 - Rodent dug holes next to railroad crossing

Figure 13 - Failed levee in Romania due to rodent tunneling holes

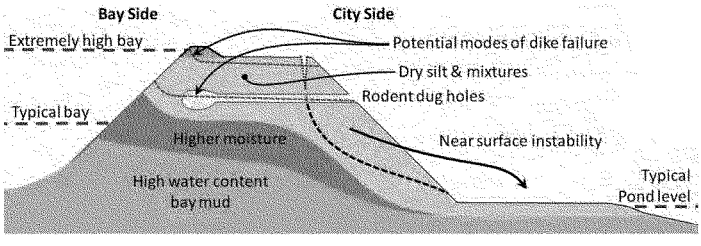

Figure 14 - Hypothetical section showing soil moisture contents, near surface instability, and rodent dug holes, and potential modes of failure.

Grass cover

Much of this dike system is covered with various types of grass cover. While grass can resist water flow the problem is that the coverage for this dike is not 100% as shown in Figure 15, there is better coverage on the bay side of the dike. There are several elevation zones of vegetation along the face of the dike likely due to the availability of water and specific soil type (see left side of Figure 16). Pickle weed was identified along upper reaches of the dike near the crest (show at the right of Figure 16). While vegetation can resist small wave action this resistance is not absolute as shown in the upper left of Figure 15.

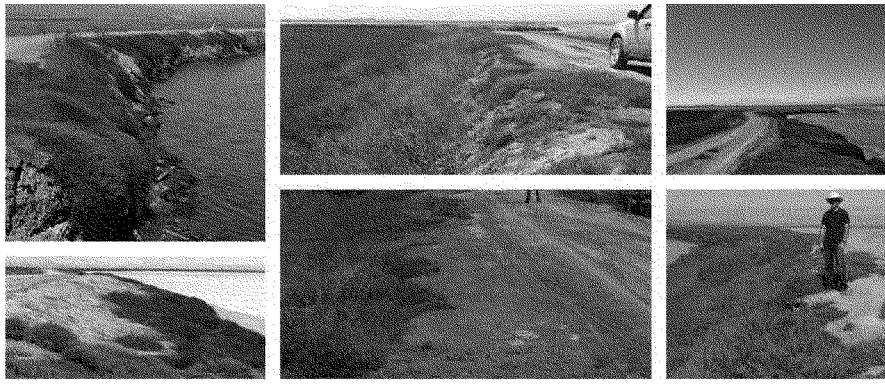

Figure 15 - Vegetation is covering much but not all the dike slopes

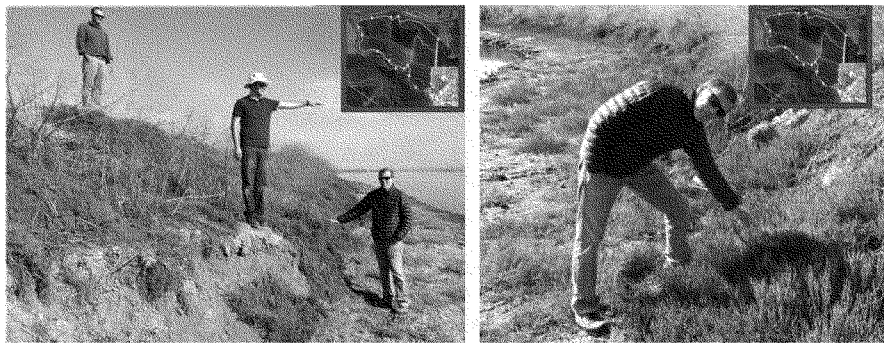

Figure 16 – Elevations of vegetation

Drainage structures

Most of the dike drainage structures for this system are showing distress (as shown in Figure 17) and could be a failure point in the future - Loss of backfill next to these structures is obvious. These structures consist of a horizontal steel pipe (about 18 inch diameter with a valve) which extends through the dike near the water line and connects to wood retaining structures on both sides. Loss of soil around pipe ends could be caused by;
a) high water velocity entrance to or exiting the pipe causing erosion of adjacent soil,
b) vibrations due to pipe water flow causing loosening and transport of nearby soils, or
c) the retaining wood structure has imperfections thus allowing silt and sand to exit creating large voids.
The likely reasons are all of the above and combinations. There are many examples of complete loss of backfill (shown in Figure 17 top right and bottom left). The top left of Figure 17 is likely caused by a generated void near the bottom of the retaining wall at the water line.

An isolated pipe through a dike section is shown Figure 18. The outside of this steel pipe has experienced severe rusting. The inside of the pipe (right side of Figure 18) shows rusting but the extent of rusting could not be observed.

Figure 17 - Water Control structures are experiencing lose of soil issues

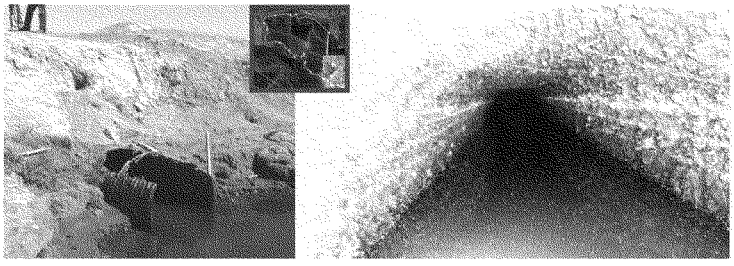

Figure 18 - Pipes through the dike are likely having rusting issues

Strength of soft Bay Mud

San Francisco bay mud strength characteristics have been well studied academically. The project geotechnical reports describe evaluation of bay mud strength based on laboratory strength tests (from boring retrieved soil samples) and predicted strengths from CPT. The soft bay mud under the dikes have experienced clay consolidation causing settlement of the dikes. This consolidation results in a strength increase under the dikes compared to bay mud deposits at same elevation beyond the dike, as shown in Figure 19. The reports don't show any analytical effort comparing strength for bay mud under the dikes to a soil column in the water beyond the dikes. It's unclear if and how the bay mud layers shown in Figure 20 were used to assign undrained strengths. A technique called the equivalent depth method could be used for comparing undrained strength versus vertical effective stress below the dike to adjacent underwater deposits. From review of the reports it cannot be discerned if the established project soil strength for the bay mud is realistic, conservative, or unconservative.

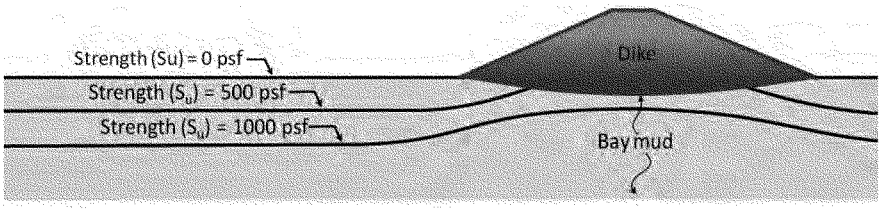

Figure 19 - Bay Mud strength beneath dike (due to consolidation and settlement) and beyond the dike

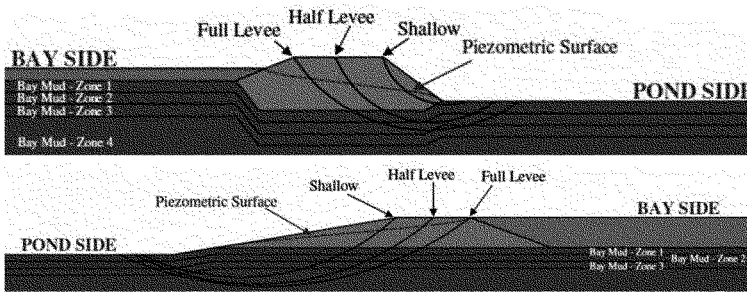

Figure 20 - Geotechnical Consultant's representing of the Bay Mud strength in terms of Bay Mud zones?

Deep Landslide Potential

A deep seated failure of this dike would require a landslide extending down and through the soft bay mud. When a landslide does occur there is a boundary between the sliding mass and non sliding soils, this is termed the failure surface. A landslide involving bay mud would cause rotational movement with the crest going down while also pushing up bay mud beyond the dike toe – generating a peninsula in the water. If such a slope failure occurred it would cause Bay mud strength level reduction along the sliding surface, and would require months to a year for strengths to be regained (if ever). The consequence is that the failure area cannot be quickly repaired. If a repair is quickly attempted it will just produce additional failures. One means of repair is to place new soil on the failure area but at a very shallow slope, such as 10:1 (10 horizontal to 1 vertical). A failure zone (and repair effort) would therefore be easy to see during a field inspection many years after the landslide.

The maintenance records from Cargel indicate no deep seated failures involving soft Bay mud. The field inspection efforts also found no evidence of historic deep seated landslides.

The geotechnical consultants spent a lot of effort performing geotechnical stability evaluation. The highly variable dike shape and crest heights were measured at numerous locations and then a generalized dike shape was used for slope stability analysis. It's unknown if the proper strengths (as discussed in previous sections on dike soil strength and bay mud strength) were used for stability evaluation. A hypothetical non circular slope instability failure surface is illustrated in Figure 21 based on realistic contours of strength under the dike. The geotechnical evaluation studies conclude that landslides are of low relative potential given the dike geometry and assuming that the soil strengths are realistic.

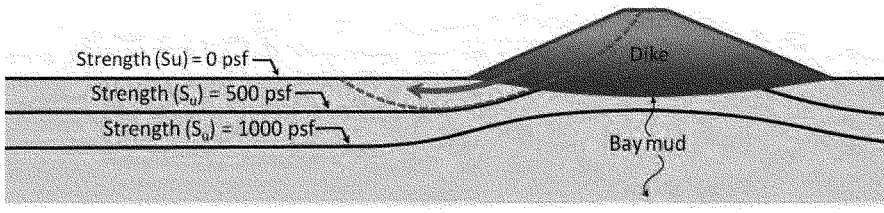

Figure 21 - Potential slip surface accounting for a realistic strength distrubution around the dike

Conclusions

There is high potential that at least one point along this dike system has highly erodible silt at the crest for a significant depth. The potential for crest erosion, during an overtopping event, is therefore high.

A large number of rodent holes were observed in this dike system (see Figure 11). There is also evidence that blading of crest soil was performed to generate small sections having a slightly higher crest elevation (see Figure 6 and Figure 7). There is unknown potential for dike failure due to rodent holes or failure through small elevated crest sections, as illustrated in Figure 14.

The potential for deep seated landslides is relatively low based on historic records as well as field observations. It could not be verified if the evaluated Bay mud strength properly accounted for strength gain under the dike and low strength immediately beyond the dike. It also could not be verified if strengths for the dike soils were unconservative based on the use of an improper simplistic evaluation method.

The historic margin of safety for this dike system has likely been very low: Failure has likely been narrowly diverted on numerous occasions. Potential for failure in the future is therefore high for water levels of historic level as well as for lower levels.

APPENDIX H

REAL ESTATE PLAN

SOUTH SAN FRANCISCO BAY SHORELINE
Alviso Ponds and Santa Clara County, California
Interim Feasibility Study

PREPARED FOR THE
SAN FRANCISCO DISTRICT
SOUTH PACIFIC DIVISION, U.S. ARMY CORPS OF ENGINEERS

OCTOBER 2015

PREPARED
BY THE
SACRAMENTO DISTRICT
REAL ESTATE DIVISION
SOUTH PACIFIC DIVISION, U.S. ARMY CORPS OF ENGINEERS

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SOUTH SAN FRANCISCO BAY SHORELINE
Alviso Ponds and Santa Clara County, California Interim Feasibility Study (Shoreline Study)
REAL ESTATE PLAN

1. Introduction

The purpose of the Shoreline Study is to address flood risk management and ecosystem restoration problems and opportunities along the southern portion of San Francisco Bay in Northern California. The decision document, a General Investigation Interim Feasibility Report and Environmental Impact Statement/Report (Integrated Document) for the South San Francisco Bay Shoreline, Alviso Ponds and Santa Clara County, California, is expected to be the basis for a recommendation to Congress for authorization of a new project. The Real Estate Plan is prepared in accordance with ER 405-1-12, Section 12-16, Real Estate Plan and in support of the Feasibility Study for the South San Francisco Bay Shoreline. The future project would be located near the community of Alviso, California and the San Jose – Santa Clara Water Treatment Plant.

The non-Federal sponsors (NFS) for the study and future project are the Santa Clara Valley Water District (SCVWD) and the California State Coastal Conservancy (SCC). The U.S. Fish and Wildlife Service (USFWS) and City of San Jose are major landowners within the study area.

This report is tentative in nature, focuses on the Recommended Plan, and is to be used for planning purposes only. There may be modifications to the plans that occur during Pre-construction, Engineering and Design (PED) phase, thus changing the final acquisition area(s) and/or administrative and land costs.

2. Project Authority

The Shoreline Study was originally authorized by Congress in 1976 to assess the need for flood protection along San Francisco Bay. A subsequent flood risk management study, completed in 1992 by the U.S. Army Corps of Engineers (USACE), found that a Federal flood risk management project along the South San Francisco Bay shoreline was not economically justifiable, largely because the future without project condition needed to assume that Cargill, Incorporated would continue to maintain existing salt pond levees that separate San Francisco Bay from developed inland areas due to their economic interest in keeping ocean and river water from diluting the brines of its salt-making operations. These salt pond levees were not engineered structures; however, they provided incidental flood protection for the surrounding communities.

In 2003, the Federal government and State of California (State) began planning a restoration project when they acquired 15,100 acres of salt ponds along southern San Francisco Bay from Cargill, Incorporated. The planned restoration project would affect the utility of the salt pond levees as flood risk management structures. As a result, the U.S. House of Representatives requested that the USACE review its previous study on flood risk management along the San Francisco Bay shoreline to determine whether changed conditions in the study area would

lead to an economically justified flood risk management project, as well as to investigate opportunities for ecosystem restoration.

The USACE completed an initial reconnaissance analysis in September 2004, which determined that due to the current and future anticipated conditions in the South Bay, it was likely that a Federal flood risk management and ecosystem restoration project would be justified. On October 24, 2005, the USACE, the Santa Clara Valley Water District, and the California State Coastal Conservancy initiated an interim feasibility study on the southern portion of the South Bay, including the Alviso Ponds and other lands and water stretching from southwest Fremont to Palo Alto in Santa Clara County.

In 2011, the study partnership reduced the geographic scale of the interim feasibility study to cover Ponds A9-A16,owned by the United States of America and managed by the United States Fish and Wildlife Service, hereafter "USFWS lands", Pond A18 (owned by the City of San Jose), and adjacent shoreline areas between Alviso Slough/Guadalupe River and Coyote Creek. This area was determined to have the highest risk for future flood damages due to its subsidence and future sea level rise. This study area also represents an opportunity to combine flood risk management and ecosystem restoration, as the restoration of Ponds A9-15 and A18 can only be accomplished after flood risk management for the adjacent inland areas has been addressed.

3. Project Description

The Recommended Plan is located near the community of Alviso, California and the San José-Santa Clara Water Pollution Control Plant (Wastewater Facility). There are three significant streams in the area: Alviso Slough, which is to the west of Alviso; Coyote Bypass, which is north of the water treatment plant; and Artesian Slough, which flows out of the Wastewater Facility. Alviso is bordered by New Chicago Marsh, and Ponds A12, A13 and A16. Pond A18 is to the north of the Wastewater Facility.

The National Economic Development and National Economic Restoration Plan (NED/NER) is a 12.5 foot flood risk management levee and ecosystem restoration on Pond A18, (non-Federally owned) and Ponds A9-15 with the recent passage of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) and the recent Implementation Guidance to propose restoration on other Federal lands.

The Recommended Plan is Alternative 3 in the Integrated Document and is described as Alviso North levee alignment15.2-foot Levee a 30:1 Ecotone (see enclosed Project Maps, Exhibit A).

The Recommended Plan includes flood risk management features (a levee and tidegate constructed on Federal and non-Federal lands), ecosystem restoration of Pond A18 with a 30:1 Ecotone, and a pedestrian bridge crossing Artesian slough and ecosystem restoration of Ponds A9-A15 (Federally owned) and recreation features on their lands. Pond restoration includes constructing features, such as starter and pilot channels, to prepare the ponds for connection with tidal flows, constructing a bayside transitional habitat zone adjacent to the proposed flood risk management levee, and breaching the ponds to allow natural sedimentation processes to create tidal marsh habitat over time. The ecosystem restoration actions would be guided by monitoring and adaptive management.

With the passage of the WRRDA 2014 and recent Implementation Guidance, the Corps will include the ecosystem restoration of the USFWS lands as part of the project, to be cost shared between the USACE and the non-Federal sponsor. The study has determined that the proposed levee, whose western segment falls primarily on USFWS lands, is the most cost effective flood risk management option. Due to the adjacency of the USFWS lands and the community of Alviso, a levee providing flood protection to the community of Alviso must fall at least partially on USFWS lands.

4. Description of Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas (LERRDs)

The Recommended Plan is shown in the table below to achieve the project goals. The non-Federal sponsors will acquire the minimum interests in real estate to support the construction and subsequent operation and maintenance of the future USACE project. Real estate interests associated with constructing, operating, and maintaining the USFWS ecosystem restoration and recreation features will need to be acquired by the non-Federal sponsor.

Once the project partnership agreement (PPA) process is complete, the San Francisco District Engineering Branch will prepare the final design for advertisement and construction. During this process the tract register and tract maps will be updated to reflect any modifications to include final staging areas, access requirements, construction haul routes, and recreation features. This information will be used for future crediting purposes.

Lands for the proposed USACE and USFWS projects consist primarily of former salt production ponds located to the west of the city of Milpitas and north of cities of San Jose and Santa Clara (see enclosed project maps). Pond A18 is immediately adjacent to the Wastewater Facility and Ponds A9-A15 located to the north of the community of Alviso (separated by New Chicago Marsh, on USFWS lands).

The Recommended Plan includes a new flood risk management levee along the existing pond levees that separate Ponds A12, A13, and A16 from New Chicago Marsh, and along the existing southern boundary of Pond A18. The USACE TSP also includes a transitional habitat feature (a 30:1 slope "ecotone") adjacent to the bayward side of the proposed levee along Pond A18. The proposed USFWS project includes a similar 30:1 ecotone along the proposed USACE levee along Ponds A12 and A13.

Project recreation features do not require additional LERRs for implementation. All recreation features for the project share space with the levee footprint. Trails and pedestrian bridges are coincident with the levee crest.

The different types of acquisitions are as follows:

Flood Protection Levee Easement will be required estimated at 29 acres.

Permanent Road Easement will be required estimated at 7 acres.

An MOU and right-of-way with USFWS lands to include approximately 25 acres for the levee alignment, 2.5 for O&M, 7 acres for staging and approximately 2,100 acres for ecosystem restoration as well as public access. See Exhibit D for draft MOU.

A Fee Estate for Ecosystem Restoration on approximately 850 acres on Pond A18 is required

An estimated 1.5 acres, more or less, will be required in Fee to secure public access for the proposed tide gate/pedestrian bridge that crosses Artesian Slough.

Temporary Work Area Easement will be required for staging areas and haul routes on private lands as identified in Exhibit A2 estimated at 45 acres. An anticipated 5 year TWAE easement will be required.

Temporary Work Area Easement will be required to support Borrow Areas. The sponsor will be required to provide 960,000 cubic yards of Borrow for the project levees, approximately 54 acres in support of the project. The sponsor has identified three projects, Upper Llagas Creek, Upper Guadalupe River and Permanente Creek, all of which are located within 30 miles from the project site. Upper Llagas Creek and Upper Guadalupe River are current Corps projects where the sponsor is required to obtain the necessary real estate and would be NOT be eligible to receive credit under LERRD's for a South San Francisco Shoreline Project. Permanente Creek is a non-Corps project; however the sponsor identified this location where Borrow will be generated and readily available for the Shoreline project levees. A Temporary Work Area Easement for approximately 20 acres, will be required to acquire the necessary borrow at Permanente Creek. An anticipated 5 year TWAE easement will be required.

An estimated 0.263 acres of the total 0.496 acres of Southern Pacific Transportation lands will require a relocation agreement for the removal and replacement of the railroad tracks. The remainder 0.233 acres is estimated for the levee alignment feature.

There is no need for disposal areas. All material that cannot be used as structural fill will be used as common fill within the project footprint.

The following Table 1 summarizes the estimated LERRDs for the USACE TSP, based on the project cadastral maps and tract register dated 8 August 2014 and 3 April 2015.

Table 1. LERRDS FOR RECOMMENDED PLAN - Levee Height of 15.2, Pond A18 Restoration with a 30:1 ecotone transitional Habitat, Pedestrian Bridge crossing Artesian Slough and Tidegate

Pond or Feature	Owner	Estate	Acres
Levee	USFWS, Southern Pacific Transportation (Project features that require lands on railroad property may cause potential delays in acquisition based on recent interactions with railroad companies on other USACE projects), , local government agencies and private owners	MOU & right-of-way with USFWS[1] and FLPE for City of San Jose and other private owners, and a non-standard estate for levee alignment feature with SLC for Artesian Slough.	~54 acres
Permanent Road Easement for Levee	USFWS, local government agencies, private owners & State of California	Permanent Road Easement	~7
Ecosystem Restoration on Pond A18 & Ponds A9-15	City of San Jose	Fee	~850 acres on Pond A18 & approx 2,135 on USFWS
Temporary Work Area Easement for Staging & Hauling	Various	TWAE (staging &haul routes on private lands)	~45
Temporary Work Area Easement for Borrow	Various	TWAE	~20
		Total (USACE Project):	~3100 ac

5. LERRDs Owned by the Non-Federal Sponsor and Crediting

Credit will only be applied to LERRDs owned and/or held by the sponsors that fall within the "project footprint," namely the LERRDs required for the TSP. Lands outside of the project requirements and that may be acquired for the sponsor's own purposes which do not support the minimum interests necessary to construct, operate and maintain the Project would not be creditable LERRDs. Only land deemed necessary to construct, operate and maintain the plan would be creditable. The value of potentially creditable lands owned by the sponsors is included in the TSP's cost estimate.

In 2003, the Department of the Interior and the State of California purchased salt making rights that had been reserved by Cargill in a previous conveyance of the lands encompassing Ponds A9-A16 to the United States. The majority of the funding for the purchase of the reserved salt making rights was provided by the State of California. Section 4027(c)(1)(b) of WRDA 2007 provides that the NFS shall receive credit for its portion of the acquisition costs for lands acquired by the State and Federal government in 2003 but currently owned by the United State of America and managed by the USFWS, (see below for Section 4027 language). The credit calculation will be based on the actual acquisition costs borne by the State of California for reserved salt making rights in the lands that are included within the USACE project.

SEC. 4027. SOUTH SAN FRANCISCO BAY SHORELINE, CALIFORNIA.
(a) IN GENERAL.—The Secretary, in cooperation with non-Federal interests, shall conduct a study of the feasibility of carrying out a project for—
(1) flood damage reduction along the South San Francisco Bay shoreline, California;
(2) restoration of the South San Francisco Bay salt ponds (including on land owned by other Federal agencies); and
(3) other related purposes, as the Secretary determines to be appropriate.
(b) REPORT.—

(1) IN GENERAL.—Not later than 3 years after the date of enactment of this Act, the Secretary shall submit to Congress a report describing the results of the study under subsection (a).
(2) INCLUSIONS.—The report under paragraph (1) shall include recommendations of the Secretary with respect to the
project described in subsection (a) based on planning, design, and land acquisition documents prepared by—
(A) the California State Coastal Conservancy;
(B) the Santa Clara Valley Water District; and
(C) other local interests.
(c) CREDIT.—
(1) IN GENERAL.—In accordance with section 221 of the Flood Control Act of 1970 (42 U.S.C. 1962d–5b), and subject to paragraph (2), the Secretary shall credit toward the non-Federal share of the cost of any project authorized by law as a result of the South San Francisco Bay shoreline study—
(A) the cost of work performed by the non-Federal interest in preparation of the feasibility study that is conducted before the date of the feasibility cost sharing agreement; and
(B) the funds expended by the non-Federal interest for acquisition costs of land that constitutes a part of such a project and that is owned by the United States Fish and Wildlife Service
(2) CONDITIONS.—The Secretary may provide credit under paragraph (1) if—
(A) the value of all or any portion of land referred to in paragraph (1)(B) that would be subject to the credit has not previously been credited to the non-Federal interest for a project; and
(B) the land was not acquired to meet any mitigation requirement of the non-Federal interest.

6. Standard Federal Estates and Non-Standard Estates

The non-Federal sponsor will be required to acquire the minimum interest in real estate that will support the construction and subsequent operation and maintenance of the proposed USACE project.

The following standard estates (with definitions) are identified as required for the project:

Flood Protection Levee Easement: A perpetual and assignable right and easement in (the land described in Schedule A) (Tracts Nos, ____, ____ and ____) to construct, maintain, repair, operate, patrol and replace a flood protection (levee) (floodwall)(gate closure) (sandbag closure), including all appurtenances thereto; reserving, however, to the owners, their heirs and assigns, all such rights and privileges in the land as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Road Easement: A (perpetual [exclusive] [non-exclusive]and assignable) (temporary) easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ____) for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); [1] subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Temporary Work Area Easement (TWAE): A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ____), for a period not to exceed _____, beginning with date possession of the land is granted to the State Coastal Conservancy and Santa Clara Valley Water District, for use by the United States, State Coastal Conservancy and/or Santa Clara Valley Water District, its representatives, non-Federal sponsors, agents, and contractors as a (borrow area) (work area),

including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Temporary Work Area Easement (above) will also apply Borrow Areas.

Fee*: The fee simple title to (the and described in Schedule A) (Tracts Nos. , and), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.
Fee simple is the standard estate for ecosystem restoration project features.

Non-standard estate
A non-standard estate for lands on State of California/State Lands Commission property for the levee feature may be required as California Code of Regulation does not currently allow State Lands Commission to grant perpetual interests over lands held in public trust. The non-standard estate, once determined, will be forwarded to SPD and HQ's for review and approval.

7. Description of any Existing Federal Projects in or Partially in the Proposed Project

There are two existing Corps civil works projects the Santa Clara Valley Water District is also a part of, Upper Guadalupe Flood Control and Upper Llagas Creek. They are within 30 miles from the Shoreline project site. During construction Upper Guadalupe and Upper Llagas Creek will generate an estimated 315,000 cubic yards and 500,000 cubic yards of borrow material, respectively. Borrow material from these locations will be readily available for the Shoreline project levees. Upper Llagas Creek and Upper Guadalupe River are current Corps projects where the sponsor is required to obtain the necessary real estate and would be NOT be eligible to receive credit under LERRD's for South San Francisco Shoreline Project.

In addition, there is one potential Federal projects in the project area.

Inland Avian Predation Management Project

This project involves the enhancement of Caspian tern habitat at sites outside of the Columbia River basin to support Federal Columbia River Power System Biological Opinion requirements associated with the Inland Avian Predation Management Plan and estuary Caspian tern management efforts. The parties involved in this include the USFWS, the USACE, and the United States Bureau of Reclamation. This action will help ensure that colonies of terns can be successfully established and managed at sites within the Don Edwards San Francisco Bay National Wildlife Refuge. Approximately 2.4 acres of Caspian tern habitat would be restored/enhanced as part of this project and approximately 0.65 acres of plover habitat would be restored/enhanced.

These islands would be distributed amongst two sites (known as Pond SF-2 and Pond A-16) which are separated geographically by approximately 10 miles in the vicinity of East Palo Alto, CA and Milpitas, CA. Three tern nesting sites and one plover nesting site would be enhanced at SF-2 while two tern nesting sites and one plover nesting site would be restored at Pond A16.

Due to limited construction routes, the project is pursuing the option of using helicopter and not ground transportation. The anticipated construction schedule for this project is November 2014 – March 2015, well before the proposed Shoreline Project construction schedule, therefore there are no conflicting schedule in terms of construction access needs.

Inland Avian Predation Management Project

8. Description of any Federally owned Land Needed for the Project

Federal lands will be required in order for the USACE to implement the Alviso segment of the proposed flood risk management levee (along Ponds A12, A13, and A16) and with the recent passage of WRRDA 2014, the USACE project will propose to include the ecosystem restoration and recreation features on USFWS lands Ponds A9-A15. An MOU and right-of-way between the NFS and USFWS is needed that would allow the necessary access for project construction and OMRR&R. Ponds A9-A15 were purchased in 2003 with the majority of funding provided by the non-Federal sponsor. Section 4027 (c)(1)(b) of WRDA 2007 provides that the NFS shall receive credit for its portion of the acquisition costs for lands acquired by the state and Federal government in 2003 but currently owned by USFWS (see below for Section 4027 language). The credit calculation will be based on the lands that are included within the future USACE project. Also included below is language for Section 1025 of the Water Resources Reform and Development Act of 2014.

SEC. 4027. SOUTH SAN FRANCISCO BAY SHORELINE, CALIFORNIA.

(a) IN GENERAL.—The Secretary, in cooperation with non-Federal interests, shall conduct a study of the feasibility of carrying out a project for—

(1) flood damage reduction along the South San Francisco Bay shoreline, California;

(2) restoration of the South San Francisco Bay salt ponds (including on land owned by other Federal agencies); and

(3) other related purposes, as the Secretary determines to be appropriate.

(b) REPORT.—

(1) IN GENERAL.—Not later than 3 years after the date of enactment of this Act, the Secretary shall submit to Congress a report describing the results of the study under subsection (a).

(2) INCLUSIONS.—The report under paragraph (1) shall include recommendations of the Secretary with respect to the

project described in subsection (a) based on planning, design, and land acquisition documents prepared by—
(A) the California State Coastal Conservancy;
(B) the Santa Clara Valley Water District; and
(C) other local interests.

(c) CREDIT.—
(1) IN GENERAL.—In accordance with section 221 of the Flood Control Act of 1970 (42 U.S.C. 1962d–5b), and subject to paragraph (2), the Secretary shall credit toward the non-Federal share of the cost of any project authorized by law as a result of the South San Francisco Bay shoreline study—
(A) the cost of work performed by the non-Federal interest in preparation of the feasibility study that is conducted before the date of the feasibility cost sharing agreement; and
(B) the funds expended by the non-Federal interest for acquisition costs of land that constitutes a part of such a project and that is owned by the United States Fish and Wildlife Service.
(2) CONDITIONS.—The Secretary may provide credit under paragraph (1) if—
(A) the value of all or any portion of land referred to in paragraph (1)(B) that would be subject to the credit has not previously been credited to the non-Federal interest for a project; and
(B) the land was not acquired to meet any mitigation requirement of the non-Federal interest.

SEC. 1025 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), Pub. L. No. 113-121, § 1025, 128 Stat. 1229 provides discretionary authority to the Secretary of the Army to carry out an authorized water resources development project on Federal land that is under the administrative jurisdiction of another Federal agency, where the cost of the acquisition of such Federal land has been paid for by the non-Federal interest for the project, after the non-Federal interest has entered into a memorandum of understanding with the Federal agency sponsors that includes such terms and conditions as the Secretary of the Army determines to be necessary.

9. Application of Navigational Servitude to the LERRDs Requirement

There are no navigational servitude issues associated with this project.

10. Project Maps

See Exhibit A.

11. Anticipated Increased Flooding and Impacts

Based on hydraulic modeling results, there will be no increased flooding from the proposed project, from either the flood risk management or ecosystem restoration actions.

12. Cost Estimate

The cost estimate is from a report prepared by SPK Appraisal Section in 2013 at the request of the San Francisco District. The highest and best use remains recreation and the land was appraised as such with the exception of project lands managed by the USFWS. The values of these lands are based on the non-Federal sponsor's acquisition per acre at $4,052. Section 4027 (c)(1)(b) of WRDA 2007 provides that the NFS shall receive credit for its portion of the acquisition costs for USACE project lands on USFWS lands (see Section 8 for Section 4027 language).

The real estate estimates for the LPP LERRDs and the NED/NER LERRDs is presented in the following tables:

Table 2- Real Estate LERRDs RECOMMENDED Plan Levee Height of 15.2, Pond A18 Restoration with a 30:1 Ecotone transitional Habitat & Restoration on USFWS Lands (approximately 10 acres more than the NED/NER)

USACE Recommended Plan Lands and Damages rounded (01 Account)	3,100 ac	$11,674,000
Incremental RE Costs rounded (25% contingency of lands & damages) (01 Account) *No contingencies applied to USFWS lands		$650,000
Non Federal Administrative Costs rounded (includes 5% contingency) (01 Account)		$660,000
Federal Administrative Costs rounded (includes 5% contingency) (including crediting) (01 Account)		$275,000
Total LERRDs plus Administrative Costs rounded (01 Account)		**$13,259,000 ***
Cost Estimate for Utility/Facility Relocations rounded (**Relocation costs only include the removal and replacement of the railroad tracks associated with the closure structure.)		$455,000
Relocation Cost Contigency (27%) (02 Account) rounded		$118,000
Relocation Escalation costs rounded (1.5%) (02 Account)		$8,000
Total LERRDs (rounded)		**13,840,000 rounded**

Table 3 – Real Estate LERRDs NED/NER Levee Height of 12.5' with Pond A18 Restoration and Ponds A9-15 on USFWS lands (approximately 10 acres less than the LPP)..

USACE Recommended Plan Lands and Damages rounded (01 Account)	3090 ac	$11,572,000
plied to USFWS lands		$650,000
Non Federal Administrative Costs rounded (includes 5% contingency) (01 Account)		$660,000
Federal Administrative Costs rounded (includes 5% contingency) (including crediting) (01 Account)		$275,000
Total LERRDs plus Administrative Costs rounded (01 Account)		**$13,157,000**
Cost Estimate for Utility/Facility Relocations rounded		$455,000
Relocation Cost Contigency (27%) (02 Account) rounded		$123,000
Relocation Escalation costs rounded (1.5%) (02 Account)		$9,000
Total LERRDs (rounded)		**13,744,000 rounded**

***Sponsor is eligible for credit on approximately 2,139 acres more or less of USFWS lands, an estimated $8,666,580, per Section 4027 (c)(1)(b) of WRDA 2007 and the passage of the Water Resources Reform and Development Act (WRRDA) of 2014 and language in Section 1025 relevant to the Shoreline Study. Also, Implementation Guidance provides the opportunity to propose ecosystem restoration of the USFWS lands as part of the NED/NER Plan or potential LPP, to be cost shared between the USACE and the non-Federal sponsor.**

The value of the 10 additional acres, more or less, identified for the LPP will not be eligible for credit.

LERRD Breakdown required for FRM features v. Ecosystem Restoration features

NED/NER 12.5' ft levee	**Approx acres**	
FRM	140 ac	$1,400,980
ER Pond A18	850 ac	$3,105,000
ER USFWS Ponds A9-15	2135 ac	$8,651,020
		NED/NER Total **$13,200,000 (rounded)**
RECOMMENDED PLAN (LPP) 15.2' ft levee		
FRM	150 ac	**$1,501,980**
ER Pond A18	850 ac	$3,106,000
ER USFWS Ponds A9-15	2135 ac	$8,651,020
		LPP Total **$13,300,000(rounded)**

13. Relocation Assistance Benefits.

The non-Federal sponsors must comply with the Uniform Relocation Assistance and Real Properties Acquisition Policies Act of 1970, as amended, 42 U.S.C. 4601 *et seq.* (P.L. 91-646, "the Uniform Act") and provide relocation assistance to qualifying residences and businesses within the project area that are displaced, as defined in the Uniform Act, as a consequence of USACE project implementation. However, no displacements will be required for the TSP.

The sponsor has also been advised of PL 91-646 requirements to pay Fair Market Value for property as part of the acquisition necessary for the project and the requirements for documenting expenses for credit purposes.

14. Mineral / Timber Activity.

There are no valuable minerals impacted by this project. There was no enhancement for mineral deposits included in the cost estimate.

15. Non-Federal Sponsor's Ability to Acquire.
The non-Federal sponsors have real estate staff and experience in acquiring real estate for county, State and Federal projects. They have not previously received credit for lands described in this report and required for this project. Pond A18 is currently owned by City of San Jose, which supports the project and has indicated a willingness to transfer these lands to the NFS.

Chapter 1405 of the California legislature's Santa Clara Valley Water District Act of 1951 (as amended) declares, "...The District may exercise the right of eminent domain, either within or without said District, to take any property necessary to carry out any of the objects of purposes of this act..."

16. Zoning Anticipated in Lieu of Acquisition.

There is no zoning in lieu of acquisition planned in connection with the project.

16. Real Estate Acquisition Schedule.

REAL ESTATE ACQUISITION SCHEDULE				
Project Name: South San Francisco Bay Shoreline Study	**USACE Start**	**USACE Finish**	**NFS Start**	**NFS Finish**
Receipt of preliminary drawings from Engineering/PM	March 2013	December 2015		
Receipt of final drawings from Engineering/PM	October 2016	February 2017		
Execution of PPA	October 2016	February 2017		
Formal transmittal of final drawings & instruction to acquire LERRDS ("Take Letter")	February 2017	March 2017		
Conduct landowner meetings (if applicable, NFS responsibility)			March 1, 2017	April 30, 2017
Prepare/review mapping & legal descriptions			March 1, 2017	April 30, 2017
Obtain/review title evidence			March 1, 2017	April 30, 2017
Obtain/review tract appraisals			March 1, 2017	April 30,2017
Conduct negotiations			April 2017	July 2017
Perform closing			July 2017	December 2018
Prepare/review condemnations			Mar 2017	Apr 2017
Perform condemnations			Apr 2017	Mar 2018
Obtain Possession			Begin March 2017	January 2018
Complete/review PL 91-646 benefit assistance			N/A	N/A
Conduct/review facility and utility relocations.			June 2018	June 2019
Certify all necessary LERRDS are available for construction	Begin January 2018	March 2018	Begin Jan 2018	March 2018
Prepare and submit credit requests (3 months)			March 2018	Dec 2018
Review/approve or deny credit requests (2 months)	June 2018	Dec 2018		
Establish value for creditable LERRDS in F&A cost accounting system	Dec 2018	April 2019		

***California State Coastal Conservancy & the Santa Clara Valley Water District will enter into an agreement with USFWS for Ponds A9-16. Santa Clara Valley Water District will acquire all other real estate required for the project.**

COE – Corps of Engineers
NFS – Non-Federal Sponsor

18. Description of Facility and Utility Relocations.

For cost-shared projects, such as USACE, the SCVWD and State Coastal Conservancy have the responsibility to perform or assure the performance of relocations. The term "relocation" as defined in applicable law and regulations, generally means providing a functionally equivalent facility to the owner of an existing utility, cemetery, highway, or other eligible public facility, and railroad (excluding existing railroad bridges and approaches thereto) when such action is authorized in accordance with applicable legal principles of just compensation. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, protecting in place or replacement (and attendant removal) of the affected facility or part thereof. Project features that require lands on railroad property may cause potential delays in acquisition based on recent current events on other USACE projects.

Consistent with requirements of Real Estate Policy Guidance Letter No. 31 – Real Estate Support to Civil Works Planning Paradigm (3x3x3) the preparation of a real estate assessment is appropriate for this feasibility study because the estimated total cost to modify all project utility/facility relocations identified in Table 4 below, Utility/Facility Inventory (including the value of any additional lands that may be required for perform the relocations) do not exceed 30 percent of estimated total project costs. Here, total project costs for the Recommended Plan is estimated at $173.9M (October 2015 Price Levels) and the utility relocations are estimated at $581,000 (whereas the NED/NER is estimated at $111.3M and utility relocations are estimated at $587,000) which is below the 30% threshold.

The real estate assessment discussed herein is based upon the following assumptions to assist in preliminarily analyzing and determining compensability for planning and budgeting purposes during the feasibility phase:

If an impacted utility/facility is likely supported by a permit that has been issued to the utility/facility owner by the underlying property owner, and the terms of the permit include conditional language stating the utility/facility owner must relocate the impacted utility/facility at its own expense at request of the underlying fee or easement owner, the relocation was categorized as a non-compensable relocation, the costs of which are borne by the utility/facility owner and/or the non-Federal sponsor, and not included in the total project cost estimate.

If the owner of the impacted utility/facility likely has an easement or real property interest in the underlying land, and the utility/facility so impacted preliminarily appears to meet the criteria for the provision of a substitute and/or replacement facility under the substitute facilities doctrine, the relocation was categorized as a compensable relocation, the costs of which are borne by the non-Federal sponsor and included in the total project cost estimate.

The proposed relocation of the City of San Jose's electrical line, the removal and replacement of railroad tracks associated with the flood gate at the railroad, and PG&E power lines are preliminarily assumed to be compensable since the utility/facility owners likely have a compensable interest in the underlying land; however, for feasibility purposes, it is presently

assumed that compensation will take the form of the provision of a substitute facility, the cost of which will be borne by the non-Federal sponsor and is included in the total project cost estimate. Following is an inventory of the utilities/facilities that have been identified as impacted by the project and likely requiring relocation.

Table 5. Utility/Facility Inventory NED/NER

Project Area Location	Station Location	Type	Utility/Facility Owner	Compensable Interest Yes or No	Cost
Buried, along east side of Artesian Slough, north of proposed flood gate	96+00	Electrical	Wastewater Facility- City of San Jose	YES	NED/NER: $102K + 1.27 contingency + 1.015 escalation = $131,000 LPP: $130,000
Running North-South between Ponds A15, A13, A12, and Pond A16, NCM, and Alviso	44+00	Removal and replacement of the Railroad tracks (assoc with flood gate at the railroad)	Southern Pacific Transportation	YES	NED/NER: $46K + 27% contingency + 1.015 escalation = $59,296 LPP: $58,000
North-south through Pond A18 and into WPCP area	130+00	Power Line	PG&E	YES	NED/NER: $308K + 27% contingency + 1.015 escalation = $397,027 LPP: 393,000
TOTAL ROUNDED					**NED/NER: $587K (contingency is 27%) LPP: $581K (contingency is 26%)**

"ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD'S RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

19. STATEMENT NON-FEDERAL SPONSOR NOTIFICATION

The non-Federal sponsors were notified in writing about the risks associated with acquiring land for the proposed project on August 23, 2013; see Exhibit C.

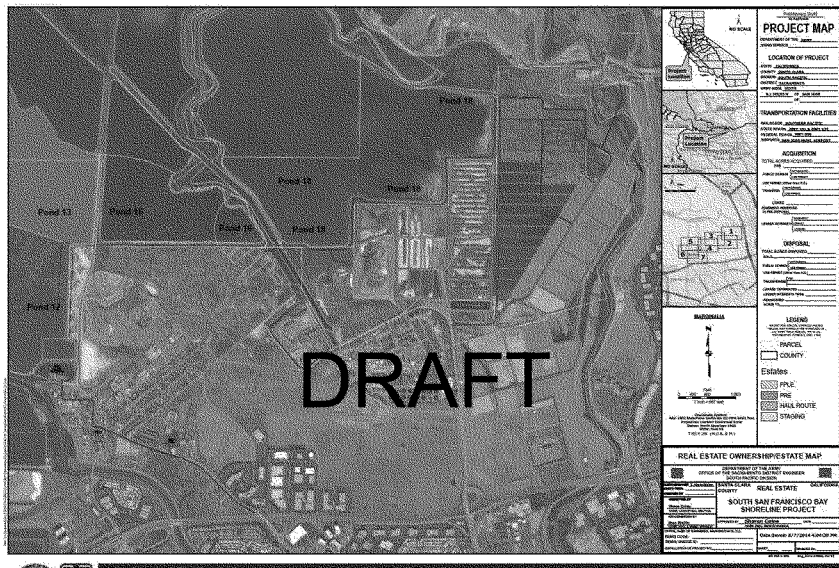
20. Hazardous, Toxic, and Radiological Waste (HTRW).

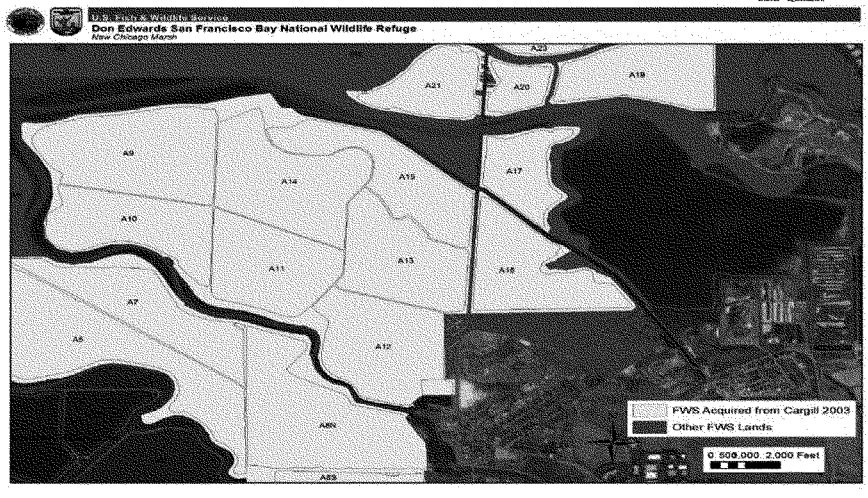
There are no known HTRW issues associated with the proposed project.

26. Attitude of Landowners.

Both the USFWS and City of San Jose (Pond A18) have expressed support for the project and have indicated their intention to cooperate.

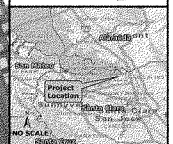
EXHIBIT A PROJECT MAPS

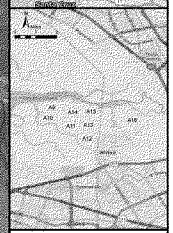




CORPS OF ENGINEERS

U.S. ARMY





FINAL
As Applicable

PROJECT MAP

DEPARTMENT OF THE ARMY
USING SERVICE

LOCATION OF PROJECT

STATE CALIFORNIA
COUNTY SANTA CLARA
DIVISION SOUTH PACIFIC
DISTRICT SACRAMENTO
ARMY AREA SIXTH
8.1 MILES N OF SAN JOSE
OF

TRANSPORTATION FACILITIES

RAILROADS SOUTHERN PACIFIC
STATE ROADS HWY 101 & HWY 237
FEDERAL ROADS HWY 880
AIRPORTS SAN JOSE MUNI. AIRPORT

ACQUISITION

TOTAL ACRES ACQUIRED
FEE
PUBLIC DOMAIN (ACTIVE/WAIV / REL/PERM)
USE PERMIT (Other than PD.)
TRANSFERS (ACTIVE/WAIV / USE PERMIT)
LEASE
EASEMENT RESERVED IN FEE DISPOSAL (ACTIVE/WAIV / LEASE)
LESSER INTERESTS (ACTIVE/WAIV / LEASE)

DISPOSAL

TOTAL ACRES DISPOSED
FEE
PUBLIC DOMAIN (ACTIVE/WAIV / USE PERMIT)
USE PERMIT (Other than PD.)
TRANSFERRED (ACTIVE / LEASE)
LEASES TERMINATED
LESSER INTERESTS TERM
REASSIGNED
ACRES TO

MARGINALIA

Feet
0 500 1,000 2,000 3,000
1 inch = 1,000 feet

Coordinate System:
NAD 1983 StatePlane California III FIPS 0403 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Feet US

T 6S R 2W (M.D.B. & M.)

LEGEND

EXCEPT FOR SPECIAL SYMBOLS SHOWN HEREON, MAP SYMBOLS ARE STANDARD IN U.S. ARMY FIELD MANUAL, FM 21-31, TOPOGRAPHIC SYMBOLS, DEC. 1968.

PARCEL
COUNTY
Alviso_Ponds

Estates

FPLE
PRE
HAUL ROUTE
STAGING

REAL ESTATE OWNERSHIP/ESTATE MAP

DEPARTMENT OF THE ARMY
OFFICE OF THE SACRAMENTO DISTRICT ENGINEER
SOUTH PACIFIC DIVISION

CARTOGRAPHER J. Hendricks
CARTO TECH
CHECKED BY
SUBMITTED BY
Steve Carey
CHIEF, CEMASTRAL SECTION
RECOMMENDED BY
Stan Walls
CHIEF REAL ESTATE DIVISION
APPROVED BY Sharon Caine
CHIEF, REAL ESTATE DIVISION
DATE
CORPS OF ENGINEERS, WASHINGTON, D.C.
REMIS CODE:
REMIS UNIQUE ID:
INSTALLATION OR PROJECT NO.
SHEET 1 OF 1
DRAWING NO.

SANTA CLARA COUNTY — REAL ESTATE — CALIFORNIA

SOUTH SAN FRANCISCO BAY SHORELINE PROJECT

Date Saved: 4/7/2015 12:19:57 PM

ER 405-1-303 Eng. Form 5454A, Oct 81

1347

TRACT ACQUISITION REGISTER: Shoreline Project - Santa Clara County, April 03, 2015.

APN	PARCEL AREA ACRES	FPLE	PRE	TWAE			Ecosystem Restoration	APN sum
				Staging	Borrow	Haul Route		
		ACRES	ACRES	ACRES	ACRES	ACRES	ACRES	ACRES
015-25-012	0.35	0.015	0.024					0.039
015-25-023	13.61	0.283	0.212					0.495
015-25-025	1.48	0.225	0.113					0.337
015-25-028	1.37	0.165	0.113					0.277
015-26-001	2.66	0.488	0.116					0.604
015-26-015	0.16	0.134	0.020					0.154
015-26-023	1.40	0.303	0.114					0.417
015-26-027	3.38	0.169	0.070					0.239
015-28-007	5.15	1.074	0.196					1.270
015-29-003	10.17	0.001	0.019					0.020
015-29-004	20.52	0.688	0.135					0.823
015-30-071	51.02			2.536		0.832		3.368
015-31-008	600.63			24.250		14.117		38.366
015-32-018	12.96	0.398						0.398
015-32-019	0.89	0.011						0.011
015-32-020	26.44	0.654	0.049					0.703
015-32-029	144.29	2.329						2.329
015-32-030	17.24	7.147	1.185					8.332
015-32-031	31.37	1.639						1.639
015-32-032	9.42	2.513	0.381					2.895
015-32-033	115.49	0.136	0.013					0.149
015-32-034	31.83	0.120	0.003				13.180	0.124
015-32-043	432.20	25.061	2.886				404.000	431.947
015-33-043	350.63	6.529	0.689				341.640	348.358
015-33-053	12.73	1.962	0.052					2.014
015-33-054	16.35	2.753	0.103			0.211		1.068
015-38-005	103.17	1.241	0.421					1.662
015-47-005	1.08					0.006		0.006
022-30-050	66.10					0.359		0.359
Public Road	N/A					2.500		2.500
015-32-042	432.05						432.050	432.050
015-33-016	409.32						408.970	408.970
15-33-037	52.85						21.5000	21.500
15-33-038	476.19						476.1900	476.190
15-33-039	38.06						3.7047	3.705
15-33-040	311.20						311.1991	311.199
15-33-041	306.93						306.6349	306.635
15-33-042	58.78						1.8702	1.870
15-33-044	4.3901						1.3527	1.353
15-33-045	13.1883						2.3781	2.378
15-33-046	234.7730						234.7730	234.773
15-33-053	12.7273						12.7273	12.727
342-05-062	158.0300				7.500			7.500
342-63-004	67.5400				7.500			7.500
189-03-019	5.0836				5.000			5.000
	2925.76	**54.04**	**6.41**	**26.79**	**20.00**	**18.02**	**2972.17**	**3064.252**

FLOOD PROTECTION LEVEE EASEMENT
TEMPORARY WORK AREA EASEMENT (Staging, Borrow, Haul Route etc.)
PERMANENT ROAD EASEMENT
Ecosystem Restoration

DRAFT Feasibility Study - BJ to CHANGE

1348

EXHIBIT B- Staging and Haul Routes

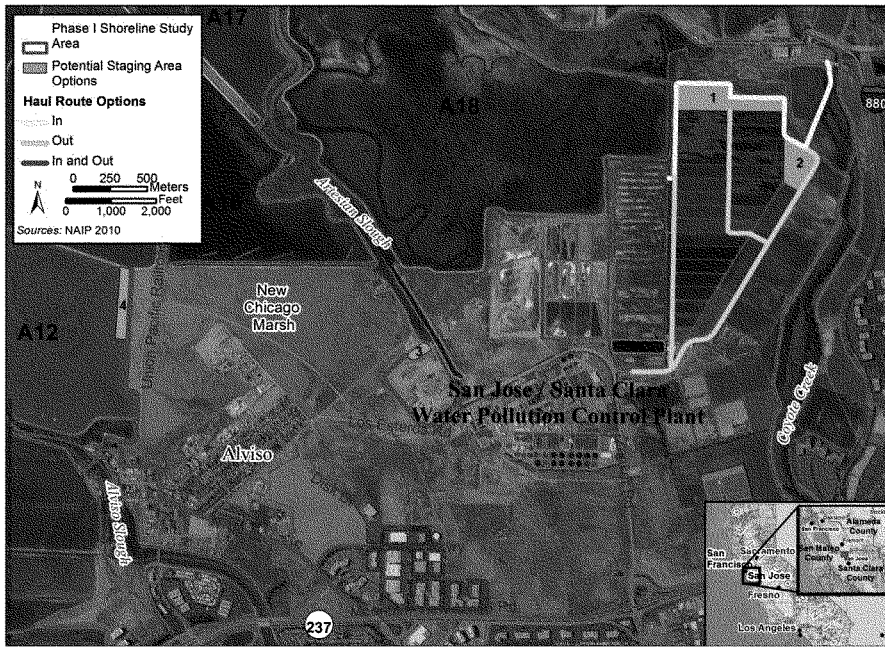


EXHIBIT C
NFS Notification of Risks prior to notification & P.L. 91-646

DEPARTMENT OF THE ARMY
U. S.ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

August 23, 2013

Acquisition & Management Branch

Mr. Samuel P. Schuchat, Executive Officer
California State Coastal Conservancy
Attention: Ms. Amy Hutzel
1330 Broadway, 13th Floor
Oakland, CA 94612-2530

Dear Ms. Hutzel:

It is our understanding that the California State Coastal Conservancy (SCC) is undertaking real estate activities/acquisition management, and acquisition of land it anticipates will be required for the proposed South San Francisco Bay Shoreline Project. This is prior to execution of the Project Partnership Agreement (PPA), and prior to the Government's formal notice to proceed with its acquisition after PPA execution.

We caution you that there are many risks associated with acquisition under such circumstances and that, as the non-Federal sponsor, your agency assumes full and sole responsibility for any and all costs, or liability arising out of the acquisition effort. Generally, these risks include, but may not be limited to the following:

a. The Congress of the United States may not appropriate funds to construct the proposed project.

b. A PPA mutually agreeable to the SCC and the Federal Government may not be executed and implemented.

c. SCC may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42, U.S.C. 9601-9675.

d. SCC may acquire interests or estates in real property that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project.

e. SCC may initially acquire insufficient or excessive real property acreage that may result in additional negotiations, payment of Public Law 91-646 (as amended) benefits, or payments of fair market value to affected landowners that could have been avoided by delaying acquisition until after PCA execution and the said formal notice by the Corps to commence acquisition of land and right of way.

f. SCC may incur costs or expenses in connection with its decision to acquire or perform acquisition activities in advance of the executed PCA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662, The Water Resources Development Act of 1986, or the PCA.

Should you have any questions, please contact Project Manager, Caleb Conn at (415) 503-6849 or Realty Specialist, Bonievee Delapaz at (415) 503-6745

Sincerely,

SHARON CAINE
Chief, Real Estate Division

Copy Furnished:

Caleb Conn - USACE Project Manager (VIA EMAIL ONLY)

DEPARTMENT OF THE ARMY
U. S.ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

August 23, 2013

Acquisition & Management Branch

Mr. Beau Goldie, Chief Executive Officer
Santa Clara Valley Water District
Attention: Mr. Ngoc Nguyen
5750 Almaden Expressway
San Jose, CA 95118-3686

Dear Mr. Nguyen:

It is our understanding that the Santa Clara Valley Water District (SCVWD) is undertaking real estate activities/acquisition management, and acquisition of land it anticipates will be required for the proposed South San Francisco Bay Shoreline Project. This is prior to execution of the Project Partnership Agreement (PPA), and prior to the Government's formal notice to proceed with its acquisition after PPA execution.

We caution you that there are many risks associated with acquisition under such circumstances and that, as the non-Federal sponsor, your agency assumes full and sole responsibility for any and all costs, or liability arising out of the acquisition effort. Generally, these risks include, but may not be limited to the following:

a. The Congress of the United States may not appropriate funds to construct the proposed project.

b. A PPA mutually agreeable to the SCVWD and the Federal Government may not be executed and implemented.

c. SCVWD may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42, U.S.C. 9601-9675.

d. SCVWD may acquire interests or estates in real property that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project.

e. SCVWD may initially acquire insufficient or excessive real property acreage that may result in additional negotiations, payment of Public Law 91-646 (as amended) benefits, or payments of fair market value to affected landowners that could have been avoided by delaying acquisition until after PCA execution and the said formal notice by the Corps to commence acquisition of land and right of way.

f. SCVWD may incur costs or expenses in connection with its decision to acquire or perform acquisition activities in advance of the executed PCA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662, The Water Resources Development Act of 1986, or the PCA.

Should you have any questions, please contact Project Manager, Caleb Conn at (415) 503-6849 or Realty Specialist, Bonievee Delapaz at (415) 503-6745

Sincerely,

SHARON CAINE
Chief, Real Estate Division

Copy Furnished:

Caleb Conn - USACE Project Manager (VIA EMAIL ONLY)

EXHIBIT D

A MEMORANDUM OF UNDERSTANDING BETWEEN THE USFWS, SANTA CLARA VALLEY WATER DISTRICT AND THE STATE COASTAL CONSERVANCY WILL BE INSERTED HERE.

EXHIBIT E

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY
Shoreline

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?
YES
b. Does the sponsor have the power of eminent domain for this project?
YES
c. Does the sponsor have "quick-take" authority for this project?
YES
d. Are any of the lands/interests in land required for the project located outside of the sponsor's political boundary?
NO
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?
YES (USFWS lands)

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including PL 91-646, as amended?
NO. Relocation assistance is not required for this project.
b. If the answer to II. A. is "yes", has a reasonable plan been developed to provide such training?
N/A
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?
YES
d. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?
YES. The SCC acquires property all the time and the SCVWD has real estate support staff.
e. Can the sponsor obtain contractor support, if required, in a timely fashion
YES
f. Will the sponsor likely request USACE assistance in acquiring real estate?
NO

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?
YES
b. Has the sponsor approved the project/real estate schedule/milestones?
YES

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?
YES
b. With regard to this project, the sponsor is anticipated to be: (Capable – Highly Capable – Not capable, etc.)
HIGHLY CAPABLE

V. Coordination:

a. Has this assessment been coordinated with the sponsor?
YES
b. Does the sponsor concur with this assessment?
YES

Prepared by:
for Laurel Parker
BONIEVEE A. DELAPAZ
Real Estate Specialist

Reviewed and Approved by:
STAN WALLIN
Chief, Real Estate Division

Appendix I

Public Comments and Responses on Draft Integrated Document

September 2015
(revised December 2015)

I Public Comments and Responses on Draft Integrated Document

I.1 Purpose of the Response to Comments

This Response to Comments appendix provides responses to comments received on the draft Shoreline Phase I EIS/EIR/Feasibility Report (Integrated Document). The draft document identified the environmental consequences associated with the implementation of the Shoreline Phase I Study features, as well as avoidance, minimization, and mitigation measures to reduce significant and potentially significant impacts. As a result of these comments, the Integrated Document has been revised.

The draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) with updates, together with this Response to Comments appendix, constitute the Final EIS/R for the proposed Shoreline Phase I Study.

The Final EIS/R is an informational document prepared by the lead agencies that must be considered by decision-makers before approving or denying a proposed project.

Sec. 1502.9(b) of the CEQ Regulations for Implementing NEPA states:

> Final environmental impact statements shall respond to comments as required in Part 1503 of this chapter. The agency shall discuss at appropriate points in the final statement any responsible opposing view which was not adequately discussed in the draft statement and shall indicate the agency's response to the issues raised.

CEQA Guidelines (Section 15132) specify that a Final EIR shall consist of:

(a) The Draft EIR or a revision of the draft

(b) Comments and recommendation received on the Draft Program EIR, either verbatim or in summary

(c) A list of persons, organizations, and public agencies commenting on the Draft Program EIR

(d) The response of the lead agency to significant environmental points raised in the review and consultation process

(e) Any other information added by the lead agency.

I.2 Environmental Review Process

On December 18, 2014, the lead agencies (U.S. Army Corps of Engineers and the Santa Clara Valley Water District) released the draft Integrated Document for public review (State Clearinghouse No. 2006012020). The public review and comment period began on December 19, 2014 and closed on February 23, 2015 after a 21 day extension was granted to the original 45-day review period.

The lead agencies provided a Notice of Availability notifying the public of the publication of the draft Integrated Document. This notice was mailed to the individuals and organizations that

have been involved in the Shoreline Phase I Study planning effort, as well as those who previously requested such notice in writing. The notice and the draft document were also posted on the USACE and SCVWD websites.

During the public review period, a public meeting was held to discuss the Proposed Project (Recommended Plan) and receive comments on the draft Integrated Document. The meeting was held on January 14, 2015 at the George Mayne Elementary School in Alviso. The date, time, and place of this meeting were identified in the publicly-circulated Notice of Availability.

I.3 Report Organization

Section 1.5 *Individual Comments and Responses* of this appendix contains copies of comments received during the comment period followed by the lead agencies' responses to those comments. Each comment is coded in the margin of the comment letter, based on the initials assigned for each letter and the order of the comments received (see Table I-1). For example, the first comment is a letter from the Baylands Conservation Committee and is coded 001_BCC. A number of comments that were received addressed similar concerns. Responses to these comments were consolidated into master responses and are provided in Section I.4 *Master Responses*. Four master responses were prepared in response to issues that elicited numerous comments. These master responses include:

- Coyote Creek Levee Alignment;
- Artesian Slough;
- The USACE's Planning Modernization Initiative; and
- Section 1025 of Water Resources Reform and Development Act (WRRDA) 2014.

Where a response includes a change to the text of the draft Integrated Document, the text has been revised in the Final Integrated Document. Minor text revisions are presented in the responses to comments; where substantial revisions were made, the responses include a reference to the revised text in the Final Integrated Document. Text changes in this Response to Comments appendix are indented and shown in underline and ~~strikeout~~ format. Text shown in underline format is new text added to the Final Integrated Document. Text shown in ~~strikeout~~ format is text deleted from the document. Indented text that is presented in normal format (no underline or strikeout) is original text excerpted from the Draft Integrated Document that will remain in the final document and is shown to provide context for the revisions.

Table I-1 lists all persons and organizations that submitted comments on the draft Integrated Document during the comment period, the code used to identify each letter, and the date of each letter.

Table I-1. Persons and Organizations that Submitted Comments on the Draft Integrated Document

Commenter	Code	Agency/Organization	Date
Emily M. Renzel	001_BCC	Baylands Conservation Committee	1/28/2015
Carin High	002_CCCR	Citizen's Committee to Complete the Refuge	1/26/2015
Alice Kaufman	003_CGF	Committee for Green Foothills	1/28/2015
James Munson	004_EPA	U.S. Environmental Protection Agency, Region 9	1/12/2015
Arthur Feinstein	005_Feinstein		1/28/2015
Matthew Liddy	006_Leddy		1/28/2015
Brian Wines	007_RWQCB	SF Bay Regional Water Quality Control Board	1/21/2015
Shani Kleinhaus	008_SCVAS	Santa Clara Valley Audubon Society	1/22/2015
Sejal Choksi-Chugh	009_SFB	San Francisco Baykeeper	1/28/2015
Yves Zsutty	010_SJPRNS	San Jose Parks, Recreation, and Neighborhood Services	1/15/2015
Cy R. Oggins	011_SLC	California State Lands Commission	1/22/2015
D.H. Sulouff	012_USCG	U.S. Coast Guard	1/22/2015
Libby Lucas	013_Lucas_1		1/17/2015
Libby Lucas	014_Lucas_2		1/28/2015
Libby Lucas	015_Lucas_3		1/29/2015
Patricia Maurice	016_Caltrans	Department of Transportation, District 4	2/9/2015
Will Fourt	017_SCPR	Santa Clara County Parks	2/23/2015
Libby Lucas	018_Lucas_4		2/22/2015
Diane Ross-Leech	019_PGE	Pacific Gas and Electric Company	2/23/2015
Roy Molseed	020_VTA	Santa Clara Valley Transportation Authority	2/23/2015
Eileen McLaughlin, Ian Wren, Alice Kaufman, Linda D. Ruthruff, Shani Kleinhaus, Michael Ferreira	021_CCCR_2	Citizen's Committee to Complete the Refuge, San Francisco Bay Keeper, Committee to Complete the Refuge, California Native Plant Society – Santa Clara County Chapter, Santa Clara Valley Audubon Society, Sierra Club Loma Prieta Chapter	2/23/2015
Shani Kleinhaus	022_SCVAS_2	Santa Clara Valley Audubon Society	2/23/2015
Paul R. Kumar	023_STB	Save the Bay	2/23/2015
Laura Thompson	024_SFBTr	San Francisco Bay Trail	2/23/2015
Mark Espinoza	025_Espinoza		2/23/2015
Sarah Richmond	026_BCDC	San Francisco Bay Conservation and Development Commission	2/23/2015
Brian Wines	027_RWQCB_2	SF Bay Regional Water Quality Control Board	2/23/2015
Carin High, Ian Wren	028_CCCR.SFB_3	Citizen's Committee to Complete the Refuge, San Francisco Bay Keeper	2/23/2015
John Stufflebean	029_SV	City of Sunnyvale	2/23/2015
Whitney Berry	030_SJ	San Jose Department of Planning, Building and Code Enforcement	2/23/2015
Kathleen Martyn Goforth	031_EPA_2	U.S. Environmental Protection Agency, Region 9	2/23/2015
Emily Renzel	032_BCC_2	Baylands Conservation Committee	2/23/2015
Scott Wilson	033_CDFW	California Department of Fish and Wildlife	2/23/2015
Dave Cortese	034_Cortese	Santa Clara County Board of Supervisors	2/19/2015
Cecilia D. Craig	035_SFBWS	San Francisco Bay Wildlife Society	2/20/2015

Table I-1. Persons and Organizations that Submitted Comments on the Draft Integrated Document

Commenter	Code	Agency/Organization	Date
Matthew Leddy	036_Leddy_2		2/20/2015
Libby Lucas	038_Lucas_5		2/23/2015
Patricia Sanderson Port	039_DOI	U.S. Department of the Interior	2/2/2015
Pat Mapelli	040_CG	Cargill	2/19/2015
Sam Liccardo, Margie Matthews	041_Liccardo Matthews	San Jose City Council	3/19/2015

I.4 Master Responses

I.4.1 Coyote Creek Levee Alignment

This master response addresses the following comments: 021_CCCR_2-1; 022_ SCVAS_2 -3; 023_STB-3; 023_STB-4; 027_RWQCB_2-5; 028_CCCR.SFB_3-13; 028_CCCR.SFB_3-32; 028_CCCR.SFB_3-34; 032_BCC_2-2; and 034_Cortese-1.

Multiple letters state that the Shoreline Study team prematurely dismissed a variation of the levee alignments that would move the last "leg" of the eastern-side of the Pond A18 levee from its northern terminus (shown in orange in Figure I-1 *Potential Wastewater Facility Segment Levee Alignments*) on the Coyote Creek Flood Protection levee, to a more eastern terminus (shown in green) on the Coyote Creek Flood Protection levee further upstream. In either terminus location, the Shoreline levee would tie into the Coyote Creek flood protection levee which is FEMA certified to provide 100-year fluvial flood protection.

Figure I-1. WPCP South – Drying Beds

An EIS/EIR must describe a reasonable range of alternatives (CEQA Guidelines, section 15126.6(a); 40 C.F.R. 1502.14). The range of alternatives to be analyzed is those that could feasibly attain most of the basic objectives of the project while avoiding or substantially lessening any of the significant effects of the project (CEQA Guidelines, section 15126.6(a)). Among the factors that may be taken into account when evaluating feasibility of alternatives are site suitability, economic viability, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries, and whether the project proponent can reasonably acquire, control or otherwise have access to the alternative site (CEQA Guidelines, section 15126.6(f)(1)). Similarly, NEPA requires an EIS to include reasonable alternatives that may be feasibly carried out based on technical, economic, environmental, and other factors (see, for example, *Sierra Club v. Froehlke*, 534 F.2d 1289, 8th Circuit 1976); alternatives that are speculative are not required to be included in an EIS (see, for example, *Seacoast Anti-Pollution League v. Nuclear Regulatory* Commission, 598 F.2d 1221, 1st Cir. 1979).

The eastern terminus alignment was not carried forward as a feasible alternative for consideration in the draft EIR/EIS (referred to in this document as an Integrated Document as combined with the USACE Interim Feasibility Study) because the City of San Jose's current plan for the San Jose-Santa Clara Regional Wastewater Facility (Wastewater Facility) is to retain the existing sludge lagoons which currently occupy the area needed to implement an eastern terminus alignment. The City of San José adopted the Plant Master Plan (PMP) for the Wastewater Facility in November 2013. The PMP is a planning document to guide improvements at the plant for the next 30 years, including defining future treatment needs and designating future land use on plant lands. The PMP identified a tentative levee alignment which would allow the Wastewater Facility's continuous use of the sludge lagoons for the dewatering treatment process. The eastern terminus alignment would require the removal of some of the lagoons. In preparing the response to this comment, the Shoreline team re-engaged the City of San José staff to solicit additional information about their operations and long-term preferences. The City of San Jose is currently conducting an evaluation of the odor impacts of the Wastewater Facility's operations, including the sludge lagoons, on the surrounding community and the feasibility of using other waste processing technology. Once the study is concluded, the City will be able to analyze its future operations and possibly determine whether or not it will continue to use the sludge lagoons.

While the City of San José will continue to work with the Shoreline Phase I team to determine the final levee alignment, given the uncertainty surrounding the Wastewater Facility's future need for the sludge lagoons, it is speculative at this time to consider the suggested eastern terminus alignment as a feasible alternative for further review in the Integrated Document.

However, should the eastern terminus alignment become possible in the future, the Shoreline Phase I team would evaluate the feasibility of incorporating this alternative in the final project design and, if necessary, would conduct additional environmental review.

I.4.2 Artesian Slough

This master response addresses the following comments: 022_ SCVAS_2-4; 023_STB-1; and 031_EPA_2-14.

Some commenters expressed concern about the proposed flood gate across Artesian Slough and that an alternative levee around Artesian Slough was eliminated from environmental review. Concerns include:

- Whether closing flood gates downstream of the Wastewater Facility's effluent discharge is feasible
- Impacts to the Wastewater Facility's treatment process
- Conversion of aquatic habitat in Artesian Slough due to freshwater discharges from the Wastewater Facility or adding an obstruction in the slough that may alter the salinity
- Direct fill of Artesian Slough for the tide gate.

As stated in the draft Integrated Document, the measure that includes constructing levees up either side of Artesian Slough to high ground was not carried forward for further analysis because "it is less economically efficient than the tide gate measure and did not provide any additional advantages relative to the other criteria." Additional analysis was conducted on the alternative to extend levees down both sides of Artesian Slough (as depicted in Figure I-2 *Potential Artesian Slough Crossing Options*) that was not included in the draft Integrated Document.

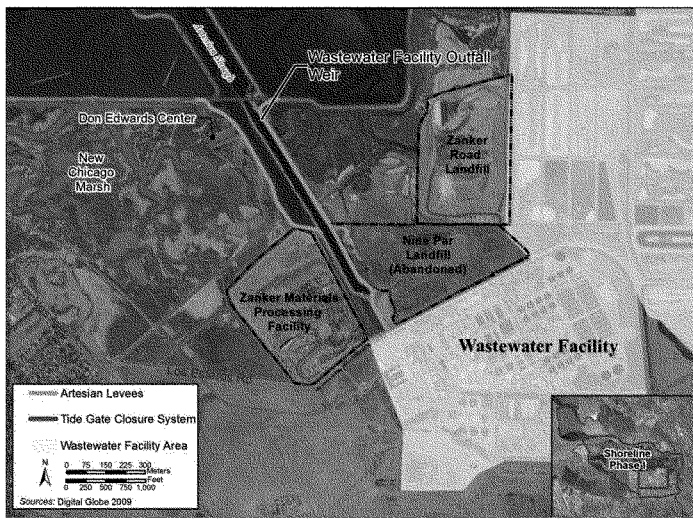


Figure I-2. Potential Artesian Slough Crossing Options

An EIR/EIS must describe a reasonable range of alternatives (CEQA Guidelines, section 15126.6(a); 40 C.F.R. 1502.14). The range of alternatives to be analyzed are those that could feasibly attain most of the basic objectives of the project while avoiding or substantially lessening any of the significant effects of the project (CEQA Guidelines, section 15126.6(a)). Similarly, under NEPA, alternatives with more significant effects than the proposed action need not be evaluated in an EIS (see for example, *Roosevelt Campobello International Park Commission v. EPA*, 684 F.2d 1041 (1st Cir. 1982)).

An alternative with levees down both sides of Artesian Slough would require the construction of a levee that would run along the south side of New Chicago Marsh to high ground associated with the Zanker Materials Processing Facility and a levee along the eastern side back to Pond A18. Such levees would require fill either into Artesian Slough, New Chicago Marsh, and/or the wetlands just to the east of this potential alignment. A preliminary analysis found that approximately 3.6 acres of fill would be required to accommodate the levees. The tide gate closure structure across Artesian Slough included as part of the USACE's National Economic Development (NED) and the non-Federal sponsors' Locally Preferred Plan (LPP; Recommended Plan) would result in approximately 1.1 acres of fill to Artesian Slough. Since the tide gate requires less fill of wetlands and waters it was considered the preferred alternative for protecting Artesian Slough from tidal flooding.

In addition to the amount of fill that would result from constructing the Artesian Slough levees, the levees would greatly interfere with Wastewater Facility utilities that exist in the proposed levee footprint (Figure I-3 *Existing Wastewater Facility Utilities*), increase the amount of levee material required by the Shoreline Phase I project which would result in increase in air quality and noise impacts, and potentially pose additional water quality concerns with bringing the levees to the base of existing and past landfills.

Artesian Slough is divided in half for 1,000 feet at its southern end by an earthen berm. The eastern channel is used by the Wastewater Facility as part of its discharge and both sides are lined with pipes, monitoring and water treatment equipment, and electrical systems. In addition, there is a weir across this channel to manage flows for the Wastewater Facility. The construction of flood protection levees on top of these utilities would likely require re-location of all these services and could fundamentally alter the current operations of the Wastewater Facility.

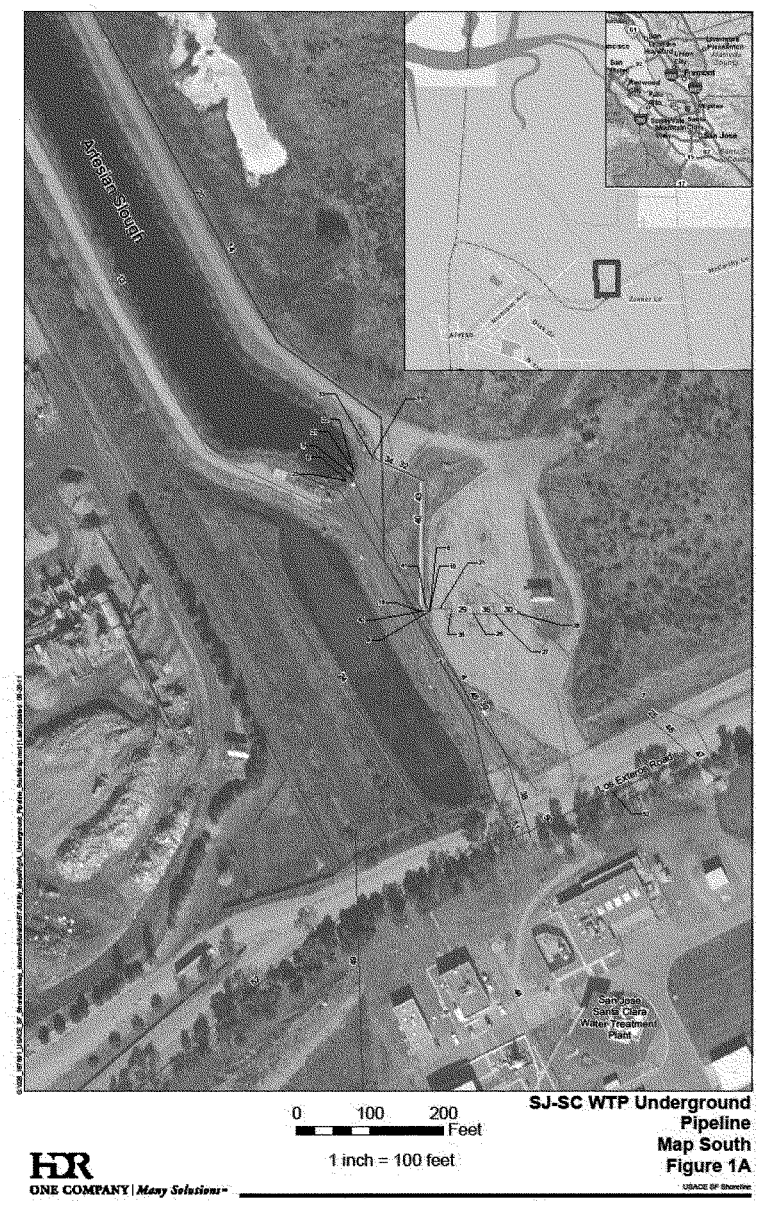


Figure I-3. Existing Wastewater Facility Utilities

Many of the concerns raised about the proposed tide gates centered on potential impacts to discharge from the Wastewater Facility and obstruction of flows in the slough. The analysis provided in the draft Integrated Document is based on information existing at the time of review. More details will be developed based on continuing technical discussions with City of San Jose staff as to how the Wastewater Facility is expected to operate in the future. However, the basic premise of the tide gate is a technically sound method to allow regular flows in Artesian Slough and secondary channel while blocking extreme tides that could flood adjacent upland areas. The proposed tide gate closure structure across the Artesian Slough is based on top-hinged traditional tide gates similar to the structure in place at the Palo Alto flood basin. This type of tide gates open when the force on the gate's upstream side, exceeds the force on the downstream side of the gate. Under varying tide and storm conditions (i.e., normal, the 10- and 100-year tide conditions), the proposed tide gates are open fully during low tides and nearly closed during high tide conditions. During low tide, the tide gates would remain fully open and the water surface elevation in Artesian Slough would reach an equilibrium level, such that the flow through the gates balances the Wastewater Facility effluent. During high tide, the gates would remain only partially open because the water surface elevation on the downstream side of the gates would be greater than the water surface elevation on the upstream side of the gates, allowing less effluent flow through the gates (i.e., during high tide some of the Wastewater Facility effluent would be stored temporarily in Artesian slough until the tide begins to drop). The proposed tide gate across the secondary channel is based on traditional flap gates, whereby the gates remain open under normal, low tide and high tide conditions, to allow flows in and out of the channel. During an extreme tidal or storm event, the gates would be closed because the downstream tidal water surface elevation would be greater than the upstream side and would prevent tidal flows from flowing inland.

The Shoreline Phase I Study team determined that a tide gate at Artesian Slough was the environmentally preferred concept based on currently available information. Additional information has been added to Chapter 3 of the Integrated Document to provide additional details about the flood gate.

I.4.3 USACE Planning Modernization Initiative

This master response addresses the following comments: 028_CCCR.SFB_3-1; 028_CCCR.SFB_3-11; 028_CCCR.SFB_3-42; 032_BCC_2-1.

Some reviewers found the Integrated Document to be "unwieldy" and that the document impeded the public's ability to provide substantive comments. One commenter noted that "Information regarding the project description, project impacts, and proposed mitigation measures are interspersed with economic analyses and rationale pertinent to the USACE, but not pertinent to the NEPA and CEQA process." It was also recommended that the draft EIS/EIR should be revised and re-circulated as a stand-alone document separate from the USACE's Interim Feasibility Report.

The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated

documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final report includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process.

I.4.4 Section 1025 of Water Resources Reform and Development Act (WRRDA) of 2014

This master response addresses the following comments: 027_RWQCB_2-27; 030_SJ-6; 031_EPA_2-1; 031_EPA_2-2; 031_EPA_2-13; 032_BCC_2-4.

The Regional Water Quality Control Board staff, in addition to the U.S. Environmental Protection Agency, Region IX and the Baylands Conservation Committee, encouraged the USACE to pursue federal funding of all ecosystem restoration elements of the Project, "since full implementation of 2,800 acres of tidal marsh restoration and ecotone restoration are likely to be necessary to provide appropriate mitigation for impacts to waters of the State." In addition, it was recommended that the document also clarify exactly what mitigation components the USACE would be assuming full responsibility for.

The USACE signed implementation guidance for WRRDA 2014, Section 1025 on 26 February 2015, which allows it to recommend a USACE project that includes the implementation of ecosystem restoration on USFWS lands. The guidance outlines processing requirements that would allow the Secretary of the Army to recommend USACE implementation of ecosystem restoration on Federal lands acquired through non-Federal funds. For this project, these requirements include a memorandum of understanding between the USFWS and the non-Federal sponsors, documentation of land acquisition by the non-Federal sponsors, and other documentation supporting USACE implementation.

The Final EIS has been revised to reflect this guidance, and explain the implementation responsibilities of the Federal and non-Federal entities, including schedule, cost/funding, construction, monitoring and adaptive management, and operation and maintenance. This information is provided in Chapter 9 *Findings and Recommended Plan* and summarized in the Executive Summary.

I.5 Individual Comments and Responses

Public comments and the responses to those comments are presented in this section.

001_BCC

From: Emily Renzel <marshmama2@att.net>
Sent: Wednesday, January 28, 2015 2:49 PM

To: Shoreline Environment SPN; MichaelMartin@valleywater.org; Brenda.Buxton@scc.ca.gov
Subject: [EXTERNAL] Please extend the comment period

Dear Commander Morrow, Ms. Buxton, and Mr. Martin:

Please extend the comment period for the South Bay Bay Shoreline Study EIS/EIR for at least another 30 days.

The EIS/EIR is at least 1,000 pages and there are over 2,000 additional pages of appendices. For those of us who are volunteers and indeed for public agencies, a 45-day comment period is very challenging to properly review and develop substantive comments. Flood control is important, but it is also crucial that the environment be protected, especially the adjacent high value resources of the Don Edwards San Francisco Bay National Wildlife Refuge, Coyote Creek and the surrounding wetland areas. 1

Please extend the comment period.

Sincerely,
Emily M. Renzel, Coordinator
Baylands Conservation Committee
1056 Forest Avenue
Palo Alto, CA 94301

002_CCCR

From: CCCR <cccrrefuge@gmail.com>
Sent: Monday, January 26, 2015 12:51 AM
To: Shoreline Environment SPN; bbuxton@scc.ca.gov; MichaelMartin@valleywater.org
Cc: anne_morkill@fws.gov; joseph_terry@fws.gov; Brush.Jason@epamail.epa.gov; Arthur Feinstein; Deb Self; jmiller@biologicaldiversity.org
Subject: [EXTERNAL] Citizens Committee to Complete the Refuge request for 30-day extension of comment period for Shoreline Study Phase I EIS/EIR
Attachments: request for time extension.pdf

Dear Commander Morrow, Ms. Buxton, and Mr. Martin,

Please find attached a request from CCCR for a 30-day time extension of the public comment period for the Shoreline Study Phase I EIS/EIR.

We would appreciate a response at your earliest convenience.

Sincerely,

Carin HIgh

CITIZENS COMMITTEE TO COMPLETE THE REFUGE

453 Tennessee Lane, Palo Alto, CA 94306 Tel: 650-493-5540 www.bayrefuge.org cccrrefuge@gmail.com

Commander John C. Morrow
U.S. Army Corps of Engineers San Francisco District
1455 Market St.
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

January 26, 2015

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
bbuxton@scc.ca.gov

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118-3686
MichaelMartin@valleywater.org

Request sent via email

RE: Request for time extension for the submittal of comments regarding the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Dear Commander Morrow, Ms. Buxton, and Mr. Martin,

The Citizens Committee to Complete the Refuge requests at minimum, a 30-day time extension of the public comment period for the above named EIS/EIR. The CCCR is a stakeholder for the South Bay Salt Pond Restoration Project and has been following this project over the course of a decade. We have participated in public update meetings and provided comments over the course of this time including scoping comments. We have never however, had the opportunity to review the identification, analysis, and proposed mitigation or the rationale to support the selection of alternatives and proposed mitigation in any detail.

1

The EIS/EIR alone is over 1,000 pages in length and there are nearly 2,050 additional pages of appendices. A 45-day time frame is simply inadequate for any member of the public, or other agency in fact, to review and provide substantive comments. While everyone recognizes the need for flood control, it is also crucial that the environment is protected, especially the adjacent high value resources of the Don Edwards San Francisco Bay National Wildlife Refuge, Coyote Creek and the surrounding wetland areas. We need additional time to review

and analyze the impacts of the proposed project and to consider the adequacy of the mitigation measures as proposed.

We recognize that there might be time frames involved for funding authorizations, however, the public must be given adequate time to review and provide substantive comments on this massive environmental review document. Given the rapidly approaching deadline, we would appreciate a reply as soon as possible.

Sincerely,

Florence M LaRiviere

Florence LaRiviere
CCCR Chairperson

Carin High

Carin High
CCCR Vice Chair

cc: Anne Morkill, USFWS
Joesph Terry, USFWS
Jason Brush, EPA
Arthur Feinstein, CCCR/Sierra Club
Deb Self, SFB Baykeeper
Jeff Miller, Center for Biological Diversity

From: Alice Kaufman <alice@greenfoothills.org>
Sent: Wednesday, January 28, 2015 5:15 PM

To: Shoreline Environment SPN; Brenda.Buxton@scc.ca.gov; MichaelMartin@valleywater.org
Subject: [EXTERNAL] Request for extension of time - South Bay Shoreline Study EIS
Attachments: South Bay Shoreline Study EIS - request for extension of time.docx

Attached is Committee for Green Foothills' request for extension of time for public comment regarding the South Bay Shoreline Study EIS/EIR.

Thank you for your consideration of this request.

Alice Kaufman
Legislative Advocate, Committee for Green Foothills
650-968-7243 x. 313
3921 East Bayshore Road
Palo Alto, CA 94303
www.greenfoothills.org

Deep Roots, Green Future

COMMITTEE FOR
GREEN FOOTHILLS

February 8, 2015

Commander John C. Morrow
U.S. Army Corps of Engineers, San Francisco District
1455 Market St.
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118-3686
MichaelMartin@valleywater.org

Re: Environmental Impact Statement/Report (EIS/EIR) South San Francisco Bay Shoreline Phase I Study

Dear Commander Morrow, Ms. Buxton, and Mr. Martin,

This is a request for a 30-day extension of time for submission of public comments for the above-referenced EIS/EIR. Currently, the public comment period closes on February 2, 2015. We are requesting that this period be extended to at least March 4, 2015.

The EIS/EIR is over 1,000 pages long, and the attached appendices total over 2,000 additional pages. Given the unusually lengthy documentation and the size and significance of the proposed project, we believe it is appropriate for your agencies to grant additional time for the public to review and comment on this important project. 1

Thank you for your consideration of this request.

Sincerely,

Alice Kaufman
Legislative Advocate, Committee for Green Foothills

COMMITTEE FOR GREEN FOOTHILLS 3921 E. Bayshore Road Palo Alto, CA 94303 650.968.7243 PHONE 650.968.8431 FAX info@GreenFoothills.org www.GreenFoothills.org

From: Munson, James <MUNSON.JAMES@EPA.GOV>
Sent: Monday, January 12, 2015 9:53 AM
To: DeJager, William R SPN
Cc: Shoreline Environment SPN

Subject: [EXTERNAL] RE: SOUTH SAN FRANCISCO BAY SHORELINE STUDY PHASE 1 (ALVISO PONDS AND SANTA CLARA COUNTY INTERIM FEASIBILITY STUDY)

Mr. Dejager,

Looks like I have sent this initially to the wrong email for you...

"I will be the lead EPA reviewer for this project. Thank you for providing a copy of the DEIS. We did receive it yesterday, however, due to the fact that the document is over 2000 pages with the appendices and we have multiple associate reviewers, EPA is requesting a 20 day time extension of the review period so we can give the document a proper 45 day review.

Awaiting your response and thank you for your time,"

James M. Munson, CFM
Environmental Protection Specialist
Enforcement Division, NEPA Section
U.S. EPA, Region IX
75 Hawthorne Street ENF- 4-2
San Francisco, Ca 94105
(415) 972-3852, Fax: (415) 947-8026

From: Munson, James
Sent: Friday, January 09, 2015 4:19 PM
To: 'William.r.dejager@spd02.usace.army.mil'
Cc: 'ShorelineEnvironment@usace.army.mil'
Subject: SOUTH SAN FRANCISCO BAY SHORELINE STUDY PHASE 1 (ALVISO PONDS AND SANTA CLARA COUNTY INTERIM FEASIBILITY STUDY)

Mr. DeJager,

I will be the lead EPA reviewer for this project. Thank you for providing a copy of the DEIS. We did receive it yesterday, however, due to the fact that the document is over 2000 pages with the appendices and we have multiple associate reviewers, EPA is requesting a 20 day time extension of the review period so we can give the document a proper 45 day review. 1

Awaiting your response and thank you for your time,

James M. Munson, CFM
Environmental Protection Specialist
Enforcement Division, NEPA Section
U.S. EPA, Region IX
75 Hawthorne Street ENF- 4-2

San Francisco, Ca 94105
(415) 972-3852, Fax: (415) 947-8026

From: Feinstein Arthur <arthurfeinstein@earthlink.net>
Sent: Wednesday, January 28, 2015 10:34 PM

To: Shoreline Environment SPN; Brenda.Buxton@scc.ca.gov; MichaelMartin@valleywater.org
Subject: [EXTERNAL] Request for extension of comment period for South Bay Shoreline Study EIS
Attachments: South Bay Study EIS ltr.docx

Commander John C. Morrow, U.S. Army Corps of Engineers San Francisco District 1455 Market St. San Francisco, CA 94103 ShorelineEnvironment@usace.army.mil

Brenda Buxton, California Coastal Conservancy 1330 Broadway, 11th Floor Oakland, California 94612; Brenda.Buxton@scc.ca.gov

Michael Martin, Santa Clara Valley Water District 5750 Almaden Expressway San Jose, CA 94118-3686; MichaelMartin@valleywater.org

RE: Request for time extension for the submittal of comments regarding the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Dear Commander Morrow, Ms. Buxton, and Mr. Martin:

I send this email in request that you extend the comment period for the above referenced EIS for at least another 30 days.

I have been a participant in the South Bay Salt Pond Project (SBSP) since its inception (actually as an advocate, even before in helping to acquire those lands under consideration in the South San Francisco Bay Shoreline Study.

I have been a member of the SBSP Stakeholder Group also since its inception. As I am sure you are all aware, this issue is one of the most complex facing the Bay Area. This is reflected in the large size of the EIS for Phase 1 Study of the above referenced project.

I think it is incumbent upon you to give the public adequate time to study the EIS and submit comments. Failure to do so only makes its public acceptance more difficult.

Considering how long it has taken the agencies to develop this EIS, it seems unfair to give the public such a short timeline to analyze it.

I appreciate all the work that is being done to protect the South Bay while preserving its ecological health. Let's not undermine it with hasty actions.

Sincerely yours,

Arthur Feinstein

Commander John C. Morrow,U.S. Army Corps of Engineers San Francisco District 1455 Market St.San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton,California Coastal Conservancy 1330 Broadway, 11th Floor Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Michael Martin, Santa Clara Valley Water District 5750 Almaden ExpresswaySan Jose, CA 94118-3686
MichaelMartin@valleywater.org

RE: Request for time extension for the submittal of comments regarding the Draft Interim Feasibility Report and Environment Impact Statement(EIS) / Report(EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Dear Commander Morrow, Ms. Buxton, and Mr. Martin:

I send this email in request that you extend the comment period for the above referenced EIS for at least another 30 days.

I have been a participant in the South Bay Salt Pond Project (SBSP) since its inception (actually as an advocate, even before in helping to acquire those lands under consideration in the South San Francisco Bay Shoreline Study.

I have been a member of the SBSP Stakeholder Group also since its inception. As I am sure you are all aware, this issue is one of the most complex facing the Bay Area. This is reflected in the large size of the EIS for Phase 1 Study of the above referenced project. 1

I think it is incumbent upon you to give the public adequate time to study the EIS and submit comments. Failure to do so only makes its public acceptance more difficult.

Considering how long it has taken the agencies to develop this EIS, it seems unfair to give the public such a short timeline to analyze it.

I appreciate all the work that is being done to protect the South Bay while preserving its ecological health. Let's not undermine it with hasty actions.

Sincerely yours,

Arthur Feinstein

From: Matt Leddy <mtleddy@sbcglobal.net>
Sent: Wednesday, January 28, 2015 6:23 PM

To: Shoreline Environment SPN; Brenda.Buxton@scc.ca.gov; MichaelMartin@valleywater.org
Subject: [EXTERNAL] Request for Comment Period Extension - Shoreline Phase 1 Project

January 26, 2015

Commander John C. Morrow
U.S. Army Corps of Engineers San Francisco District
1455 Market St. San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton California
Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118-3686
MichaelMartin@valleywater.org

Request sent via email

RE: Request for time extension for the submittal of comments regarding the South San Francisco Bay Shoreline Phase 1 Project Draft Integrated Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR)

Dear Commander Morrow, Ms. Buxton, and Mr. Martin,

I am requesting a 30-day time extension for the public comment period for the Shoreline Phase 1 Project Feasibility Report and Draft EIS/EIR for the following reasons:

1. The Draft Integrated Feasibility Report and Environmental Impact Statement / Report is 1,022 pages long, with over 2,000 pages in the supporting documents. I have been working on comments, but because of the length of the report, much more time is needed. The contents of the report are too important to be rushed through the public comment period. Even with a 30-day extension, it will be challenging for people to read and evaluate the contents of this document. 1

2. Looking at the official webpage for the Project, (http://www.southbayshoreline.org/), members of the public would not even be aware that they can submit written comments on the Draft EIS/EIR, or any information on how and to whom

comments should be submitted.

2. There are eighteen pre-written questions on the website's Frequently Asked Questions page (http://www.southbayshoreline.org/faq.html), and not one of them includes the question, "How do members of the public comment on the Draft EIS/EIR?" Even if people do know that they can submit written comments, they don't know where or to whom those comments should be directed.

3. Under "News" on the Project website home page, the public is directed to links for both the SCVWD and USACE for information on the "draft Shoreline Study and environmental analysis document", but neither site provides information on how and where to submit written comments.

4. A flyer provided at the January 15, 2015 Public Hearing, which I attended, included information on how and where written comments could be submitted, but this was provided to the public when only 19 days remained for review and comment on this very large and complex document.

For all of the reasons outlined above, I respectfully request that the deadline for submission of written comments be extended for at least 30 days, and that the specific information needed for the public to submit written comments be prominently posted on the Shoreline Project, SCVWD and USACE websites.

Thank you in advance for ensuring that the public receives adequate notification and opportunity to submit written comments on these important documents.

Sincerely,

Matthew Leddy

mtleddy@sbcglobal.net
275 D Street, Redwood City CA 94063

007_RWQCB

From: Wines, Brian@Waterboards <Brian.Wines@waterboards.ca.gov>
Sent: Wednesday, January 21, 2015 11:38 AM
To: Shoreline Environment SPN

Cc: Lichten, Keith@Waterboards; Bowyer, Dale@Waterboards; valiela.luisa@epa.gov
Subject: [EXTERNAL] Request to Extend Comment Period for South San Francisco Bay Shoreline DEIS by 3 weeks

HI Mr. DeJager

This email is a follow-up to my voicemail today.

Water Board staff only learned today that the DEIS/DEIR for the SSF Bay Shoreline had been posted for public review.

Since Water Board staff had met with SSF Bay Shoreline Project staff in late 2014 to discuss Water Board permitting concerns, we were hoping to receive notification when the DEIS/EIR was released for comment. But we did not receive notification from the Corps or the State Clearinghouse.

Also, it was not easy for us to find the DEIS/EIR on the Corps website. It does not appear in the public notices for 2014 – 2015 menu. And the FOIA Hot Topics links for the project do not make it clear that the posting includes a DEIS. None of the links to documents actually contain "DEIS"; it was only by opening the links that it became clear that one of the documents was the DEIS/EIR. 1

Since the comment period closes on Feb. 2, 2015, it will not be possible to for Water Board staff to perform an adequate review and prepare comments in less than a week. Do to the size of the DEIS/EIR and the complexity of the project, we 2 would like the comment period to be extended by 3 weeks.

Thanks for your consideration.

Brian Wines
Water Resources Control Engineer
San Francisco Bay Regional Water Quality Control Board
510-622-5680

From: shani kleinhaus <shani@scvas.org>
Sent: Wednesday, January 28, 2015 9:46 PM

To: Shoreline Environment SPN; Brenda.Buxton@scc.ca.gov; MichaelMartin@valleywater.org
Subject: [EXTERNAL] SCVAS request for a 30-day time extension for submittal of comments for the South Bay Shoreline Study EIS/EIR
Attachments: Request for Extension - Shoreline levee.pdf

Dear Commander Morrow, Ms. Buxton and Mr. Martin,

Please find attached Santa Clara Valley Audubon Society's request for a 30-day time extension for submittal of comments for the South Bay Shoreline Study EIS/EIR

Thank you,

Shani Kleinhaus, Ph.D.
Environmental Advocate
Santa Clara Valley Audubon Society
22221 McClellan Rd. Cupertino 95014
Tel. (650) 868 2114
shani@scvas.org

Santa Clara Valley
Audubon Society

January 22nd, 2015 *via email*

Commander John C. Morrow
U.S. Army Corps of Engineers San Francisco District
1455 Market St.
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118---3686
MichaelMartin@valleywater.org

RE: Request for time extension for the submittal of comments regarding the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Dear Commander Morrow, Ms. Buxton, and Mr. Martin,

The Santa Clara Valley Audubon Society is requesting a 30---day time extension of the public comment period for the Shoreline Study EIS/EIR. Our organization actively reviews all development plans along the South San Francisco Bay Shoreline.

We recognize the concern of providing flood protection, however, numerous species of concern occur within the project footprint and vicinity, and the forty---five day time frame is far too short for substantive review of this document of nearly 3,000 pages. 1

22221 McClellan Road, Cupertino, CA 95014 Phone: (408) 252-3748 * Fax: (408) 252-2850
email: scvas@scvas.org * www.scvas.org

We believe the request for a 30---day time extension is very reasonable given the overwhelming size of this document and the resources that may be impacted by the proposed project.

Sincerely,

Shani Kleinhaus, Ph.D.
Environmental Advocate

22221 McClellan Road, Cupertino, CA 95014 Phone: (408) 252-3748 * Fax: (408) 252-2850
email: scvas@scvas.org * www.scvas.org

From: Sejal Choksi <sejal@baykeeper.org>
Sent: Wednesday, January 28, 2015 6:03 PM

To: Shoreline Environment SPN; MichaelMartin@valleywater.org; Brenda.Buxton@scc.ca.gov
Cc: Ian Wren
Subject: [EXTERNAL] Baykeeper requests extension for shoreline study Phase 1 public comment period
Attachments: 2015.1.28 BK Request for extension.pdf

Dear Mr. Martin, Ms. Buxton, and Commander Morrow,

Please see attached letter requesting an extension for the public comment period that is currently set to close on February 2, 2015.

We appreciate your thoughtful consideration of this matter.

Thanks,
Sejal

Sejal Choksi-Chugh
Program Director
San Francisco Baykeeper 1736
Franklin Street Suite 800
Oakland, CA 94612
510-735-9700 x107

Protecting San Francisco Bay since 1989 www.baykeeper.org
Follow us on Twitter: @sejalc and @SFBaykeeper

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January 28, 2015

Commander John C. Morrow
U.S. Army Corps of Engineers San Francisco District
1455 Market St.
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118-3686
MichaelMartin@valleywater.org

RE: Request for time extension for public comment on the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Dear Commander Morrow, Ms. Buxton, and Mr. Martin:

On behalf of San Francisco Baykeeper and our over 3,000 members who use and enjoy the environmental, recreational, and aesthetic qualities of San Francisco Bay and its surrounding tributaries and ecosystems, we respectfully submit this request for an extension of the public comment period. We are requesting at minimum, a 30-day time extension of the public comment period for the above named EIS/EIR.

The EIS/EIR is over 1,000 pages in length and there are nearly 2,050 additional pages of appendices. A 45-day time frame is insufficient for any member of the public, or other agency in fact, to review and provide substantive comments. We recognize the need for flood control, however we feel that given the proximity to the Don Edwards San Francisco Bay National Wildlife Refuge as well as Coyote Creek on top of the wetland areas mean that environmental protection is even more crucial than ever in this case. The environmental community needs additional time to review and analyze the impacts of the proposed project and to consider the adequacy of the mitigation measures as proposed. 1

We strongly believe that the public must be given this additional time to adequately review and provide comments on this document. Given the approaching deadline, we would appreciate a reply as soon as possible.

Sincerely,

Sejal Choksi-Chugh
Program Director

ID	Issue Text	Response Text
001_BCC-1	Please extend the comment period for the South Bay Shoreline Study EIS/EIR for at least another 30 days. The EIS/EIR is at least 1,000 pages and there are over 2,000 additional pages of appendices. For those of us who are volunteers and indeed for public agencies, a 45-day comment period is very challenging to properly review and develop substantive comments. Flood control is important, but it is also crucial that the environment be protected, especially the adjacent high value resources of the Don Edwards San Francisco Bay National Wildlife Refuge, Coyote Creek and the surrounding wetland areas. Please extend the comment period.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
002_CCCR-1	Please find attached a request from CCCR for a 30-day time extension of the public comment period for the Shoreline Study Phase I EIS/EIR. We would appreciate a response at your earliest convenience.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
003_CGF-1	This is a request for a 30-day extension of time for submission of public comments for the above referenced EIS/EIR. Currently, the public comment period closes on February 2, 2015. We are requesting that this period be extended to at least March 4, 2015.The EIS/EIR is over 1,000 pages long, and the attached appendices total over 2,000 additional pages. Given the unusually lengthy documentation and the size and significance of the proposed project, we believe it is appropriate for your agencies to grant additional time for the public to review and comment on this important project. Thank you for your consideration of this request.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
004_EPA-1	I will be the lead EPA reviewer for this project. Thank you for providing a copy of the DEIS. We did receive it yesterday, however, due to the fact that the document is over 2000 pages with the appendices and we have multiple associate reviewers, EPA is requesting a 20 day time extension of the review period so we can give the document a proper 45 day review. Awaiting your response and thank you for your time,	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
005_Feinstein-1	I send this email in request that you extend the comment period for the above referenced EIS for at least another 30 days. I have been a participant in the South Bay Salt Pond Project (SBSP) since its inception (actually as an advocate, even before in helping to acquire those lands under consideration in the South San Francisco Bay Shoreline Study. I have been a member of the SBSP Stakeholder Group also since its inception. As I am sure you are all aware, this issue is one of the most complex facing the Bay Area. This is reflected in the large size of the EIS for Phase 1 Study of the above referenced project. I think it is incumbent upon you to give the public adequate time to study the EIS and submit comments. Failure to do so only makes its public acceptance more difficult. Considering how long it has taken the agencies to develop this EIS, it seems unfair to give the public such a short timeline to analyze it. I appreciate all the work that is being done to protect the South Bay while preserving its ecological health. Let's not undermine it with hasty actions.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
006_Leddy-1	I am requesting a 30-day time extension for the public comment period for the Shoreline Phase 1 Project Feasibility Report and Draft EIS/EIR for the following reasons: 1. The Draft Integrated Feasibility Report and Environmental Impact Statement / Report is 1,022 pages long, with over 2,000 pages in the supporting documents. I have been working on comments, but because of the length of the report, much more time is needed. The contents of the report are too important to be rushed through the public comment period. Even with a 30-day extension, it will be challenging for people to read and evaluate the contents of this document. 2. Looking at the official webpage for the Project, (http://www.southbayshoreline.org/), members of the public would not even be aware that they can submit written comments on the Draft EIS/EIR, or any information on how and to whom comments should be submitted. 2. There are eighteen pre-written questions on the website's Frequently Asked Questions page (http://www.southbayshoreline.org/faq.html), and not one of them includes the question, "How do members of the public comment on the Draft EIS/EIR?" Even if people do know that they can submit written comments, they don't know where or to whom those comments should be directed. 3. Under "News" on the Project website home page, the public is directed to links for both the SCVWD and USACE for information on the "draft Shoreline Study and environmental analysis document", but neither site provides information on how and where to submit written comments. 4. A flyer provided at the January 15, 2015 Public Hearing, which I attended, included information on how and where written comments could be submitted, but this was provided to the public when only 19 days remained for review and comment on this very large and complex document. For all of the reasons outlined above, I respectfully request that the deadline for submission of written comments be extended for at least 30 days, and that the specific information needed for the public to submit written comments be prominently posted on the Shoreline Project, SCVWD and USACE websites. Thank you in advance for ensuring that the public receives adequate notification and opportunity to submit written comments on these important documents.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.

1388

007_RWQCB-1	1 This email is a follow-up to my voicemail today. Water Board staff only learned today that the DEIS/DEIR for the SSF Bay Shoreline had been posted for public review. Since Water Board staff had met with SSF Bay Shoreline Project staff in late 2014 to discuss Water Board permitting concerns, we were hoping to receive notification when the DEIS/EIR was released for comment. But we did not receive notification from the Corps or the State Clearinghouse. Also, it was not easy for us to find the DEIS/EIR on the Corps website. It does not appear in the public notices for 2014 – 2015 menu. And the FOIA Hot Topics links for the project do not make it clear that the posting includes a DEIS. None of the links to documents actually contain "DEIS"; it was only by opening the links that it became clear that one of the documents was the DEIS/EIR.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
008_SCVAS-1	The Santa Clara Valley Audubon Society is requesting a 30-day time extension of the public comment period for the Shoreline Study EIS/EIR. Our organization actively reviews all development plans along the South San Francisco Bay Shoreline. We recognize the concern of providing flood protection, however, numerous species of concern occur within the project footprint and vicinity, and the forty-five day time frame is far too short for substantive review of this document of nearly 3,000 pages. We believe the request for a 30-day time extension is very reasonable given the overwhelming size of this document and the resources that may be impacted by the proposed project.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.
009_SFB-1	On behalf of San Francisco Baykeeper and our over 3,000 members who use and enjoy the environmental, recreational, and aesthetic qualities of San Francisco Bay and its surrounding tributaries and ecosystems, we respectfully submit this request for an extension of the public comment period. We are requesting at minimum, a 30-day time extension of the public comment period for the above named EIS/EIR. The EIS/EIR is over 1,000 pages in length and there are nearly 2,050 additional pages of appendices. A 45-day time frame is insufficient for any member of the public, or other agency in fact, to review and provide substantive comments. We recognize the need for flood control, however we feel that given the proximity to the Don Edwards San Francisco Bay National Wildlife Refuge as well as Coyote Creek on top of the wetland areas mean that environmental protection is even more crucial than ever in this case. The environmental community needs additional time to review and analyze the impacts of the proposed project and to consider the adequacy of the mitigation measures as proposed. We strongly believe that the public must be given this additional time to adequately review and provide comments on this document. Given the approaching deadline, we would appreciate a reply as soon as possible.	Thank you for your interest in reviewing the Shoreline Phase I Study Integrated Document. The comment period was extended by three weeks for a total of 60 days for review and comment submittal.

From: Zsutty, Yves <Yves.Zsutty@sanjoseca.gov>
Sent: Thursday, January 15, 2015 12:42 PM

To: Shoreline Environment SPN; bbuxton@scc.ca.gov
Subject: [EXTERNAL] Comments: City of San Jose / Dept of Parks Recreation and Neighborhood Services
Attachments: City of San Jose PRNS comments 2015 01 15.doc

Yves Zsutty, Trail Manager

City of San Jose - Trail Program
Parks Recreation and Neighborhood Services
200 East Santa Clara Street, 9th Floor
San Jose, CA 95113
408 793 5561, fax 408 292 6416

Trail Program homepage
Twitter SanJoseTrails
Park/Trail Concerns email

Comments
South San Francisco Bay Shoreline Study Draft Feasibility/Environmental Document

Submitted by:
City of San Jose
Department of Parks Recreation and Neighborhood Services
200 East Santa Clara Street, 9th Floor
San Jose, CA 95113
Yves Zsutty, Trail Manager, 408 793 5561
Yves.zsutty@sanjoseca.gov

Thank you for the opportunity to review and provide comment. I'd like to offer the following input about the draft study.

Section 4.9.1. When referring to Highway 237, please also indicate that the adjacent bikeway follows the north and/or south sides of the highway and provides limited bike access to project area. 1

Figure 4.9.1. Update to show the Highway 237 Bikeway on both sides of freeway. The paved bikeway extends from east of Zanker Road to McCarthy Road. 2

Section 4.9.1.1.2.3. Also note the following General Plan goals and policies:

- Goal PR-1 – High Quality Facilities and Programs
- Provide park lands, trails, open space, recreation amenities, and programs, nationally recognized for their excellence, which enhance the livability of the urban and suburban environments; preserve significant natural, historic, scenic and other open space resources; and meet the parks and recreation services needs of San José's residents, workers, and visitors.
- PR-1.11 Develop an integrated parks system that connects new and existing large parks together through a network of interconnected trails and/or bike lanes/routes. 3
- Goal PR-3 – Provide an Equitable Park System
- Create a balanced park system that provides all residents access to parks, trails, open space,
- PR-6.7 In design and construction, consider the role of parks, trails, and open space in preserving, enhancing, or restoring existing ecosystems/wildlife habitat, where appropriate.
- PR-7.1 Encourage non-vehicular transportation to and from parks, trails, and open spaces by developing trail and other pleasant walking and bicycle connections to existing and planned urban and suburban parks facilities.

Section 4.9.1.2.3. In discussion about "Class I Multi-Use Paths", include sentence, "The City of San Jose commonly refers to these Class I facilities as Trails". 4

The "Class I Bicycle Path" along Highway 237 is noted in this section but doesn't describe the entire alignment. The link leads to a map of the entire Highway 237 Bikeway in its current form: http://www.sanjoseca.gov/index.aspx?nid=2835 Please update section to accurately show this facility. 5

Section 4.11.1.1.3. Perhaps not here, but somewhere in this section, there should be acknowledgement of the City of San Jose's Bay Trail Master Plan. That planning document governs our approach to trail development in the shoreline area. 6

Figure 4.11-1. The red dotted line identifies an "Existing Surface Street Trail". San Jose does not have surface street trails. It is accurate to report that this is a "Class III on-street bikeway". The map needs to be amended to show this on-street facility as being on the south side of Highway 237. There is no existing road or trail as noted on the north side of Highway 237. Refer to link to this trail system website for a map of existing facilities. San Jose is agreeable to having a future Class I trail shown on the north side of Highway 237 if space and land rights permit that to occur. 7

Supplemental Information:
San Jose's General Plan recognizes trails as part of the overall transportation system. It may be best to recognize that fact in the "Transportation" section of the study, but also direct readers to the "Recreation" section for detailed discussion. With this recognition, continue to focus trail discussion in the Recreation section.

If seeking language for the reference, be aware that the General Plan states, "Recognizing the function that trails play in the City's multi-modal transportation system, separate Trail Network Policies are included in the Land Use and Transportation section of the *Envision General Plan*. Because of their recreational component, some Policies related to trails are incorporated into this (Transportation) section as well." and "Recognizing that trails serve an important role in San José's transportation system, providing significant environmental and recreational benefit, the City has established an ambitious goal to be a national leader in the development of an urban trail system." 8

Opportunity to leverage planning and/or share resources:
Within the "Recreation" section, there should be recognition that San Jose's Guadalupe River Trail and Coyote Creek Trails terminate at the southern boundary of the study area. Per the City's General Plan, interconnection of trails is an important goal. 9

The Study should confirm that connections to these trails are to be made and locate them on the most appropriate figures.

The study proposes an elevated pedestrian bridge to span over the active railway. San Jose has spent several years (with ABAG and Federal investment) to plan, secure NEPA clearance and partially design a pedestrian bridge that will span across Alviso Slough/Lower Guadalupe River, and be parallel to the railway. There may be an opportunity for the study identify a leveraging opportunity. The study should determine 10

if it might consider use of the City's planned bridge as an alternative means along the railroad and reach the loop trails to the west. The linked page offers some information on the bridge project. http://www.sanjoseca.gov/index.aspx?nid=2772

For access to the loop trail to the east, consider the use of Gold Street as a relatively low-volume Class III facility to travel from the Lower Guadalupe River Trail to a future trail that follows the eastern edge of the railway alignment. 11

Staff is happy to respond to any questions if the study might be able to leverage this future resource and/or champion its funding. The City estimates that about $7,000,000 is required. This amount of funding is well beyond the City's Parks Budget and is not typical for regional or State grant awards. A federal source might support this project. It could be advantageous for the report to include the City's pedestrian bridge (if suitable option for the rail over-crossing) as part of the final study, and make it eligible for a Congressional funding action. 12

ID	Issue Text	Response Text
010_SJPRNS-1	Section 4.9.1. When referring to Highway 237, please also indicate that the adjacent bikeway follows the north and/or south sides of the highway and provides limited bike access to project area.	The suggested revision to Section 4.9.1 has been made. The first bullet in list has been revised as follows: "SR 237 parallels the south side of the Shoreline Phase I Study Area and is a primary route for people traveling to the Alviso and northern San José areas. Project-related transportation effects that affect mobility on SR 237, such as construction traffic entering and exiting work areas, could affect intersections on SR 237 that are used to access surrounding urban areas. An intermittent bikeway runs adjacent to SR 237 following the north and/or south sides of the highway and provides limited bike access to project area."
010_SJPRNS-2	Figure 4.9.1. Update to show the Highway 237 Bikeway on both sides of freeway. The paved bikeway extends from east of Zanker Road to McCarthy Road.	Your comment is acknowledged. However, Table 4.9-1 and surrounding discussion is specific to vehicular traffic (i.e., doesn't reflect any bicycle or pedestrian trails), so no change to the map itself has been made. To avoid any confusion and clarify the focus of the map, the figure title has been changed to: "Figure 4.9 1. Transportation Study Area and Vehicular Lane Configurations".
010_SJPRNS-3	Section 4.9.1.1.2.3. Also note the following General Plan goals and policies:- Goal PR-1 – High Quality Facilities and Programs- Provide park lands, trails, open space, recreation amenities, and programs, nationally recognized for their excellence, which enhance the livability of the urban and suburban environments; preserve significant natural, historic, scenic and other open space resources; and meet the parks and recreation services needs of San José's residents, workers, and visitors.- PR-1.11 Develop an integrated parks system that connects new and existing large parks together through a network of interconnected trails and/or bike lanes/routes.- Goal PR-3 – Provide an Equitable Park System- Create a balanced park system that provides all residents access to parks, trails, open space,- PR-6.7 In design and construction, consider the role of parks, trails, and open space in preserving, enhancing, or restoring existing ecosystems/wildlife habitat, where appropriate.- PR-7.1 Encourage non-vehicular transportation to and from parks, trails, and open spaces by developing trail and other pleasant walking and bicycle connections to existing and planned urban and suburban parks facilities.	The suggested revisions to Section 4.9.1.1.2.3 have been made. All of the General Plan goals and policies were added to the bulleted list as requested.
010_SJPRNS-4	Section 4.9.1.2.3. In discussion about "Class I Multi-Use Paths", include sentence, "The City of San Jose commonly refers to these Class I facilities as Trails".	Thank you for providing additional information regarding Class I facilities; the suggested revision to Section 4.9.1.2.3 has been made. The first bullet in list has been revised as follows: "Class I Multi-Use Path: a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized. The City of San Jose commonly refers to Class I facilities as "trails".
010_SJPRNS-5	The "Class I Bicycle Path" along Highway 237 is noted in this section but doesn't describe the entire alignment. The link leads to a map of the entire Highway 237 Bikeway in its current form: http://www.sanjoseca.gov/index.aspx?nid=2835 Please update section to accurately show this facility.	Thank you for your input regarding the status of the Hwy 237 trails. The suggested updates to Section 4.9.1.2.3 have been made. The discussion of bicycle paths has been revised as follows: "Within the transportation study area, a Class I bicycle paths exists north and south of and parallel to SR 237, starting at the Zanker Road/SR 237 westbound ramp and continuing east toward the northern stretch of Coyote Creek Trail. This approximately 5-mile stretch along Highway 237 was designated in 2009 as part of the National Recreation Trail system. In addition, the same reach along the north side of the highway has been designated as part of the San Francisco Bay Trail and the Juan Bautista De Anza National Historic Trail. Class II bike lanes connect to the Class I path at Zanker Road and progress west to 1st Street and south crossing Montague Expressway. Class II bike lanes also exist along Dixon Landing Road west of the I-880 southbound ramp. According to the City of Milpitas Bikeway Master Plan Update (Alta Planning + Design 2012), Class II bike lanes are planned along Dixon Landing Road east of the I-880 southbound ramp as well."
010_SJPRNS-6	Section 4.11.1.1.3. Perhaps not here, but somewhere in this section, there should be acknowledgement of the City of San Jose's Bay Trail Master Plan. That planning document governs our approach to trail development in the shoreline area.	The suggested revision to Section 4.11.1.1.3 has been made. The discussion of the San José Bay Trail master plan has been added following discussion of the Envision San José 2040 General Plan. Per information found on the City of San Jose website, the following paragraph has been added: "In 2002, San José's City Council adopted the San José Bay Trail master plan. Once built, the San José portion of the trail will be approximately 13 miles in length and follow the shore and some roadways in Alviso (see Section 4.11.1.1.2.3 The Bay Trail for more information on the San Francisco Bay Trail Project)."
010_SJPRNS-7	Figure 4.11-1. The red dotted line identifies an "Existing Surface Street Trail". San Jose does not have surface street trails. It is accurate to report that this is a "Class III on-street bikeway". The map needs to be amended to show this on-street facility as being on the south side of Highway 237. There is no existing road or trail as noted on the north side of Highway 237. Refer to link to this trail system website for a map of existing facilities. San Jose is agreeable to having a future Class I trail shown on the north side of Highway 237 if space and land rights permit that to occur.	Thank you for the additional information about the City's trail networks. Figure 4.11-1 will be changed as follows: Official Bay Trail designation (per current maps at http://baytrail.org/baytrailmap.html) will be noted with appropriate color for the Alviso Slough Trail (inside loop only), Mallard Slough Trail (around Ponds A16 and segment in Pond A17), and Alviso Marina County Park and segment down Alviso Slough/Guadalupe River to Gold Street Bridge. The gap between end of Bay Trail/Alviso Slough Trail at the railroad line and Guadalupe River Trail at the Gold Street Bridge will be shown with a dashed line. The "Existing Surface Street Trail" label in the map legend and the dashed red line in the map will be deleted. However, the "bike lanes on street" trails will not be added to map as the street bike lane system is largely south of Highway 237 and the Shoreline Study is focused on improving the trail networks closer to the project area, north of Highway 237. The Shoreline Study team will continue to work with the City of San Jose on implementing the proposed Class I bike lane on the north side of Highway 237.

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010_SJPRNS-8	Supplemental Information: San Jose's General Plan recognizes trails as part of the overall transportation system. It may be best to recognize that fact in the "Transportation" section of the study, but also direct readers to the "Recreation" section for detailed discussion. With this recognition, continue to focus trail discussion in the Recreation section. If seeking language for the reference, be aware that the General Plan states, "Recognizing the function that trails play in the City's multi-modal transportation system, separate Trail Network Policies are included in the Land Use and Transportation section of the Envision General Plan. Because of their recreational component, some Policies related to trails are incorporated into this (Transportation) section as well." and "Recognizing that trails serve an important role in San José's transportation system, providing significant environmental and recreational benefit, the City has established an ambitious goal to be a national leader in the development of an urban trail system."	Chapter 4. 9 Transportation will be updated to recognize that San Jose recognizes trails as part of the overall transportation system per the General Plan language cited and will direct readers to Chapter 4.11 Recreation for further discussion.
010_SJPRNS-9	Opportunity to leverage planning and/or share resources: Within the "Recreation" section, there should be recognition that San Jose's Guadalupe River Trail and Coyote Creek Trails terminate at the southern boundary of the study area. Per the City's General Plan, interconnection of trails is an important goal. The Study should confirm that connections to these trails are to be made and locate them on the most appropriate figures.	The Guadalupe River Trail and the Coyote Creek Trail are shown on Figure 4.11-1 but the Coyote Creek Trail is just noted as "Bay Trail". This label will be changed to "Bay Trail/Coyote Creek Trail". The following sections will be added to Chapter 4.11 as "4.11.1.2.4 Adjacent Trails" in order to better describe the existing trail networks and gaps: "The Bay Trail/Coyote Creek Trail runs adjacent to Coyote Creek but does not currently directly connect with the Shoreline Study Project area. Other trails leading to the Shoreline Study area include the Guadalupe River Trail. The Guadalupe River Trail officially ends at the Gold Street Bridge. (This is also where the Guadalupe River changes its name and becomes Alviso Slough. This is why the trail downstream of here on the same river levee system is called the Alviso Slough Trail.) The City of San Jose has plans for a safe pedestrian crossing under the railroad tracks that would seamlessly connect the Guadalupe River Trail with the Alviso Slough Trail but this railroad crossing is currently not funded. Western segments of the Bay Trail currently end at Pond A8, outside of the project area. A connection through Pond A8 is planned but not currently funded. In addition to these trails, a network of street bike lanes provides bicycle connections between Coyote Creek and the Guadalupe River outside of the project area, south of Highway 237." The following sentence will be added to "4.11.1.2.3 Alviso Marina County Park" "Trails from the Marina also head south along the Alviso Slough Trail. This trail terminates at the railroad crossing. Once the Gold Street Bridge connection is completed, there will be a safe pedestrian crossing that would join the Alviso Slough Trail to the Guadalupe River Trail."
010_SJPRNS-10	The study proposes an elevated pedestrian bridge to span over the active railway. San Jose has spent several years (with ABAG and Federal investment) to plan, secure NEPA clearance and partially design a pedestrian bridge that will span across Alviso Slough/Lower Guadalupe River, and be parallel to the railway. There may be an opportunity for the study identify a leveraging opportunity. The study should determine if it might consider use of the City's planned bridge as an alternative means along the railroad and reach the loop trails to the west. The linked page offers some information on the bridge project. http://www.sanjoseca.gov/index.aspx?nid=2772	Thank you for providing the additional information about the existing and proposed trail network in the Alviso area. The Lower Guadalupe River crossing is a high priority for the regional trail network but, unfortunately, is outside of the Shoreline Study area and would not be eligible for cost-sharing under USACE guidelines. A Lower Guadalupe River crossing near the Gold Street Bridge would compliment but not replace the need for a safe pedestrian crossing over the railroad line as proposed by the Shoreline Project. The pedestrian crossing over the rail line connects two segments of what should be a continuous levee-top trail.
010_SJPRNS-11	For access to the loop trail to the east, consider the use of Gold Street as a relatively low volume Class III facility to travel from the Lower Guadalupe River Trail to a future trail that follows the eastern edge of the railway alignment.	The bikeway improvements proposed for adjacent to Highway 237 are intended to provide a paved alternative to the levee-top trail so bicyclists could more easily access western alignments of the Bay Trial and the town of Alviso via either the Class III facility on Gold Street or the Guadalupe River Trail. We will add Gold Street as a Class III to the trail maps.
010_SJPRNS-12	Staff is happy to respond to any questions if the study might be able to leverage this future resource and/or champion its funding. The City estimates that about $7,000,000 is required. This amount of funding is well beyond the City's Parks Budget and is not typical for regional or State grant awards. A federal source might support this project. It could be advantageous for the report to include the City's pedestrian bridge (if suitable option for the rail over-crossing) as part of the final study, and make it eligible for a Congressional funding action.	The City of San Jose's planned improvements will provide much needed connections to western alignments of the Bay Trail as well as other regional trails. In addition, the City's project will improve trail access to the town of Alviso and the adjacent Refuge. However, as these improvements are outside of the Shoreline Project area, they are not eligible under the USACE criteria for cost-sharing on recreational improvements. However, the State Coastal Conservancy anticipates continuing to work with the City, outside of the Shoreline Study process, to close the gaps in the regional trail network.

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STATE OF CALIFORNIA EDMUND G. BROWN JR., *Governor*

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

Established in 1938

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* **(916) 574-1810**
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from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-1890**
Contact FAX: **(916) 574-1885**

January 22, 2015

File Ref: SCH # 2006012020

Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

Subject: Draft Environmental Impact Statement/Report (EIS/EIR) for South San Francisco Bay Shoreline Phase I Study, Santa Clara County

Dear Mr. Martin:

The California State Lands Commission (CSLC) staff has reviewed the subject Draft EIS/EIR for the South San Francisco Bay Shoreline Phase I Study (Project), which is being prepared jointly by the Santa Clara Valley Water District (District) as the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.), and the U.S. Army Corps of Engineers (USACE) and/or the U.S. Fish and Wildlife Service (USFWS) as the lead agency(ies) under the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.). The CSLC is a trustee agency for projects that could directly or indirectly affect sovereign lands and their accompanying Public Trust resources or uses. Additionally, because the Project involves work within sovereign lands, the CSLC will act as a responsible agency. CSLC staff previously provided comments on the District's revised Notice of Preparation (NOP) in a letter dated October 1, 2014 (enclosed).

CSLC Jurisdiction and Public Trust Lands

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the Common Law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of

all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

After reviewing the information contained in the Draft EIS/EIR, and as stated in its prior letter to the District, CSLC staff has determined the Project includes State-owned sovereign lands under the jurisdiction of the CSLC consisting of natural, navigable, and tidal portions of Coyote Creek, Guadalupe Slough, Alviso Slough, Mallard Slough, and Mud Slough; therefore, a lease from the CSLC will be required for the District to implement the Project on sovereign lands. Please contact Al Franzoia (see contact information below) at your earliest convenience for further information about the extent of the CSLC's sovereign ownership and leasing requirements. Lease applications can be found on the CSLC's website, www.slc.ca.gov/Online_Forms/Online_Forms_Home_Page.html.

This letter is not intended, nor should it be construed as a waiver or limitation of any right, title, or interest of the State of California in any lands under its jurisdiction.

Project Description

The Project would encompass an area between the Guadalupe River and Coyote Creek in San Jose including portions of the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) (which includes most of the former salt ponds in the Project area, with the exception of Pond A-18). The District and USACE propose to reduce tidal flood risk in the area, which will also facilitate the tidal marsh restoration activity.

The proposed Project would include engineered levees along the Alviso North and Water Pollution Control Plant South alignments following existing levees built to protect against the 1 percent tidal event with anticipated sea level rise; a tide gate across Artesian Slough; "basic" restoration of salt ponds A9, A10, A11, A12, A13, A14, A15, and A18; a transition habitat slope of 30:1; and recreation measures to compensate for the loss of public access as the ponds in the Refuge are breached and restored to tidal marsh. These recreation measures include multi-use trails on top of the new proposed flood risk management levee with connection to the Bay Trail network, viewing platforms and benches, and trail upgrades to be made to an existing segment of the Bay Trail system along State Route 237.

Environmental Review

While many of the comments and suggestions in CSLC's October 1, 2014 letter appear to have been addressed, the Draft EIS/EIR does not discuss several specific comments related to (1) CSLC leasing jurisdiction, (2) adequacy of the Project Description, and (3)

adequacy of the impact analysis. CSLC staff, therefore, submits the following comments in its capacity as a trustee and responsible agency pursuant to CEQA, and requests that the City consider the following comments on the Draft EIS/EIR.

General Comments

1. Agency Requirements: As stated in our previous letter and above, a lease from the CSLC will be required for the District to implement the Project on sovereign lands. Please revise Table 6.2-1 and Table 6.3-3 to state that the CSLC would require a lease (rather than an encroachment permit, as currently stated). 1

2. Project Description: On page CS-1, the Draft EIS/EIR states that Alternative 3, the Locally Preferred Project or Plan (LPP) is the "Proposed Project." Although the Proposed Project Description generally identifies what areas would be impacted, no construction details are provided, nor does it reference where such details can be reviewed. Appendix G does contain additional information about the LPP including plan sets; however, the level of detail requested in our previous letter (e.g., types of equipment or methods that may be used, seasonal work windows, etc.) is not provided or would be difficult for the general public to find in the document. CSLC staff suggest that the Proposed Project Description be revised so that a complete overview of the components of the Proposed Project are clearly outlined and project-level detail is provided, to aid CSLC staff in determining exactly what actions would be taking place within CSLC jurisdiction. 2

3. Impact Analysis: Under section 9.6.2, Preconstruction Engineering and Design (PED) (p. 9-21), the Draft EIS/EIR states that during the PED phase, several additional studies would be conducted as part of developing detailed designs for the Project. These studies include, for example, topographic and ground surveys for project design; a Phase I Environmental Site Assessment to identify potential hazardous materials wastes within the study area; water quality analysis of construction activities and methods; and intensive cultural resources surveys, evaluations, and mitigation in consultation with the State Historic Preservation Officer (SHPO), and Native American Tribes. Please note that CEQA requires a lead agency to disclose and analyze all that it feasibly can in order to ensure informed decision-making. The studies and analyses listed in the PED would provide critical information related to the potential for, and significance of, environmental effects resulting from the Project. Unless conducting these analyses is truly infeasible at this time, which the District does not state is the case, they should be conducted and the Draft EIS/EIR revised and recirculated to provide an opportunity for full public disclosure and review. Without such analyses in the EIS/EIR, meaningful review of the impacts and adequacy of the mitigation by CSLC staff is precluded, which may result in the need for additional information to be submitted with the lease application, and if previously undisclosed or more severe impacts could result, the District could be subject to additional review requirements under section 15162 of the State CEQA Guidelines. 3

Michael Martin Page 4 January 22, 2015

4. Mitigation: Project approval by the CSLC would require the adoption of all Avoidance and Minimization Measures, and Mitigation Measures, outlined in the Final EIS/EIR that are applicable to lands under the jurisdiction of the CSLC. Please note that a Mitigation, Monitoring, and Reporting Plan (MMRP) should be prepared to facilitate this requirement. 4

Cultural Resources

5. Title to Resources: As requested in our previous letter, per California Public Resources Code section 6313, please mention that the title to all archaeological sites and historic or cultural resources on or in submerged lands of California is vested in the State and under the jurisdiction of the CSLC. CSLC staff suggests that this text be added under section 4.15.1.1.2 *State Regulations*. In addition, CSLC staff requests that the lead agencies consult with Assistant Chief Counsel Pam Griggs (see contact information below), should any cultural resources on State lands be discovered during construction of the proposed Project. 5

Thank you for the opportunity to comment on the Draft EIS/EIR for the Project. Please send copies of future Project-related documents, including electronic copies of the Final EIS/EIR, MMRP, Notice of Determination (NOD), CEQA Findings and, if applicable, Statement of Overriding Considerations when they become available, and refer questions concerning environmental review to Cynthia Herzog, Senior Environmental Scientist, at (916) 574-1310 or via e-mail at Cynthia.Herzog@slc.ca.gov. For questions concerning archaeological or historic resources under CSLC jurisdiction, please contact Assistant Chief Counsel Pam Griggs at (916) 574-1854 or via email at Pamela.Griggs@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Alfred Franzoia, Public Land Management Specialist, at (916) 574-0992, or via email at Alfred.Franzoia@slc.ca.gov.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
A. Franzoia, CSLC
C. Herzog, CSLC
J. Rader, CSLC

Enclosure

ID	Issue Text	Response Text
011_SLC-1	Agency Requirements: As stated in our previous letter and above, a lease from CSLC will be required for the District to implement the Project on sovereign lands. Please revise Table 6.2-1 and Table 6.3-3 to state that the CSLC would require a lease (rather than an encroachment permit, as currently stated).	Thank you for your comment and clarification. Per your request, both Tables 1.7-1 and 6.3-3 were updated to state that the State Lands Commission would require a lease in order to implement the project on sovereign lands.
011_SLC-2	Project Description: On page CS-1, the Draft EIS/EIR states that Alternative 3, the Locally Preferred Project or Plan (LPP) is the "Proposed Project." Although the Proposed Project Description generally identifies what areas would be impacted, no construction details are provided, nor does it reference where such details can be reviewed. Appendix G does contain additional information about the LPP including plan sets; however, the level of detail requested in our previous letter (e.g., types of equipment or methods that may be used, seasonal work windows, etc.) is not provided or would be difficult for the general public to find in the document. CSLC staff suggest that the Proposed Project Description be revised so that a complete overview of the components of the Proposed Project are clearly outlined and project-level detail is provided, to aid CSLC staff in determining exactly what actions would be taking place within CSLC jurisdiction.	As possible, the suggested revisions were made to the main document; more details of construction were included in Chapter 3 to describe the alternatives and their related features. However, some of the details described in the comment will not be determined until final design, so are not currently available to be included in the document. Seasonal work windows, specifically related to the potential for impacts to aquatic and/or terrestrial species, are included in Sections 4.6 and 4.7 in species impact discussions.
011_SLC-3	Impact Analysis: Under section 9.6.2, Preconstruction Engineering and Design (PED) (p. 9-21), the Draft EIS/EIR states that during the PED phase, several additional studies would be conducted as part of developing detailed designs for the Project. These studies include, for example, topographic and ground surveys for project design; a Phase I Environmental Site Assessment to identify potential hazardous materials wastes within the study area; water quality analysis of construction activities and methods; and intensive cultural resources surveys, evaluations, and mitigation in consultation with the State Historic Preservation Officer (SHPO), and Native American Tribes. Please note that CEQA requires a lead agency to disclose and analyze all that it feasibly can in order to ensure informed decision-making. The studies and analyses listed in the PED would provide critical information related to the potential for, and significance of, environmental effects resulting from the Project. Unless conducting these analyses is truly infeasible at this time, which the District does not state is the case, they should be conducted and the Draft EIS/EIR revised and recirculated to provide an opportunity for full public disclosure and review. Without such analyses in the EIS/EIR, meaningful review of the impacts and adequacy of the mitigation by CSLC staff is precluded, which may result in the need for additional information to be submitted with the lease application, and if previously undisclosed or more severe impacts could result, the District could be subject to additional review requirements under section 15162 of the State CEQA Guidelines.	The studies and analysis discussed for Pre-construction Engineering and Design are those regularly done to inform the detailed design of a project. Environmental review is typically done at an earlier phase of project development, prior to a time when full detail designs are complete. Generally, EIRs are prepared as early as feasible in the planning process to enable environmental considerations to influence project program and design and yet late enough to provide meaningful information for assessment. CEQA Guidelines, section 15004(b). An EIR should provide a sufficient degree of analysis to provide decision makers with information needed to make an intelligent decision concerning the project, but the environmental evaluation need not be exhaustive; the sufficiency of an EIR is to be reviewed in light of what is reasonably feasible. CEQA Guidelines, section 15151. The EIS/EIR contains adequate information for the public and decision makers to make informed decisions about the potential environmental impacts of the project as required by CEQA and NEPA. • Section 4.8 contains a full listing of known hazardous materials sites within or adjacent to the potential area of disturbance including a summary of the known hazards (see Table 4.8-1). The analysis of Section 4.8 includes a discussion of potential hazards from these sites and mitigation measures to avoid significant impacts to human health or the environment. • Current water quality is discussed in Section 4.5 based on recent studies conducted for the Project and the South Bay Salt Ponds Restoration Project. • Cultural Resources are evaluated in Section 4.15 based on the SBSP Restoration Project Final Cultural Resources Assessment Strategy Memorandum and Historic Context Report and Cultural Resources Assessment: South San Francisco Bay Shoreline Interim Feasibility Study. The SCVWD acknowledges that a subsequent EIR may be required per CEQA Guidelines, section 15162, if, after the EIR is certified, the later studies or analyses demonstrate that the project would result in new significant environmental effects or substantially more severe significant effects.
011_SLC-4	Mitigation: Project approval by the CSLC would require the adoption of all Avoidance and Minimization Measures, and Mitigation Measures, outlined in the Final EIS/EIR that are applicable to lands under the jurisdiction of the CSLC. Please note that a Mitigation, Monitoring, and Reporting Plan (MMRP) should be prepared to facilitate this requirement.	Your comment is acknowledged. Under CEQA, a lead agency may not approve a project for which an EIR has been certified without first making the necessary CEQA findings. One of the possible findings is that changes or alterations have been required in, or incorporated into, the project which avoid or substantially lessen the significant environmental effects as identified in the final EIR. CEQA Guidelines, section 15091(a). When the lead agency makes such a finding, it is also required to adopt a program for monitoring or reporting on the project revisions which it has required in the project and the measures it has imposed to mitigate or avoid significant impacts. CEQA Guidelines, section 15097(a). As such, a MMRP which will include all Avoidance and Minimization Measures and Mitigation Measures identified in the document will be prepared as part of the Final EIS/EIR and if the SCVWD decides to approve the project, it will adopt the MMRP in conjunction with project approval.
011_SLC-5	Cultural Resources: Title to Resources: As requested in our previous letter, per California Public Resources Code section 6313, please mention that the title to all archaeological sites and historic or cultural resources on or in submerged lands of California is vested in the State and under the jurisdiction of the CSLC. CSLC staff suggests that this text be added under section 4.15.1.1.2 State Regulations. In addition, CSLC staff requests that the lead agencies consult with Assistant Chief Counsel Pam Griggs (see contact information below), should any cultural resources on State lands be discovered during construction of the proposed Project.	Section 4.15.1.1.2 will be revised as suggested in the comment. The project proponents will consult with the State Lands Commission if historic resources are discovered on State lands.

1400

U.S. Department of Homeland Security
United States Coast Guard

Commander
Eleventh District

U.S. Coast Guard Island, Bldg 50-2
Alameda, CA 94501-5100
Staff Symbol: (dpw)
Phone: (510) 437-3514
Fax: (510) 437-5836

16591
South Bay Shoreline Project
22 Jan 2015

MEMORANDUM

From: D. H. SULOUFF
Chief, Bridge Section

To: U. S. Army Corps of Engineers, San Francisco District
Attn: William Dejager

Subj: PROPOSED BRIDGES, SOUTH SAN FRANCISCO BAY SHORELINE PHASE "1" PROJECT, ARTESIAN SLOUGH AND AN UNNAMED DITCH NEAR ALVISO, CA

1. The General Bridge Act of 1946 requires the approval of the location and plans of bridges prior to the start of construction (33 U.S.C. 525). As the Federal regulatory agency responsible for permitting proposed bridges under the provisions of the General Bridge Act of 1946, the USCG has completed our review Corps Federal Register notice dated 19 Dec 2014, and the draft Environmental Impact Statement (DEIS) for the subject project at the Don Edwards Wildlife Refuge, near San Jose, Santa Clara County, California. 1

2. The Commandant of the Coast Guard has given advance approval to the location and plans of bridges to be constructed across reaches of waterways considered navigable, but not actually navigated by other than logs, log rafts, rowboats, canoes and small motorboats. In such cases the clearances provided for high water stages will be considered adequate to meet the reasonable needs of navigation. (33 CFR 115.70).

3. We understand two proposed pedestrian bridges are included in the project crossing Artesian Slough at mile 2.0, and un-named ditch 4,565 feet north of Alviso, CA in position N37° 26' 25" W121° 58' 33".

a. Artesian Slough is considered navigable by Coast Guard standards, for bridge permitting, from its confluence with Coyote Creek at mile 0.0 to its upper limit at mile 2.5. However, at the project site, mile 2.0, Artesian Slough conforms to Advance Approval bridge permitting criteria in paragraph 2 above, and the Corps of Engineers has not indicated plans to make navigational improvements that would result in larger watercraft passing through the 2
proposed bridge. Therefore, no individual Coast Guard bridge permit will be required for this bridge. This does not relieve the applicant from complying with all applicable federal, state and local laws and associated permit requirements. The bridge owner is required to notify this office at least 30 days prior to beginning construction so we may provide appropriate notices to mariners. "As built" drawings showing horizontal (pier face to pier face), and vertical (above mean high water), navigational clearance measurements and a photograph of the bridge are required when the bridge is complete. This advance approval determination for Artesian Slough

16591
22 Jan 2015

is valid for a period of 2 years from the date of this memorandum. If the character of navigation changes, such that the waterway no longer meets advance approval criteria, the Coast Guard will promptly withdraw the advance approval designation for this project and notify all interested parties.

b. Under the provisions of the Coast Guard Authorization Act of 1982, the Coast Guard has determined the proposed bridge crossing an unnamed ditch 4,565 feet north of Alviso, CA in position N37° 26' 25" W121° 58' 33", will not require Coast Guard involvement for bridge permitting purposes. 3

4. We recommend the following edits to the NEPA document:

a. It does not appear there are any proposed bridges over Alviso Slough, associated with this project. Change "Alviso Slough" to the appropriate waterway name wherever appropriate. 4

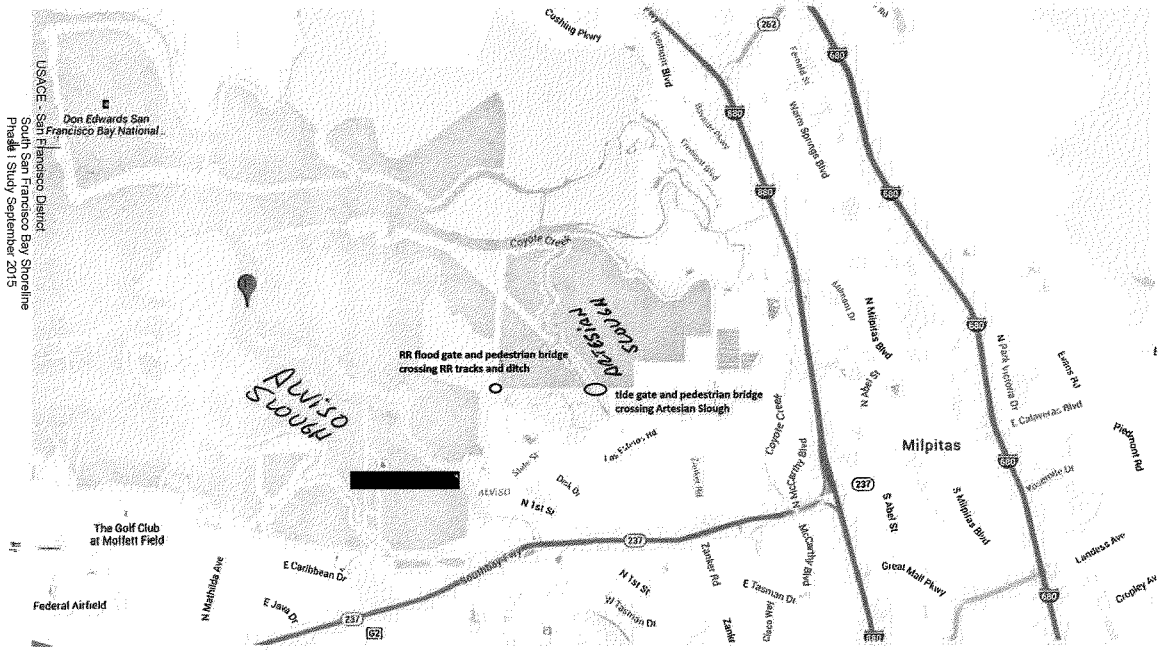
b. Ensure this Coast Guard determination is reflected in the NEPA documentation for the project. 5

5. You may contact Mr. Carl Hausner, Project Manager, by telephone at (510) 437-3515 to discuss this project.

#

Copy: CG-BRG-2

ACME Mapper 2.1 - 1.5 mi N of Alviso CA



ENCLOSURE ( )

01/13/2015

http://mapper.acme.com/

ID	Issue Text	Response Text
012_USCG-1	1. The General Bridge Act of 1946 requires the approval of the location and plans of bridges prior to the start of construction (33 U.S.C. 525). As the Federal regulatory agency responsible for permitting proposed bridges under the provisions of the General Bridge Act of 1946, the USCG has completed our review Corps Federal Register notice dated 19 Dec 2014, and the draft Environmental Impact Statement (DEIS) for the subject project at the Don Edwards Wildlife Refuge, near San Jose, Santa Clara County, California. 2. The Commandant of the Coast Guard has given advance approval to the location and plans of bridges to be constructed across reaches of waterways considered navigable, but not actually navigated by other than logs, log rafts, rowboats, canoes and small motorboats. In such cases the clearances provided for high water stages will be considered adequate to meet the reasonable needs of navigation. (33 CFR 115.70).	Your comment is acknowledged.
012_USCG-2	3. We understand two proposed pedestrian bridges are included in the project crossing Artesian Slough at mile 2.0, and un-named ditch 4,565 feet north of Alviso, CA in position N37 26'25" W121 58'33".a. Artesian Slough is considered navigable by Coast Guard standards, for bridge permitting, from its confluence with Coyote Creek at mile 0.0 to its upper limit at mile 2.5. However, at the project site, mile 2.0, Artesian Slough conforms to Advance Approval bridge permitting criteria in paragraph 2 above, and the Corps of Engineers has not indicated plans to make navigational improvements that would result in larger watercraft passing through the proposed bridge. Therefore, no individual Coast Guard bridge permit will be required for this bridge. This does not relieve the applicant from complying with all applicable federal, state and local laws and associated permit requirements. The bridge owner is required to notify this office at least 30 days prior to beginning construction so we may provide appropriate notices to mariners. "As built" drawings showing horizontal (pier face to pier face), and vertical (above mean high water), navigational clearance measurements and a photograph of the bridge are required when the bridge is complete. This advance approval determination for Artesian Slough is valid for a period of 2 years from the date of this memorandum. If the character of navigation changes, such that the waterway no longer meets advance approval criteria, the Coast Guard will promptly withdraw the advance approval designation for this project and notify all interested parties.	Your comment is acknowledged. The bridge owner will notify the Coast Guard as required.
012_USCG-3	b. Under the provisions of the Coast Guard Authorization Act of 1982, the Coast Guard has determined the proposed bridge crossing an unnamed ditch 4,565 feet north of Alviso, CA in position N37 26'25" W121 58'33", will not require Coast Guard involvement for bridge permitting purposes.	Your comment is acknowledged.
012_USCG-4	4. We recommend the following edits to the NEPA document: a. It does not appear there are any proposed bridges over Alviso Slough, associated with this project. Change "Alviso Slough" to the appropriate waterway name whenever appropriate.	Per your comment, it is agreed that there are no proposed bridges over Alviso Slough. Chapters 3 and 9 references to the proposed pedestrian bridge were clarified as being proposed for Artesian Slough, not Alviso Slough.
012_USCG-5	4. We recommend the following edits to the NEPA document: b. Ensure this Coast Guard determination is reflected in the NEPA documentation for the project.	Thank you for your advance approval to the location and plans of bridges to be constructed across Artesian Slough at mile 2.0 and un-named ditch 4,565 feet north of Alviso, CA. Per your request, this determination has been recorded as part of the environmental document; reference to the determination has been added to Table 8.3-1 Applicable Federal Regulations that Apply to the Shoreline Phase I Study Environmental Review, and the complete letter is included in Appendix I, as part of the package of public comments and responses.

1404

From: JLucas1099@aol.com
Sent: Saturday, January 17, 2015 9:56 AM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase 1 Project

Mr. Bill DeJager
1455 Market Street
San Francisco, California 94103

January 17, 2015

RE: South San Francisco Bay Shoreline Phase 1 Project

Dear Bill DeJager,

On making a first superficial review of your extensive document on proposed flood control measures in the Alviso area of South San Francisco Bay, would like to comment on basic aspects of study with which I take exception. However as need time to ferret out flood studies that I cite, will forward full text of concerns later.

Initially, cannot agree with premise that riverine flooding in Alviso area is no longer a concern, but rather that flooding from South Bay needs to be sole focus of a major COE designed flood control shoreline levee. Think you will find that Guadalupe River no longer has its original COE design channel capacity for 17,000 cfs flow, while Coyote Creek flow has been so muted in recent decades that debris dams now compromise channel. 1

Though subsidence in San Jose and Alviso area, study notes, is cause of high siltation rate in local streams, do not believe it accurately describes present evolution of what can be called delta of Guadalupe and Coyote River systems found north of #237 and perhaps extending south to #101. Latter area does not drain well and in storm events pumps storm waters to river. High groundwater and saltwater intrusion complicate condition. 2

In recent heavy rain, am told, roads in Alviso were flooded from clogged drainage and over eager construction site pumping. If somewhat routine urban runoff can result in high water, then careful consideration needs to be given to effect major storm event will have in Alviso neighborhood when bounded by high berm flood levee. 3

When bay levels run high in storm conditions, rivers will reflux and overbank, regardless of height of bay or river levee protection, so safety for communities must be considered from both river and bay directions. This, I do not believe, is adequately accommodated in this study's proposed COE super levee design. 4

The ongoing Napa River flood project has established a wetlands preserve flood water holding basin between Town of Napa and San Francisco Bay that tries to adequately absorb spike river flow until bay levels recede. It is an equivalent bay buffer flood water holding basin that COE's levee proposal neglects to consider and so it results in a critical deficiency in this project document. 5

In assessing neighboring rivers in Palo Alto, study does not analyse City of Palo Alto's baylands flood basin which is another example of flood retention buffer regulating flows between river and bay in peak storm event. Will attempt to find SCVWD description of their consideration of timing of storm flows with rising bay levels. 6

Alternatives analysis I find deficient in that it only considers alinement of levee along shore of water treatment plant levee which will eliminate prime habitat for endangered South Bay species of Califonria Clapper Rail and Salt Marsh Harvest
7
Mouse. Continuity of corridor is vital for SMHM here, where it rounds end of Bay.

Propose consideration be given to upgrade railroad track levee to be COE flood levee across South Bay, from Alviso to Fremont with tide gates at Drawbridge for Coyote Creek and at Guadalupe River Gold Street bridge in Alviso. Believe distance of five miles is equivalent for both alinements (aprox.) and cost benefit ratio better.

Then would envision inner tidal basin with diverse wetlands habitat designed to attract waterfowl historically known to either visit South Bay marshes on migratory flight or to be resident, or species of special concern. 8

Subsequent submittal will touch on elements of concern as the four dozen western pond turtles identified by Navy in process of excavating contaminants from Northern Channel, as well as try to document flood data.

Thank you for consideration of these comments and hope they are being sent to correct e-mail address.

Libby Lucas
174 Yerba Santa Ave.,
Los Altos, CA 94022

ID	Issue Text	Response Text
013_Lucas_1-1	Initially, cannot agree with premise that riverine flooding in Alviso area is no longer a concern, but rather that flooding from South Bay needs to be sole focus of a major COE designed flood control shoreline levee. Think you will find that Guadalupe River no longer has its original COE design channel capacity for 17,000 cfs flow, while Coyote Creek flow has been so muted in recent decades that debris dams now compromise channel.	It is impossible to design and build a flood risk management structure that will provide a 100% guarantee against flooding; there will always be some remaining risk of flooding. The proposed project levee elevation, 15.2 ft is less that the adjacent riverine levee elevation, 16 ft. Residual flooding from the proposed project is negligible. Any residual flows would flow into the marsh. Federally constructed riverine levees on both Coyote Creek and Guadalupe River were designed to safely contain the 1% ACE flood event. Flows of magnitude equal to or less than the 1% ACE flood event will be contained in the channels within the hydrologic study area. Once the proposed levee is built, the largest residual flood risk in the hydrologic study area will come from fluvial flooding from the Guadalupe River. Nuisance flooding from the storm drain network is expected to remain the same. Also the Guadalupe River (downtown and lower Guadalupe) and the Coyote Creek projects are inspected annually by the Corps and by the Santa Clara Water District. Any significant shoaling in the channels would be noted in regular inspection reports.
013_Lucas_1-2	Though subsidence in San Jose and Alviso area, study notes, is cause of high siltation rate in local streams, do not believe it accurately describes present evolution of what can be called delta of Guadalupe and Coyote River systems found north of #237 and perhaps extending south to #101. Latter area does not drain well and in storm events pumps storm waters to river. High groundwater and saltwater intrusion complicate condition.	Comment noted. Page E-22 of Appendix E Water Resources Engineering briefly discusses an analysis done by Scott (2009) which describes the systems north of Highway 237. The study is also referenced on page E-43. The analysis was a field assessment which evaluated five South San Francisco Bay streams (Coyote Creek, Guadalupe River, Calabazas Creek, Stevens Creek and Permanente Creek) in support of the riverine sediment transport component. The evaluation consisted of observing the lower reaches of the streams with general reach boundaries extending from Highway 101 to the bay sloughs. Sediment samples were taken along each stream reach where feasible particularly in areas where the bed slope or bed sediment composition was changing. Observations of channel cross sections were made along with in-stream controls, vegetation or stream corridor controls such as levees. Base flows were noted within the channels and sediment deposits in floodplains were examined. The channels above Highway 101 are gravel-cobble bed steep gradient channels for which sand, silt and clay behave as wash load during intermediate to large flow events. Downstream of Highway 101 a number of factors make the lower channels a depositional area for sand sized sediments. A decrease in channel slope combined with the influence of bay tides and backwater elevations due to the bridges spanning the streams result in deposition of sand sized sediments between Highway 101 and the lower Highway 237 Bridge. Below Highway 237, sediment transport consists primarily of silts and clays along with some very fine and fine sand.
013_Lucas_1-3	In recent heavy rain, am told, roads in Alviso were flooded from clogged drainage and over eager construction site pumping. If somewhat routine urban runoff can result in high water, then careful consideration needs to be given to effect major storm event will have in Alviso neighborhood when bounded by high berm flood levee.	There will be no back water effects caused by the proposed levee. Local drainage issues, due to clogged drains or overtaxed system, may still occur. This occurs in many communities. Corps policy does not allow for project participation in local drainage issues (Engineer Regulation 1105-2-100, page 3-12). This is not an objective of the project, and local drainage patterns as described will not be impacted by the project. The City of San Jose is looking into the issue separately.
013_Lucas_1-4	When bay levels run high in storm conditions, rivers will reflux and overbank, regardless of height of bay or river levee protection, so safety for communities must be considered from both river and bay directions. This, I do not believe, is adequately accommodated in this study's proposed COE super levee design.	We agree that you must consider both high bay and river elevations when designing the levee system, which we did for this project. A coincident frequency analysis (CFA) was performed to determine the effects of coincidence of the peak tide and peak stream discharge and to determine the downstream boundary water surface levels. Without-project coincident frequency analyses assumed that coastal water surface elevations and riverine flows are independent. Subsequent to the original study, it was shown that flow in the Guadalupe River is well correlated with storm surge, and that tidal residuals of up to two feet may be expected due to the correlation. The coincident frequency analysis predicted the downstream boundary condition, influenced by tidal stage, for the unsteady HEC-RAS models. The maximum tidewater elevation modeled under without-project conditions was 13 feet. Maximum tidewater elevations were increased in the with-project models to 15 feet to account for storm surge effects. Minimum tidewater elevation in both without and with-project conditions was 2.83 ft NAVD 88. The coincident frequency analysis only applied to the area of the channel where the tide driven water levels and the creek flow meet or commingle. Downstream of the commingling area the water levels are tidally driven and upstream of this area the water levels are dominated by the creek flow.
013_Lucas_1-5	The ongoing Napa River flood project has established a wetlands preserve flood water holding basin between Town of Napa and San Francisco Bay that tries to adequately absorb spike river flow until bay levels recede. It is an equivalent bay buffer flood water holding basin that COE's levee proposal neglects to consider and so it results in a critical deficiency in this project document.	A number of alternatives to address the flooding from the bay were considered and discussed. The bay buffer water basin is not necessary with the proposed levee design since there are no backwater effects.
013_Lucas_1-6	In assessing neighboring rivers in Palo Alto, study does not analyse City of Palo Alto's baylands flood basin which is another example of flood retention buffer regulating flows between river and bay in peak storm event. Will attempt to find SCVWD description of their consideration of timing of storm flows with rising bay levels.	The Integrated Document does not analyze the Palo Alto Flood Basin as it is outside the current Shoreline Study Phase I project area. The Palo Alto Flood Basin will be part of the Shoreline Study's evaluation in the future phase of the Shoreline Study which will look at flood protection, habitat restoration, and recreational opportunities along the remaining shoreline of Santa Clara County. The Santa Clara Valley Water District is responsible for operation of 15 out of 16 of the Palo Alto tide gates and is aware of the flood basin's operational capacity. A bay buffer water basin is not necessary with the proposed levee design since there are no backwater effects.

1407

013_Lucas_1-7	Alternatives analysis I find deficient in that it only considers alinement of levee along shore of water treatment plant levee which will eliminate prime habitat for endangered South Bay species of California Clapper Rail and Salt Marsh Harvest Mouse. Continuity of corridor is vital for SMHM here, where it rounds end of Bay.	The Shoreline project shares the commenter's concern over impacts to the SMHM. One of the key species to benefit from the construction of ecotone (the project includes broad upland transition zones adjacent to the engineered levee) is the SMHM. The ecotone will provide sufficient cover and habitat to protect the SMHM during high tides and storms and allow for migration along the shoreline. When completed, the Shoreline project will create nearly 3,000 acres of SMHM habitat and when combined with the already-restored Pond A17, the south bay will have a continuous band of salt marsh habitat from Alviso Slough Ponds A9-15 through A17 to Coyote Creek's fringing marshes and Pond A18. The only disruption would be the existing Union Pacific Railroad line. This ultimate vision will provide much greater habitat connectivity, and the construction of the ecotone and the phased approach to restoration will help to minimize the direct effects of the initial restoration actions.
013_Lucas_1-8	Propose consideration be given to upgrade railroad track levee to be COE flood levee across South Bay, from Alviso to Fremont with tide gates at Drawbridge for Coyote Creek and at Guadalupe River Gold Street bridge in Alviso. Believe distance of five miles is equivalent for both alinements (aprox.) and cost benefit ratio better. Then would envision inner tidal basin with diverse wetlands habitat designed to attract waterfowl historically known to either visit South Bay marshes on migratory flight or to be resident, or species of special concern.	Early in the Shoreline Study planning process, options similar to the commenter's suggestion were considered such as hardening outboard levees and installing tide gates strategic locations to hold back tidal flooding. This would convert the former south bay salt ponds to essentially flood detention basins. Such basins can successfully be managed as either tidal and/or riparian flood flows (depending on how they are designed) and create habitat, but they result in highly-altered environments with the need for intensive, long-term management. Consistent with the vision created by the South Bay Salt Pond Restoration Project and consistent with Corps of Engineers ecosystem restoration policy, the Shoreline Study has tried to incorporate more natural, less managed solutions into the project, as much as possible, in order to reduce environmental impacts, costs, and long-term complications from highly-managed systems. Using the railroad line to create tidal basins would also conflict with the Shoreline Study's identified habitat goals of tidal restoration through an adaptive management process. Tidal basins and tide gates usually preclude full tidal restoration. While these muted tidal systems can provide valuable habitat, they do not have all of the geomorphic and ecological functions that existed historically when the South Bay was dominated by unconstrained tidal marshes. Furthermore, the creation of tidal detention basins would conflict with the habitat goals of the South Bay Salt Pond Restoration Project and other regional plans, such as the Baylands Ecosystem Habitat Goals and the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California in that it would not provide extensive habitat for special status species such as the salt marsh harvest mouse and Ridgway's rail. A central goal of these plans is to create largely unbroken swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations. For these reasons, these types of flood protection solutions were not carried forward for further analysis.

1408

From: JLucas1099@aol.com
Sent: Wednesday, January 28, 2015 1:54 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase 1 Project Draft FR/EIS/EIR(cont comment)

Mr. Bill DeJager
1455 Market Street
San Francisco, California 94103

January 28, 2015

RE: South San Francisco Bay Shoreline Phase 1 Project Draft FR/EIS/EIR (comment continued)

Dear Bill DeJager,

Enclosed please find 'historic' documentation of endangered species habitat, mitigation marsh wetlands, and Pacific Flyway as well as resident waterfowl and wildlife presence in the Alviso Shoreline project region.
~ 1978 San Jose-Santa Clara Water Treatment Plant EIR Figure 4-8 Endangered Species in the Baylands
~ Coyote Creek Flood Project Reach 1A Salt Marsh Harvest Mouse Mitigation site and Waterbird Pond (1-5)
~ South Bay Salt Pond Restoration Project Figure 6-7 Salt Marsh Harvest Mouse Habitat, Capture Locations
~ San Jose-Santa Clara Water Treatment Plant Lands Distribution of Biotic Habitats H.T.Harvey 2006 Fig.8

Believe that these former environmental assessments of prime habitat locations for California Clapper Rail, Salt Marsh Harvest Mouse and other endangered and special concern indicator species show how critically they will be impacted by the shoreline levee alignment as proposed in this Phase ! Project Draft FR/EIS/EIR. 1

The staggered levee of old biosolids' lagoons has provided high ground refugia for decades, and associated with slough levees and New Chicago Marsh habitat, has been essential to calibre and continuity of wildlife corridor around south end of Bay. Viability of this habitat has made South Bay prime region of wildlife refuge.

Alviso marsh area would be aesthetically altered by proposed South Bay Shoreline levee alignment as the mass and height of shoreline levee would obscure bay vistas for recreation users as well as for residents. To experience bleak, unvegetated wall of soil super levees provide, suggest visit to Redwood Shores outer levee. 2

Finally, find loss and degradation due to levee design is deficient in alternative analysis and substantiation. If precedent of choices of London and Venice for flood gates on Thames and Adriatic to repel intermittent flood surges from intense storm systems is evaluated, believe conditions are comparable to high water in Alviso. 3

In regards to this Shoreline study's premise that riverine flooding is no longer a threat to Alviso, please review Guadalupe River flood project data from 1985 COE report which cites flow at confluence of Los Gatos Creek and Guadalupe River at 17,000 cfs. Add to this groundwater pumping at San Jose's International Airport and City of San Jose's urban stormwater runoff pumps at Montague Expressway of 5000 cfs plus global warming increase in storm intensity rate of watershed runoff of 3000 cfs and then 25,000 cfs is likely total at Alviso.

Do not believe that you will find channel capacity in Lower Guadalupe River will accommodate 25,000 cfs. SCVWD used to remove sediment annually from alternate sides of channel but gave practice up years ago. 4

To quote from your COE earlier 1989 Shoreline Study;
"land subsidence has increased both tidal and fluvial flood problems in South Bay.....Fluvial problems have been increased by land subsidence because stream channels were reduced in elevation relative to the Bay and the gradients of the channels were flattened near the Bay. This increases backwater effects of high tides, increases the deposition of sediment, and reduces flow velocities and channel capacities. Subsidence also increased interior drainage problems because protected areas were reduced in elevation relative to drainage channels and the Bay so that gravity drainage has become less effective...."
.....and the report goes on to evaluate Sea Level Rise.

With these constraints in fluvial capacity, believe incidence of stormwater overbanking upstream from Alviso is of sufficient concern to compromise integrity of super levee as proposed protection for inboard commercial development and neighborhoods. In ignoring fluvial flooding feasibility this FR/EIS/EIR is therefore deficient.

The 1989 SF COE Shoreline Study gives consideration to frequency of 'coincidental tidal and fluvial events', with a correlation of both extreme high tides and high fluvial runoff caused by low pressure storm systems. Such conditions need to be fully analyzed in proposed Shoreline Phase 1 levee project Draft FR/EIS/EIR, including tide and wind combinations with resulting 3 foot wave ride-up in South Bay under El Nino events. Did not find such analysis in three volume draft or did I miss it? Is study deficient in regards perfect storms? 5

Global warming reinforces the guarantee of correlation of king high tides with intense storm systems. Former study evaluated global meteorological conditions with local meteorological conditions, local winds, freeboard and interior drainage. The proposed project Draft FR/EIS/EIR needs to update relevant data and do the same. 6

Such evaluation needs to also include analysis of present Napa River flood project and its wetlands retention basin between Downtown Napa and San Francisco Bay. The preservation of this marsh basin to retain peak Napa River flood flows for sufficient time to mute river reflux from high water in San Francisco Bay is similar to scenario of storm systems affecting either Coyote Creek or Guadalupe River systems or both in protection of Alviso from river reflux over-banking. 7

As the Golden Triangle, between #237 and #101, no longer offers land available for sizeable retention basin, (though it had been suggested in past) it would appear wetlands inboard of railroad tracks and drawbridge would be most flexible retention marsh complex capable of absorbing most climactic storm systems that might hold over both Mt. Umunhum and Mount Hamilton. 8

A mosaic of marsh habitat can be managed in sustainable, environmental manner to accommodate resident endangered species, rare or locally unique birds and species of special concern, historically known to reside or forage in South Bay wetlands. Vista from Alviso to Mount Diablo Range is especially valuable to preserve. 9

The South Bay Shoreline alternative of flood gates at the railroad crossing at Drawbridge (Coyote Creek) and Gold Street (Guadalupe River) is preferred alternative that was not investigated and which I find is only one that can satisfy all constraints of flood protection for subsided Alviso neighborhoods, and for Highways #237 and #880 under extended high water conditions.

In regards upgrade of railroad line levee from Alviso to Fremont, actual COE flood control levee could be sited inboard or outboard, whichever ties in best with infrastructure at either end. Flood gates to be implemented only in occasional, high storm events - frequency similar to implementation of flood gates on River Thames - would leave full, normal tidal action to replenish refuge marshes. This preserves continuity of wildlife corridor and mitigation marshes in Reach 1 of Coyote Creek and around south end of San Francisco Bay. 10

Cost benefit analysis would be improved with protection of #880 at Dixon Landing and City of Milpitas? 11

Think I must get these over sized attachments into surface mail or miss your deadline so will close for now.

Libby Lucas
174 Yerba Santa Ave.,
Los Altos, CA 94022

ID	Issue Text	Response Text
014_Lucas_2-1	Enclosed please find 'historic' documentation of endangered species habitat, mitigation marsh wetlands, and Pacific Flyway as well as resident waterfowl and wildlife presence in the Alviso Shoreline project region.~ 1978 San Jose-Santa Clara Water Treatment Plant EIR Figure 4-8 Endangered Species in the Baylands~ Coyote Creek Flood Project Reach 1A Salt Marsh Harvest Mouse Mitigation site and Waterbird Pond (1-5)~ South Bay Salt Pond Restoration Project Figure 6-7 Salt Marsh Harvest Mouse Habitat, Capture Locations~ San Jose-Santa Clara Water Treatment Plant Lands Distribution of Biotic Habitats H.T.Harvey 2006 Fig.8Believe that these former environmental assessments of prime habitat locations for California Clapper Rail, Salt Marsh Harvest Mouse and other endangered and special concern indicator species show how critically they will be impacted by the shoreline levee alignment as proposed in this Phase I Project Draft FR/EIS/EIR.The staggered levee of old biosolids' lagoons has provided high ground refugia for decades, and associated with slough levees and New Chicago Marsh habitat, has been essential to calibre and continuity of wildlife corridor around south end of Bay. Viability of this habitat has made South Bay prime region of wildlife refuge.	Your comment is acknowledged. One of the project goals is to restore large swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations to benefit the Ridgway rail (formally California Clapper Rail) and salt marsh harvest mouse as called for in the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. As discussed in Section 4.7, the proposed project is consistent with applicable recovery plans (Impact TBR-5).
014_Lucas_2-2	Alviso marsh area would be aesthetically altered by proposed South Bay Shoreline levee alignment as the mass and height of shoreline levee would obscure bay vistas for recreation users as well as for residents. To experience bleak, unvegetated wall of soil super levees provide, suggest visit to Redwood Shores outer levee.	Unlike the existing berms around the ponds, the proposed flood protection levees will not feature steeply sloping sides. The levee will be much wider and have a gentler slope which will include erosion control vegetation near the top and planted natural vegetation closer to the ponds and marsh. The flood protection levee is not expected to noticeably affect the views of the surrounding landscape and the horizon from the town of Alviso. It will be more noticeable at the Alviso Marina County Park and at the US FWS's Environmental Education Center because these visitor destinations will be much closer to the levee; but even there it is not expected to be significant. Please see Chapter 4.12 Aesthetics for additional discussion of the levee appearance and visual simulations of the proposed levees from various points in Alviso. Please also note that the levee will feature a trail on top which will provide enhanced (from slightly higher up) views of the surrounding landscape. In addition, the ponds will be restored to tidal marshes, bringing back more of what was originally the natural landscape in the Alviso area.
014_Lucas_2-3	Finally, find loss and degradation due to levee design is deficient in alternative analysis and substantiation. If precedent of choices of London and Venice for flood gates on Thames and Adriatic to repel intermittent flood surges from intense storm systems is evaluated, believe conditions are comparable to high water in Alviso.	Flooding from the south bay is not restricted to water course outfalls, thus flood gates or barriers alone would not provide a comprehensive solution to flood risk posed by the current system of salt pond dikes adjacent to Alviso.
014_Lucas_2-4	In regards to this Shoreline study's premise that riverine flooding is no longer a threat to Alviso, please review Guadalupe River flood project data from 1985 COE report which cites flow at confluence of Los Gatos Creek and Guadalupe River at 17,000 cfs. Add to this groundwater pumping at San Jose's International Airport and City of San Jose's urban stormwater runoff pumps at Montague Expressway of 5000 cfs plus global warming increase in storm intensity rate of watershed runoff of 3000 cfs and then 25,000 cfs is likely total at Alviso. Do not believe that you will find channel capacity in Lower Guadalupe River will accommodate 25,000 cfs. SCVWD used to remove sediment annually from alternate sides of channel but gave practice up years ago. To quote from your COE earlier 1989 Shoreline Study; "land subsidence has increased both tidal and fluvial flood problems in South Bay.....Fluvial problems have been increased by land subsidence because stream channels were reduced in elevation relative to the Bay and the gradients of the channels were flattened near the Bay. This increases backwater effects of high tides, increases the deposition of sediment, and reduces flow velocities and channel capacities. Subsidence also increased interior drainage problems because protected areas were reduced in elevation relative to drainage channels and the Bay so that gravity drainage has become less effective...." .....and the report goes on to evaluate Sea Level Rise. With these constraints in fluvial capacity, believe incidence of stormwater overbanking upstream from Alviso is of sufficient concern to compromise integrity of super levee as proposed protection for inboard commercial development and neighborhoods. In ignoring fluvial flooding feasibility this FR/EIS/EIR is therefore deficient.	Flood risk due to fluvial or riverine sources has been addressed by the current levee system, which was designed with consideration to downstream tidal conditions and potential for coincident events. With regard to the potential 25,000 cfs downstream, we do not agree. Pumping is controllable, and would not likely be added to a peak watershed's flow due to timing within the system. There are no currently credible estimates of specific hydrologic changes in runoff due to "global warming" as cited which may be downscaled to the watershed scale, though we agree that changes in future hydrology are certainly possible under many future climate change scenarios. The Guadalupe River (downtown and lower Guadalupe) project is inspected annually by the Corps and by the Santa Clara Valley Water District. Any significant shoaling in the channels would be noted in regular inspection reports, and a channel capacity evaluation would be made. The study has comprehensively analyzed fluvial hydrology, hydraulics and sedimentation, and we do not agree that consideration of fluvial flood risk has been neglected. (Reference App D1, Scott 2009 analysis) The conclusions from the 1989 report are still relevant in the study area; however riverine levee systems are now in places which address fluvial flood risk. Currently, there is an increasing risk of tidal flooding as the reliability of the salt pond dike systems to control low frequency tidal flooding continues to decrease over time with sea level rise. Stormwater drainage is impacted by subsidence and will continue to rely on pumping to maintain drainage within Alviso.
014_Lucas_2-5	The 1989 SF COE Shoreline Study gives consideration to frequency of 'coincidental tidal and fluvial events', with a correlation of both extreme high tides and high fluvial runoff caused by low pressure storm systems. Such conditions need to be fully analyzed in proposed Shoreline Phase 1 levee project Draft FR/EIS/EIR, including tide and wind combinations with resulting 3 foot wave ride-up in South Bay under El Nino events. Did not find such analysis in three volume draft or did I miss it? Is study deficient in regards perfect storms?	The current study did consider coincident tidal events when analyzing fluvial and tidal flood risk, various analyses may be found throughout Appendix D2. With regard to tidal flood risk, several methods were utilized to develop extreme or total tidal water levels. Extreme water levels for shoreline are based on a statistical analysis of historical storm tide levels in San Francisco Bay. The proposed levee design with the ecotone vegetation would not experience large wave run up and any wave energy would be quickly dissipated by the vegetation in the 30:1 ecotone slope.

1411

014_Lucas_2-6	Global warming reinforces the guarantee of correlation of king high tides with intense storm systems. Former study evaluated global meteorological conditions with local meteorological conditions, local winds, freeboard and interior drainage. The proposed project Draft FR/EIS/EIR needs to update relevant data and do the same.	Assuming that global warming refers to impacts from climate change or variability, including sea level change, the current study has accounted for impacts as prescribed by USACE policy and guidance, ER 1100-2-1862, "Incorporating Sea Level Change in Civil Works Programs", and ETL 1100-2-1, "Procedures to Evaluate Sea Level Change, Impacts, Responses, and Adaptation" As part of the analysis, 110 years of tidal records were analyzed to develop extreme water level statistics. These statistics were adjusted to account for sea level rise over a 100 year future period for three different future climate scenarios to determine a design levee height which would provide tidal flood risk reduction while accounting for an unknown future level of sea level rise. The combination of storms and King Tide suggested by the comment is one of many possible storm event combinations, which are represented in the overall extreme water level statistics and translate to the proposed design levee height of 15.2 feet.
014_Lucas_2-7	Such evaluation needs to also include analysis of present Napa River flood project and its wetlands retention basin between Downtown Napa and San Francisco Bay. The preservation of this marsh basin to retain peak Napa River flood flows for sufficient time to mute river reflux from high water in San Francisco Bay is similar to scenario of storm systems affecting either Coyote Creek or Guadalupe River systems or both in protection of Alviso from river reflux over-banking.	A number of alternatives to address the flooding from the bay were considered and discussed. The bay buffer water basin is not necessary with the proposed levee design since there are no backwater effects and would not fulfill the habitat restoration objective as the proposed project does.
014_Lucas_2-8	As the Golden Triangle, between #237 and #101, no longer offers land available for sizeable retention basin, (though it had been suggested in past) it would appear wetlands inboard of railroad tracks and drawbridge would be most flexible retention marsh complex capable of absorbing most climactic storm systems that might hold over both Mt. Umunhum and Mount Hamilton.	Using the railroad line to create tidal basins would conflict with the Shoreline Study's identified habitat goals of tidal restoration as tidal basins and tide gates usually preclude full tidal restoration. While muted tidal systems can provide valuable habitat, they do not have all of the geomorphic and ecological functions that existed historically when the South Bay was dominated by unconstrained tidal marshes. Furthermore, the creation of tidal detention basins would conflict with the habitat goals of the South Bay Salt Pond Restoration Project and other regional plans, such as the Baylands Ecosystem Habitat Goals and the United States Fish and Wildlife Services (USFWS) Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California as it would not provide large areas of contiguous salt marsh. A central goal of these plans is to create largely unbroken swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations. For these reasons, these types of flood protection solutions were not carried forward for further analysis.
014_Lucas_2-9	A mosaic of marsh habitat can be managed in sustainable, environmental manner to accommodate resident endangered species, rare or locally unique birds and species of special concern, historically known to reside or forage in South Bay wetlands. Vista from Alviso to Mount Diablo Range is especially valuable to preserve.	Consistent with the Baylands Ecosystem Habitat Goals and the United States Fish and Wildlife Services (USFWS) Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California the project will allow for the restoration of large areas of tidal marsh which will benefit resident endangered species and other species of concern.
014_Lucas_2-10	The South Bay Shoreline alternative of flood gates at the railroad crossing at Drawbridge (Coyote Creek) and Gold Street (Guadalupe River) is preferred alternative that was not investigated and which I find is only one that can satisfy all constraints of flood protection for subsided Alviso neighborhoods, and for Highways #237 and #880 under extended high water conditions. In regards upgrade of railroad line levee from Alviso to Fremont, actual COE flood control levee could be sited inboard or outboard, whichever ties in best with infrastructure at either end. Flood gates to be implemented only in occasional, high storm events - frequency similar to implementation of flood gates on River Thames - would leave full, normal tidal action to replenish refuge marshes. This preserves continuity of wildlife corridor and mitigation marshes in Reach 1 of Coyote Creek and around south end of San Francisco Bay.	Early in the Shoreline Study planning process, options similar to the commenter's suggestion were considered such as hardening outboard levees and installing tide gates strategic locations to hold back tidal flooding. This would convert the former south bay salt ponds to essentially flood detention basins. Such basins can successfully be managed as either tidal and/or riparian flood flows (depending on how they are designed) and create habitat, but they result in highly-altered environments with the need for intensive, long-term management. Consistent with the vision created by the South Bay Salt Pond Restoration Project and consistent with Corps of Engineers ecosystem restoration policy, the Shoreline Study has tried to incorporate more natural, less managed solutions into the project, as much as possible, in order to reduce environmental impacts, costs, and long-term complications from highly-managed systems. Using the railroad line to create tidal basins would also conflict with the Shoreline Study's identified habitat goals of tidal restoration through an adaptive management process. Tidal basins and tide gates usually preclude full tidal restoration. While these muted tidal systems can provide valuable habitat, they do not have all of the geomorphic and ecological functions that existed historically when the South Bay was dominated by unconstrained tidal marshes. Furthermore, the creation of tidal detention basins would conflict with the habitat goals of the South Bay Salt Pond Restoration Project and other regional plans, such as the Baylands Ecosystem Habitat Goals and the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. A central goal of these plans is to create largely unbroken swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations. For these reasons, these types of flood protection solutions were not carried forward for further analysis.
014_Lucas_2-11	Cost benefit analysis would be improved with protection of #880 at Dixon Landing and City of Milpitas?	The Recommended Plan has been formulated to address the risk of tidal flooding to the community of Alviso from a potential failure of existing dikes in the Study Area located west of Interstate 880. The highway is not currently threatened by tidal flooding from a failure of these dikes. Further, this plan will not increase the risk of tidal flooding to the highway. Although the plan was formulated to address tidal flooding from the bay, the report does include the results of hydrologic and hydraulic analyses for Coyote Creek, including floodplain mapping (see Appendix D1 Coastal Engineering and Riverine Hydraulics Summary). This analysis shows that flow breakout locations are concentrated downstream from Interstate 880 and the highway is not at risk from overtopping for the one percent annual chance exceedance event.

1412

From: JLucas1099@aol.com
Sent: Thursday, January 29, 2015 1:27 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Franicisco Bay Shoreline Phase 1 Project Draft DEIS/DEIR (cont. com.3)

Mr. Bill DeJager
1455 Market Street
San Francisco, California 94103

January 29, 2015

RE: South San Francisco Bay Shoreline Phase 1 Project (continued comment 3)

Dear Bill DeJager,

There were errata in the COE South San Francisco Bay Shoreline Project DEIS/DEIR that failed to mention in previous comments, but which believe are of sufficient importance to negatively effect project design.

In regards high tides, and three foot wave ride-up in South Bay please reference San Francisco District COE October 1984 San Francisco Bay Tidal Stage vs.Frequency Study for what believe is accurate definitive data. (Explain notation on Project DEIS/DEIR chart that claimed Coyote Creek tide data as N/A not applicable?) 1

For sediment transfer data to South Bay, please reference Professor Krone studies as included in COE 1989 Sediment Budget Study for San Francisco Bay. Believe Professor Krone's scientific observations have been born out by rapid marsh restoration soil recruitment experienced in Island Ponds along lower Coyote Creek. One has only to stand on drawbridge to appreciate sediment laden tides that extend to extreme South Bay. 2

Project DEIS/DEIR says 'sediment supplies to San Francisco Bay via Sacramento San Joaquin Delta tend to settle in upper bays'. Believe this sufficiently misleading to necessitate DEIS/DEIR replace 2.5 sediment section with accurate COE earlier sediment study data. (E 20) 3

"South Bay has undergone net erosion from 1956 to 1983 rather than deposition '...and following sediment yield to South Bay data I find flawed and lacking in substantiation.

E 23 - Claims wind driven waves are minimal and in 2.6.2 that 'swell' is not significant factor. Please explain statement in view of research by COE 1984 tidal frequency report that finds South Bay ride-up of three feet. 4

"The largest remaining flood risk for Alviso comes from tidal floods", is completely unsubstantiated claim and is critical deficiency in Project DEIS/DEIR. Note previously cited data on Guadalupe River channel capacity. 5

Then did find references to flood concerns on neighboring streams of Adobe Creek and Matadero Creek to be unrelated to interface with San Francisco Bay tides in general and City of Palo Alto Flood Basin in particular. The timing of peak stream flows coming out of Santa Cruz Mountain Range and reaching San Francisco Bay in three to four hours does coincide with peak storm event tides driven from Golden Gate by wind and wave down Bay to Palo Alto and Mayfield Slough in three hours, and this DEIS/DEIR should have analyzed. 6

Conditions are quite different in Alviso when storm system hits Mount Umunhum, historically, pre-reservoir, it took peak flows 14 hours to reach Montague Expressway, which will not coincide with high intensity storm king tides and waves driven down Bay from Golden Gate in four hours? DEIS/DEIR needs to analyze this.

However, if this same storm system holds over either Mount Umunhum or Mount Hamilton, or both, for 24 or 48 hours then a more complex peak riverine flood flow and riverine reflux scenario needs to be evaluated. Has this been done or is it planned to be done? 7

In context of global warming and ocean rise associated with the increases in storm intensity and storm duration that is now experienced throughout the world, find for DEIS/SEIR not to include relevant data on Coyote Creek and 8

Guadalupe River flows in assessing South Bay tidal flooding to be a critical deficiency. Or is discussion of El Nino and Pineapple Express storm system scenario in three volume report that I missed?

There is another aspect to evaluation of peak riverine storm flows as they reach high king tide water levels, and that is anticipating where historic break-away points or over-banking of channels will occur. This needs to be investigated if a super levee is constructed around Alviso and Water Treatment Plant industrial parks it will tend to trap inboard flows from exiting to bay marshes and create a deadly deep retention basin in Alviso. Will DEIS/DEIR evaluate such conditions that are likely to occur in intertwined South Bay delta channels? 9

There is the unique method of interface with South Bay in adjacent stream systems of San Tomas Aquino Creek and Sunnyvale East and Sunnyvale West Channels as they outflow to Guadalupe Slough which needs to be referenced in Shoreline Project report. Here historic series of canals to collect storm water runoff from valley floor agriculture and neighborhoods serves as buffer to protect water quality in salt pond production. As land uses have changed, these canals can now serve as buffer to absorb stream flows and release to bay as high tides recede, with an added aid of inboard wetlands preserves to mute peaks from both stream and bay. 10

This canal complex is bound to be threatened by further extension of proposed super levee but feel efficacy and flexibility of its design that can accommodate, so far, range of uses for industrial park, park lands and water treatment facilities which abut the bay here, as well as sustain prime habitat for wildlife and waterfowl of South Bay needs to be accurately documented. Present use of parallel canals especially suits waterfowl.

Note that Northern Channel adjacent to Moffett Field was found by US Navy to host four dozen western pond turtles rather than just five as recorded in DEIS/SEIR. 11

Anadromous fish species of steelhead and Chinook salmon need special considerations in any alterations to channels within South Bay marshes. Proposals in regards pilot channels between sloughs and salt ponds must consider that pulse flows only attract migratory species to mainstream channels that can reach upper watershed and spawning areas. Pulse flows need be at times for migration that provide cool upstream habitat of sustainable duration as well. Cool stream temperatures are especially important for health of salmon runs. 12

Did not find full range description of avian species, both resident and migratory, that historically have found South Bay marsh habitat viable and healthy refugia. Was this in volume I missed? ie Which marshes are attracting and able to sustain special or unique species? What marsh habitat needs to be created? 13

SCVWD Coyote Creek mitigation water-bird pond is not as successful as it was initially. How will super levee interface with wildlife corridor and critical wetlands and marsh acreage which supports endangered species of California Clapper Rail and Salt Marsh Harvest Mouse here, in lower Reach 1 of Coyote Creek?
(Locations of nesting and foraging sites for these endangered species was in earlier comment enclosures). 14

Thank you for bearing with my extended range of comments and can provide referenced COE documents.

Libby Lucas,
174 Yerba Santa Ave.,
Los Altos, CA 94022

ID	Issue Text	Response Text
015_Lucas_3-1	There were errata in the COE South San Francisco Bay Shoreline Project DEIS/DEIR that failed to mention in previous comments, but which believe are of sufficient importance to negatively effect project design. In regards high tides, and three foot wave ride-up in South Bay please reference San Francisco District COE October 1984 San Francisco Bay Tidal Stage vs.Frequency Study for what believe is accurate definitive data. (Explain notation on Project DEIS/DEIR chart that claimed Coyote Creek tide data as N/A not applicable?)	The DEIS/DEIR for this project utilized a similar technical procedure to update flood frequency data. Dynamic components of the water level were considered in the flood frequency analysis, but because of the physical characteristics of the area, (ie shallow depths), and the very low probability of a sustained wind of sufficient magnitude and direction coincident with high tide and surge such wave ride-up is unlikely. The design of the proposed ecotone levee with a 30:1 slope would dampen any significant wave run up should one occur. The Coyote Creek tide gage data was marked as "N/A" since it has only been intermittently operated since the 1980's and does not have sufficient records to develop tidal stage frequency statistics.
015_Lucas_3-2	For sediment transfer data to South Bay, please reference Professor Krone studies as included in COE 1989 Sediment Budget Study for San Francisco Bay. Believe Professor Krone's scientific observations have been born out by rapid marsh restoration soil recruitment experienced in Island Ponds along lower Coyote Creek. One has only to stand on drawbridge to appreciate sediment laden tides that extend to extreme South Bay.	The updated sediment budget and hydrodynamic modeling confirms your observation that marsh has been restored in Island Ponds along lower Coyote Creek. The sediment budget discussion in the technical appendix will be updated for clarity. Krone (1979) analyzed baywide bathymetric change from 1870 to 1950, and noted the slow migration of excess sediment resulting from historic hydraulic mining practices. This migration took place over decadal time scales. This study provided strong evidence of the temporal lag between sediment supply from the delta and sediment availability to the Central and South Bay systems. The analysis by Ogden Beeman & Associates (1992) includes a baywide evaluation of morphologic change from 1955-1990. Of note in this study is the pattern of persistent erosion in South Bay north of Dumbarton Bridge, and persistent deposition in Far South Bay (south of Dumbarton Bridge). This deposition persisted in spite of dramatic subsidence in Far South bay associated with drought and groundwater withdrawal. Some general conclusions are drawn from these studies, and from the results of observation and numerical modeling : Wind wave resuspension tends to mobilize the sediment in the mudflats of South Bay and Far South Bay. Residual circulation induced by these summer winds tends to be toward Far South Bay in the shallows, and towards Central Bay in the deeper tidal channel. Hence, as wind waves resuspends sediment in the shallows, the sediment is driven by residual circulation into Far South Bay. Wave heights in Far South Bay are mitigated by their passage though the gap at Dumbarton Bridge (Smith, 2009). This can create a suspended sediment concentration gradient across the Dumbarton Bridge opening, and drive a net tidal dispersive transport towards Far South Bay. Sediment deposits in Far South Bay until an equilibrium is achieved between sediment supply and wind wave erosion. The excess sediment is then transported towards Central Bay via the main tidal channel, and recirculates through the system. Locally derived sediment from tributaries is a significant fraction of the total available sediment in the system. These sediments are transported together with the sediments derived from the Delta.
015_Lucas_3-3	Project DEIS/DEIR says 'sediment supplies to San Francisco Bay via Sacramento San Joaquin Delta tend to settle in upper bays'. Believe this sufficiently misleading to necessitate DEIS/DEIR replace 2.5 sediment section with accurate COE earlier sediment study data. (E 20) "South Bay has undergone net erosion from 1956 to 1983 rather than deposition '...and following sediment yield to South Bay data I find flawed and lacking in substantiation.	Comment noted. Section 2.5 of the Coastal Engineering and Riverine Hydraulics Summary (now Appendix D1) has been updated in the Final Feasibility Study. The general circulation pattern of sediment within San Francisco Bay has been well described by several researchers (e.g., Ogden Beeman & Associates, 1992). Quantification of these various transport mechanisms is very problematic, but a qualitative description of the dominant processes can be given for general guidance. Sediment supplied to the Bay via the Sacramento/ San Joaquin Delta tends to settle in the upper bays. Some large flow events can carry suspended sediment all the way to Central and South Bay, but most of the annual sediment load is deposited further upstream. Most of this sediment inflow occurs during the winter and spring. In the summer, daily winds tend to resuspend the sediment in the shallows via wind-wave action. The sediment is then slowly transported though the bay system to Central Bay. When the sediment reaches Central Bay, it either resettles in Central Bay, travels through the Golden Gate and out of the system, or is transported into South Bay. Once in South Bay, the sediment is either deposited within the bay, or passes through Dumbarton Bridge into Far South Bay. Wind wave resuspension tends to mobilize the sediment in the mudflats of South Bay and Far South Bay. Residual circulation induced by these summer winds tends to be toward Far South Bay in the shallows, and towards Central Bay in the deeper tidal channel. Hence, as wind waves resuspend sediment in the shallows, the sediment is driven by residual circulation into Far South Bay. In addition, wave heights in Far South Bay are mitigated by their passage though the gap at Dumbarton Bridge (Smith, 2009). This can create a suspended sediment concentration gradient across the Dumbarton Bridge opening, and drive a net tidal dispersive transport towards Far South Bay. Sediment deposits in Far South Bay until an equilibrium is achieved between sediment supply and wind wave erosion. The excess sediment is then transported towards Central Bay via the main tidal channel, and recirculates through the system. Locally derived sediment from tributaries is a significant fraction of the total available sediment in the system. These sediments are transported together with the sediments derived from the Delta.
015_Lucas_3-4	E 23 - Claims wind driven waves are minimal and in 2.6.2 that 'swell' is not significant factor. Please explain statement in view of research by COE 1984 tidal frequency report that finds South Bay ride-up of three feet.	Extensive hydrodynamic computer modeling not available in the early 1980's confirmed the statements in the technical report. Due to the sheltering effect provided by the neighboring salt ponds and levees, seas (wind-generated short-period waves) within the hydrologic study area are minimal. Additional factors such as water depth, obstructions and other physical factors impact waves. The hydrodynamic model used in this technical study is the three-dimensional hydrodynamic model UnTRIM (Casulli and Zanolli, 2002). The UnTRIM Bay-Delta Model (MacWilliams et al., 2007; MacWilliams and Gross, 2007; MacWilliams et al., 2008; MacWilliams et al., 2009) was applied to evaluate water levels in the project area under with project conditions. The UnTRIM Bay-Delta model extends from the Pacific Ocean through all of San Francisco Bay and the entire Sacramento-San Joaquin Delta. A high-resolution model grid of the project site was developed using the most recent available bathymetry. The model also provided information on waves and sediment transport potential which was used in the study. More information on the model and its application may be found towards the end of Appendix D1 (Appendix E in the draft report) in the "South San Francisco Bay Long Wave Modeling Report" section.

1415

015_Lucas_3-5	"The largest remaining flood risk for Alviso comes from tidal floods", is completely unsubstantiated claim and is critical deficiency in Project DEIS/DEIR. Note previously cited data on Guadalupe River channel capacity.	In terms of potential flood volume and extent of flooding that could potentially occur in the community of Alviso, the largest flood risk is from a coastal storm event combined with a failure of one or more outer dikes in the salt pond-dike complex adjacent to Alviso. Appendix D2 of this report, "Tidal Flood Risk Analysis Summary Report" presents in detail this flood risk. We agree that a more holistic discussion of flood risk would be beneficial to the project documentation and will update Appendix D with a summary.
015_Lucas_3-6	Then did find references to flood concerns on neighboring streams of Adobe Creek and Matadero Creek to be unrelated to interface with San Francisco Bay tides in general and City of Palo Alto Flood Basin in particular. The timing of peak stream flows coming out of Santa Cruz Mountain Range and reaching San Francisco Bay in three to four hours does coincide with peak storm event tides driven from Golden Gate by wind and wave down Bay to Palo Alto and Mayfield Slough in three hours, and this DEIS/DEIR should have analyzed.	The draft Integrated Document provided such an analysis. Adobe and Matadero Creeks were investigated in the "without project" condition by developing hydraulic models to define the riverine response to the downstream tidal conditions. The coincidence of tide was investigated and areas of inundation for frequency-based storm events were determined by modeling breakout flows on the floodplain. A coincident frequency analysis was performed to determine the effects of coincidence of the peak tide and peak stream discharge and to determine the downstream boundary water surface levels. The coincident frequency analysis predicted the downstream boundary condition, influenced by tidal stage. The coincident frequency analysis developed a probability for the riverine downstream boundary condition using the method of total probability. Hourly tide probability distribution functions at the river mouths were obtained in the vicinity of Adobe Creek, Permanente Creek, Stevens Creek, Guadalupe Slough, Alviso Slough and Coyote Creek. Additional details of this analysis may be found in Appendix D1, "Riverine Hydraulics", May 2013.
015_Lucas_3-7	Conditions are quite different in Alviso when storm system hits Mount Umunhum, historically, pre-reservoir, it took peak flows 14 hours to reach Montague Expressway, which will not coincide with high intensity storm king tides and waves driven down Bay from Golden Gate in four hours? DEIS/DEIR needs to analyze this. However, if this same storm system holds over either Mount Umunhum or Mount Hamilton, or both, for 24 or 48 hours then a more complex peak riverine flood flow and riverine reflux scenario needs to be evaluated. Has this been done or is it planned to be done?	While the specific investigation was not done for the study, extensive modeling was done on the rivers in the project area which may be found in Appendix D1, "Riverine Hydraulics" , May 2013.
015_Lucas_3-8	In context of global warming and ocean rise associated with the increases in storm intensity and storm duration that is now experienced throughout the world, find for DEIS/SEIR not to include relevant data on Coyote Creek and Guadalupe River flows in assessing South Bay tidal flooding to be a critical deficiency. Or is discussion of El Nino and Pineapple Express storm system scenario in three volume report that I missed?	El Nino Southern Oscillation events do impact both hydrology and bay water levels. The impact on water levels is described in Appendix D2, 3.2.6 and considered in the water level statistics. Specific impacts on fluvial hydrology due to global warming were not studied as there is no definitive downscaled hydrology for global warming scenarios currently available at the small watershed scale at the time the Riverine Hydraulic study was in progress.
015_Lucas_3-9	There is another aspect to evaluation of peak riverine storm flows as they reach high king tide water levels, and that is anticipating where historic break-away points or over-banking of channels will occur. This needs to be investigated if a super levee is constructed around Alviso and Water Treatment Plant industrial parks it will tend to trap inboard flows from exiting to bay marshes and create a deadly deep retention basin in Alviso. Will DEIS/DEIR evaluate such conditions that are likely to occur in intertwined South Bay delta channels?	The effects of riverine flows on the tidally-dominated South San Francisco Bay shoreline were evaluated and are included in Appendix D1 *Coastal Engineering and Riverine Hydraulics Summary*. Additionally, the effects of the proposed coastal flood protection levee on riverine hydraulics were quantified. The extents of the tidal influence along the streams are limited to the lower reaches. The extent of the tidal influence is dependent on the relative magnitudes of the flows in the streams and the tide itself. Frequent, low magnitude flows are much more greatly influenced by tides than less frequent, large magnitude events like the 1% annual chance exceedance (100-year) event. For example, water surface elevations in the Guadalupe River during a 1% event will be the same upstream of Highway 237, 1000 feet from the bay, if the tide elevation is 2 ft as they would be if the tide were to be 11 ft. On the other hand, water surface elevations during a 50% annual chance exceedance (2-year) event will measurably higher (greater than 0.1 ft) as far upstream as Trimble Road (about 4 miles) over the same range of tidal conditions.
015_Lucas_3-10	There is the unique method of interface with South Bay in adjacent stream systems of San Tomas Aquino Creek and Sunnyvale East and Sunnyvale West Channels as they outflow to Guadalupe Slough which needs to be referenced in Shoreline Project report. Here historic series of canals to collect storm water runoff from valley floor agriculture and neighborhoods serves as buffer to protect water quality in salt pond production. As land uses have changed, these canals can now serve as buffer to absorb stream flows and release to bay as high tides recede, with an added aid of inboard wetlands preserves to mute peaks from both stream and bay. This canal complex is bound to be threatened by further extension of proposed super levee but feel efficacy and flexibility of its design that can accommodate, so far, range of uses for industrial park, park lands and water treatment facilities which abut the bay here, as well as sustain prime habitat for wildlife and waterfowl of South Bay needs to be accurately documented. Present use of parallel canals especially suits waterfowl.	San Tomas Aquino Creek and Sunnyvale East and West Channels are outside of the project area in EIA 8, 9 and 10. These streams are hydrologically independent from the proposed Shoreline Study Phase 1 area (EIA11) and will not be affected by the construction of a flood protection levee in the Phase 1 area. The SCVWD is currently undertaking an engineering study to consider coastal flooding induced by tides and storm surge as well as fluvial breakout flows for the remaining areas of Santa Clara County (EIAs 1 to 10). This study will assess potential tidal vulnerability with three future sea level rise scenarios on a risk and uncertainty basis and evaluate cost/benefit for the preferred alternative under 1% tidal flood protection with three sea level rise conditions. The analysis is expected to be complete by the end of December 2016. This analysis will include San Tomas Aquino Creek and Sunnyvale East and West Channels. Habitat restoration goals for these areas will be consistent with the vision created by the South Bay Salt Pond Restoration Project and consistent with USACE ecosystem restoration policy.
015_Lucas_3-11	Note that Northern Channel adjacent to Moffett Field was found by US Navy to host four dozen western pond turtles rather than just five as recorded in DEIS/SEIR.	The Northern Channel is adjacent to Moffett Field which will be addressed in subsequent phases of the Shoreline Study. It is not part of the current project area. While Western pond turtles could occasionally occur in the Shoreline Study Phase 1 area, such appearances are expected to be very infrequent due to the lack of viable populations along the lower reaches of streams such as Coyote Creek or the Guadalupe River as discussed in Section 4.7.
015_Lucas_3-12	Anadromous fish species of steelhead and Chinook salmon need special considerations in any alterations to channels within South Bay marshes. Proposals in regards pilot channels between sloughs and salt ponds must consider that pulse flows only attract migratory species to mainstream channels that can reach upper watershed and spawning areas. Pulse flows need be at times for migration that provide cool upstream habitat of sustainable duration as well. Cool stream temperatures are especially important for health of salmon runs.	The Shoreline Study project is not proposing to manage the flows in and out of ponds but to let natural processes determine flows, shape channels, and restore the marshes. There would be no barriers to salmonid use of the pilot channels or pond habitats. Pulse flows are sometimes used in freshwater streams to facilitate salmonid migration, but this project would not alter stream flows. Water temperatures can be a concern for salmonids in local streams but are not an issue for these fish when they are in San Francisco Bay. As has been done on other restoration project around San Francisco Bay, small pilot channels would be excavated through fringing marsh in order to enhance the tidal connection between the former salt pond and the adjacent sloughs and bay. Monitoring data from the Island Ponds restoration project indicates that these channels as

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		well as the ponds are used by numerous fish species and could be used by migratory salmonids. Creating pilot channels should have a beneficial effect on all fish species by making restored marsh habitat available to them.
015_Lucas_3-13	Did not find full range description of avian species, both resident and migratory, that historically have found South Bay marsh habitat viable and healthy refugia. Was this in volume I missed? ie Which marshes are attracting and able to sustain special or unique species? What marsh habitat needs to be created?	The avian species lists have been reviewed by the Refuge staff and USFWS. Please see App B5 for a full list of species. See Chapter 4.7.1.2.7 that describes existing conditions of bird species. Several references to other documents were made because birds are widely studied, as well as references to the SBSP Restoration Project for additional information.
015_Lucas_3-14	SCVWD Coyote Creek mitigation water-bird pond is not as successful as it was initially. How will super levee interface with wildlife corridor and critical wetlands and marsh acreage which supports endangered species of California Clapper Rail and Salt Marsh Harvest Mouse here, in lower Reach 1 of Coyote Creek? (Locations of nesting and foraging sites for these endangered species was in earlier comment enclosures).	The proposed levee alongside Pond A18 would tie into the Coyote Creek Flood Protection Levee west of Reach 1A in approximately the same location where the existing A18 berm connects. The lower reaches of Coyote Creek would be unchanged by the proposed levee alignments. The proposed levee alongside Pond A18 would be larger than the existing one to protect inland areas from tidal flooding, but it would not be any higher than the existing levee alongside Reach 1A, nor would it change the hydrology in this reach. Therefore the project will not adversely affect wildlife corridors and critical wetlands. Overall the project will provide a beneficial effect by creating continuous marsh habitat between Coyote Creek and Alviso Slough which will support Ridgway's rail and salt marsh harvest mouse.

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STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY EDMUND G. BROWN Jr., Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 4
P.O. BOX 23660
OAKLAND, CA 94623-0660
PHONE (510) 286-6053
FAX (510) 286-5559
TTY 711
www.dot.ca.gov

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February 9, 2015

SCL237207
SCL/237/PM VAR
SCH# 2006012020

Mr. Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

Dear Mr. Martin:

South San Francisco Bay Shoreline Phase I Study – Draft Environmental Impact Report (DEIR)

Thank you for continuing to include the California Department of Transportation (Caltrans) in the environmental review process for the project referenced above. Please refer to Caltrans comment letter, dated October 2, 2014, on the Notice of Preparation (NOP). We have reviewed the DEIR and have the following comments to offer.

Traffic Impact Study (TIS)
As requested in our NOP letter, please provide a TIS for this proposed project. The TIS should include construction traffic impacts and potential traffic impacts to Interstate (I-) 880 and State Route (SR) 237 due to flooding. Also, the time between 9:00 am and 3:00 pm is not completely outside of the weekday a.m. and p.m. peak commute traffic hours for I-880 and SR 237. I-880 and SR 237 starts ramp metering as early as 2:30 pm in the afternoon. Delivery truck and worker trips leaving the construction site during ramp metering hours are likely to impact ramp metering operations causing longer queues on freeway on-ramp. The extended queues may spill back on the local street affecting the local street operation. Caltrans recommends mitigation be included for this impact or trips be strictly limited to outside peak commute hours. 1

Lead Agency
As the lead agency, Santa Clara Valley Water District (SCVWD) is responsible for all project mitigation, including any needed improvements to State highways. The project's financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures. This information should also be presented in the Mitigation Monitoring and Reporting Plan of the environmental document. 2

"Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability"

Mr. Michael Martin/SCVWD
February 9, 2015
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Hydrology & Design

Further hydrological and geological studies, continued monitoring of the development in this area, the maintenance of current levees, and construction of new levees to ensure I-880 and SR 237, particularly within vicinity of the I-880/Dixon Landing Road interchange, remain free of flooding should be conducted in coordination with Caltrans District 4. The studies and the DEIR are incomplete, in that they do not address any effects of the proposed development on the Caltrans or local transportation infrastructures. 3

1. The floodwall and gates across the Artesian Slough would eventually cause a backwater, when the outbound tides are high and flow out of the slough is restricted. As sea level rises, will pumps eventually be used to pump the accumulated flows over the levee? Caltrans recommends the DEIR discuss the potential for backwater and its potential impacts on I-880 and SR 237 and proposed mitigation for those impacts. 4

2. It appears from the DEIR that the preferred levee alignment eventually terminates at the existing levee along the Alviso Slough. Caltrans recommends the DEIR clarify precisely where the preferred levee alignment terminates. 5

3. The DEIR is not clear where the proposed levee actually terminates along the southern border of Pond 18. Caltrans is concerned about possible flooding due to sea level rise within the vicinity of the I-880/Dixon Landing Road interchange, where there is the greatest risk for flooding. Please clarify as to which existing levee that this new levee will conform. 6

4. It appears the SR 237 and I-880 existing bridges are at elevations high enough to accommodate future sea level rise and that none of the bridges are in danger of overtopping due to sea level rise. However, Caltrans recommends the DEIR discuss in detail the inequality of water table pressure caused by the proposed project and the possibility for water seepage around the abutments of the nearby bridge structures. Caltrans District 4 Hydraulics Office will also check the roadway profiles along both these facilities to assess the risk of flooding due to future sea level rise.

   The existing bridges within the project area are: 7

   - Alviso Slough/Guadalupe River Bridge, SCL-237, post mile (PM) 6.406, Bridge Number 37-244 R & L with an overtopping flood elevation of 7.42 meters on North American Datum (NAD)83 vertical datum;

   - Coyote Creek Bridge, SCL-237, PM 8.72, Bridge Number 37-84 R & L with an overtopping flood elevation of 11.6 meters on NAD83 vertical datum; and

   - Penitencia Creek Bridge, SCL-880, PM 10.38, Bridge Number 37-0582 R & L with an overtopping flood elevation of 5.2 meters on NAD83 datum.

Mr. Michael Martin/SCVWD
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Landscape Architecture

1. Seeding and/or planting is proposed for the bayward side of the Flood Risk Management (FRM) Levee, but not for the landward side. Caltrans recommends that planting on the landward side of the levee, as well as the bayward side, be included as a minimization measure in Section 4.12.2.1. Planting the landward side would also help to ensure that invasive weeds do not establish and proliferate on the levee. 8

2. Caltrans recommends the legend for Figure 4.12.2 Photograph of Location Points be modified to include a list of the Alternatives associated with the different levee alignments. 9

3. Figure 4.12-7 Simulated View from Location 2 appears to be titled incorrectly; instead, it appears as though the view should be noted the same as Figures 4.12-5 and 4.12-6. 10

4. Caltrans recommends that a Visual Impact Assessment be prepared as a Technical Document and included as an appendix to the DEIR. 11

Transportation Management Plan

Caltrans recommends a Transportation Management Plan (TMP) or construction TIS may be required of the developer for approval by Caltrans prior to construction. TMPs must be prepared in accordance with California *Manual on Uniform Traffic Control Devices.* Further information is available for download at the following web address:
http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd2012/Part6.pdf. 12

Please ensure that such plans are also prepared in accordance with the transportation management plan requirements of the corresponding jurisdictions. For further TMP assistance, please contact the Office of Traffic Management Plans at (510) 286-4647.

Encroachment Permit

Please be advised that any work or traffic control that encroaches onto the State ROW requires an encroachment permit that is issued by Caltrans. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating State ROW must be submitted to: David Salladay, District Office Chief, Office of Permits, California Department of Transportation, District 4, P.O. Box 23660, Oakland, CA 94623-0660. Traffic-related mitigation measures should be incorporated into the construction plans prior to the encroachment permit process. See this website for more information:
http://www.dot.ca.gov/hq/traffops/developserv/permits. 13

Mr. Michael Martin/SCVWD
February 9, 2015
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Should you have any questions regarding this letter, please contact Brian Brandert of my staff at (510) 286-5505 or brian.brandert@dot.ca.gov.

Sincerely,

PATRICIA MAURICE
Acting District Branch Chief
Local Development - Intergovernmental Review

c: Scott Morgan, State Clearinghouse
Bill DeJager, U.S. Army Corps of Engineers – electronic copy

ID	Issue Text	Response Text
016_Caltrans-1	Traffic Impact Study (TIS): As requested in our NOP letter, please provide a TIS for this proposed project. The TIS should include construction traffic impacts and potential traffic impacts to Interstate (I-) 880 and State Route (SR) 237 due to flooding. Also, the time between 9:00 am and 3:00 pm is not completely outside f the weekday a.m. and p.m. peak commute traffic hours for I-880 and SR 237. I-880 and SR 237 starts ramp metering as early as 2:30 pm in the afternoon. Delivery truck and worker trips leaving the construction site during ramp metering hours are likely to impact ramp metering operations causing longer queues on freeway on-ramp. The extended queues may spill back on the local street affecting the local street operation. Caltrans recommends mitigation be included for this impact or trips be strictly limited to outside peak commute hours.	Appendix A3 (Appendix L in the draft release) includes a preliminary Construction Traffic Access Route Plan that has been developed during this feasibility study stage of the project. A more detailed Transportation Management Plan, if requested by Caltrans, will be prepared prior to construction and if so, will follow the guidance provided by the CA Manual on Uniform Traffic Control Devices. Impact TRN-1 discusses whether the proposed project/action would conflict with an applicable plan or policy establishing measures of effectiveness for the performance of the circulations system. In analyzing this impact, future traffic volumes were estimated for horizon Year 2019, the peak construction year for the levee. The analysis assumes that all truck deliveries would occur outside the weekday AM and PM peak commute traffic hours (i.e., deliveries would occur between 9 am and 3 pm). Indeed, AMM-TRN-1 provides that truck delivery and regular construction work hours would be outside the AM and PM peak traffic hours. The EIR/EIS concludes that with these restrictions, the project impact on traffic would be less than significant. While we do not disagree that there could be delivery truck and work trips leaving the construction site during ramp metering hours which can occur at as early as 2:30 pm and more stringent restrictions on the delivery/construction hours (e.g., limiting delivery/construction to only between 9 am and 2:30 pm) could further reduce the traffic impact on a daily basis, reducing the construction window to a 5.5-hours per day would affect the project schedule and likely extend the number of construction days needed to complete the project (and thus more severe or prolonged environmental impacts). In addition, the currently proposed restriction in construction hours is sufficient in keeping the project traffic impacts at a level of less than significant by avoiding delivery trips and construction during the most heavy traffic hours.
016_Caltrans-2	As the lead agency, Santa Clara Valley Water District (SCVWD) is responsible for all project mitigation, including any needed improvements to State highways. The project's financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures. This information should also be presented in the Mitigation Monitoring and Reporting Plan of the environmental document.	No significant impacts are identified to the state highway system of other transportation related resource, therefore no mitigation is proposed.
016_Caltrans-3	Hydrology & Design: Further hydrological and geological studies, continued monitoring of the development in this area, the maintenance of current levees, and construction of new levees to ensure I-880/Dixon Landing Road interchange, remain free of flooding should be conducted in coordination with Caltrans District 4. The studies and the DEIR are incomplete, in that they do not address any effects of the proposed development on the Caltrans or local transportation infrastructures.	The Shoreline Study is intended to protect against tidal flood event and takes into account sea level rise. The Shoreline Study has comprehensively analyzed riverine or fluvial hydrology, hydraulics and sedimentation. A coincident frequency analysis was performed to determine the effects of coincidence of the peak tide and peak stream discharge and to determine the downstream boundary water surface levels. Without-project coincident frequency analyses assumed that coastal water surface elevations and fluvial flows are independent. Subsequent to the original study, it was shown that flow in the Guadalupe River is well correlated with storm surge, and that tidal residuals of up to two feet may be expected due to the correlation. The coincident frequency analysis predicted the downstream boundary condition, influenced by tidal stage, for the unsteady HEC-RAS models. The maximum tidewater elevation modeled under without-project conditions was 13 feet NAVD 88. Maximum tidewater elevations were increased in the with-project models to 15 feet NAVD 88 to account for storm surge effects. Minimum tidewater elevation in both without and with-project conditions was 2.83 feet NAVD 88. The coincident frequency analysis only applied to the area of the channel where the tide driven water levels and the creek flow meet or commingle. Downstream of the commingling area the water levels are tidally driven and upstream of this area the water levels are dominated by the creek flow. Various analyses can be found in the Integrated Document's Technical Appendix D1. Based on the analysis there will be no effect on proposed development, Caltrans or local transportation infrastructures by this project.
016_Caltrans-4	1. The floodwall and gates across the Artesian Slough would eventually cause a backwater, when the outbound tides are high and flow out of the slough is restricted. As sea level rises, will pumps eventually be used to pump the accumulated flows over the levee? Caltrans recommends the DEIR discuss the potential for backwater and its potential impacts on I-880 and SR 237 and proposed mitigation for those impacts.	The San Jose Regional Wastewater Facility is anticipating the need to pump effluent in the future as a response to sea level rise with or without the proposed project. The project team is continuing to analyze the configuration and operations of the proposed closure on Artesian Slough to avoid the need to install pumping sooner than would otherwise occur in a "without-project" condition. Backwater effects occurring during a higher water event (~ hours) are very unlikely to induce substantial flooding in the project area and not beyond to I-880 and SR237.
016_Caltrans-5	It appears from the DEIR that the preferred levee alignment eventually terminates at the existing levee along the Alviso Slough. Caltrans recommends the DEIR clarify precisely where the preferred levee alignment terminates.	The proposed levee alignment terminates, and connects to, the existing area of high ground near the former Alviso Marina. This area is sufficiently high and wide to provide a continuous line of flood protection between the downstream extent of the existing Guadalupe River FRM features and the proposed levee. A new figure, Figure 3.10 1. Recommended Plan Flood Risk Management Levee Connections to Existing Flood Risk Management Levees, was added to Section 3.10 to show where levee facilities in the project area exist today and where the tie-ins for the proposed levee will be.
016_Caltrans-6	3. The DEIR is not clear where the proposed levee actually terminates along the southern border of Pond 18. Caltrans is concerned about possible flooding due to sea level rise within the vicinity of the I-880/Dixon Landing Road interchange, where there is the greatest risk for flooding. Please clarify as to which existing levee that this new levee will conform.	The proposed levee alignment terminates, and connects to, the existing Coyote Creek Bypass FRM levee on the left bank of Coyote Creek. The noted area of concern is located on the opposite bank of Coyote Creek, outside of the Shoreline Phase I project. A new figure, Figure 3.10 1. Recommended Plan Flood Risk Management Levee Connections to Existing Flood Risk Management Levees, was added to Section 3.10 to show where levee facilities in the project area exist today and where the tie-ins for the proposed levee will be.

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016_Caltrans-7	4. It appears the SR 237 and I-880 existing bridges are at elevations high enough to accommodate future sea level rise and that none of the bridges are in danger of overtopping due to sea level rise. However, Caltrans recommends the DEIR discuss in detail the inequality of water table pressure caused by the proposed project and the possibility for water seepage around the abutments of the nearby bridge structures. Caltrans District 4 Hydraulics Office will also check the roadway profiles along both these facilities to assess the risk of flooding due to future sea level rise. The existing bridges within the project area are: - Alviso Slough/Guadalupe River Bridge, SCL-237, post mile (PM) 6.406, Bridge Number 37-244 R & L with an overtopping flood elevation of 7.42 meters on North American Datum (NAD) 83 vertical datum; - Coyote Creek Bridge, SCL-237, PM 8.72, Bridge Number 37-84 R & L with an overtopping flood elevation of 11.6 meters on NAD83 vertical datum; and - Penitencia Creek Bridge, SCL-880, PM 10.38, Bridge Number 37-0582 R & L with an overtopping flood elevation of 5.2 meters on NAD83 datum.	The proposed project will not induce increases in the water table surface, or induce piezometric head, beyond the immediate footprint of construction. Fill areas to construct project levees and habitat fills will induce localized piezometric heads that will dissipate with time. Dissipation time will vary from very short (~weeks to months) in areas of thin fills or where wick drains are implemented to long (years) in areas of thick (>10 ft) habitat fills. Regardless, these localized piezometric changes will not induce measureable variations in the water table/pressure beyond the footprint of new fills.
016_Caltrans-8	Landscape Architecture 1. Seeding and/or planting is proposed for the bayward side of the Flood Risk Management (FRM) Levee, but not for the landward side. Caltrans recommends that planting on the landward side of the levee, as well as the bayward side, be included as a minimization measure in Section 4.12.2.1. Planting the landward side would also help to ensure that invasive weeds do not establish and proliferate on the levee.	Under AMM-AES-1 both the bayward side of the levee/ectotone and landward side of the levee will be hydroseeded with a blend of native upland grasses.
016_Caltrans-9	Landscape Architecture2. Caltrans recommends the legend for Figure 4.12.2 Photograph of Location Points be modified to include a list of the Alternatives associated with the different levee alignments.	Thank you for your comment. Per your recommendation, the names of the alternatives corresponding to each alignment shown have been added to the legend in Figure 4.12.3 (previously 4.12.2 in draft document).
016_Caltrans-10	Landscape Architecture3. Figure 4.12-7 Simulated View from Location 2 appears to be titled incorrectly; instead, it appears as though the view should be noted the same as Figures 4.12-5 and 4.12-6.	Thank you for alerting us to the incorrect title for Figure 4.12-8 (previously 4.12-7 in draft report). The title has been corrected and now reads: Simulated View from Location 2 - View North from Elizabeth Street and Gold Street of Alviso South Levee Alignment (Alternative 5).
016_Caltrans-11	Landscape Architecture 4. Caltrans recommends that a Visual Impact Assessment be prepared as a Technical Document and included as an appendix to the DEIR.	Aesthetic effects from the proposed project and alternatives have been adequately analyzed throughout Chapter 4 (4.1.2) in the Integrated Document. There is no need to prepare a separate Visual Impact Assessment at this time.
016_Caltrans-12	Transportation Management PlanCaltrans recommends a Transportation Management Plan (TMP) or construction TIS may be required of the developer for approval by Caltrans prior to construction. TMPs must be prepared in accordance with California Manual on Uniform Traffic Control Devices. Further information is available for download at the following web address: htt;://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd2012/Part6.pdf. Please ensure that such plans are also prepared in accordance with the transportation management plan requirements of the corresponding jurisdictions. For further TMP assistance, please contact the Office of Traffic Management Plans at (510) 286-4647.	Thank you for your comment. Appendix A3 (Appendix L in the draft release) includes a preliminary Construction Traffic Access Route Plan that has been developed during this feasibility study stage of the project. A more detailed Transportation Management Plan will be prepared prior to construction and if so, will follow the guidance provided by the CA Manual on Uniform Traffic Control Devices.
016_Caltrans-13	Encroachment Permit: Please be advised that any work or traffic control that encroaches onto the State ROW requires an encroachment permit that is issued by Caltrans. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating State ROW must be submitted to: David Salladay, District Office Chief, Office of Permits, California Department of Transportation, District 4, P.O. Box 23660, Oakland, CA 94623-0660. Traffic-related mitigation measures should be incorporated into the construction plans prior to the encroachment permit process. See this website for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits.	Thank you for your comment. It is understood that any work or traffic control that could encroach onto the State ROW will require a Caltrans encroachment permit and an application will be submitted, if necessary, following design planning. The traffic-related avoidance and minimization measures from the Integrated Document will be incorporated into the construction plans.

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017_SCPR

From: Fourt, Will [mailto:William.Fourt@PRK.SCCGOV.ORG]
Sent: Monday, February 23, 2015 9:11 AM
To: Michael Martin
Cc: Brosseau, Kimberly; Yeung, Ivana
Subject: County Parks comments on South Bay Shoreline Study

Hi Michael
Please see attached comment letter from County Parks regarding the South Bay Shoreline Study Draft Integrated Document.

Thank you
Will

Will Fourt, Park Planner III
Santa Clara County Parks | 298 Garden Hill Drive | Los Gatos, CA 95032
william.fourt@prk.sccgov.org | 408.355.2228 | http://www.parkhere.org

County of Santa Clara
Parks and Recreation Department
298 Garden Hill Drive
Los Gatos, California 95032-7669
(408) 355-2200 FAX 355-2290
Reservations (408) 355-2201
www.parkhere.org

February 23, 2015

Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA

Subject: Notice of availability of Draft Integrated Document

Project Title: Shoreline Phase I Study Draft Integrated Interim Feasibility Study and Environmental Impact Statement/Report

Dear Mr. Martin,

The County of Santa Clara Parks and Recreation Department has reviewed the Draft Environmental Impact Report and Draft Environmental Impact Statement for the Shoreline Phase I Study Draft Integrated Interim Feasibility Study and offers the following comments to be considered:

Section 4.11.1.1.3
In the discussion of the relevant sections of the Santa Clara County General Plan, please add reference to the *Santa Clara County Countywide Trails Master Plan Update* ("Countywide Trails Master Plan"). This document is part of the County General Plan that was adopted by the County of Santa Clara's Board of Supervisors in 1995 and is incorporated as part of the Parks and Recreation Element of the General Plan.

The Countywide Trails Master Plan identifies three regional trail routes in the project area: 1
- The San Francisco Bay Trail (R4)
- The Guadalupe Trail (S3)
- The Coyote Creek Trail (S5)

The proposed continuous Bay Trail alignment included in the project description, from Alviso Marina County Park to Coyote Creek, is consistent with the intent of the Countywide Trails Master Plan.

Thank you for your consideration.

Sincerely,

Will Fourt
Park Planner III

CC: Ivana Yeung, County Roads & Airports Department

ID	Issue Text	Response Text
017_SCPR-1	Section 4.11.1.1.3 In the discussion of the relevant sections of the Santa Clara County General Plan, please add reference to the Santa Clara County Countywide Trails Master Plan Update ("Countywide Trails Master Plan"). This document is part of the County General Plan that was adopted by the County of Santa Clara's Board of Supervisors in 1995 and is incorporated as part of the Parks and Recreation Element of the General Plan. The Countywide Trails Master Plan identifies three regional trail routes in the project area: • The San Francisco Bay Trail (R4) • The Guadalupe Trail (S3) • The Coyote Creek Trail (S5) The proposed continuous Bay Trail alignment included in the project description, from Alviso Marina County Park to Coyote Creek, is consistent with the intent of the Countywide Trails Master Plan.	The suggested revisions to Section 4.11.1.1.3 have been made and the following paragraph has been added to the discussion of the Santa Clara County General Plan: In addition, the Santa Clara County Countywide Trails Master Plan Update ("Countywide Trails Master Plan") is also part of the County General Plan and is incorporated as part of the Parks and Recreation Element of the General Plan. The Countywide Trails Master Plan identifies three regional trail routes in the project area: •The San Francisco Bay Trail (R4); • The Guadalupe Trail (S3); • The Coyote Creek Trail (S5).

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Edwards, Dawn

From: JLucas1099@aol.com
Sent: Sunday, February 22, 2015 1:35 PM
To: Shoreline Environment SPN
Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase 1 Project - cont. comment (4)

Bill DeJager
US Army Corps of Engineers
1455 Market Street
San Francisco, California 94103

February 22, 2015

RE: South San Francisco Bay Shoreline Phase 1 Project

Dear Bill DeJager,

In substantiation of my three previous comment submittals concerning South San Francisco Bay Shoreline Phase 1 Project, I would appreciate further indulgence in consideration of salient factors in background data.

As evident in South Bay Salt Pond Restoration Project's Figure 3.6-7 of Salt Marsh Harvest Mouse Habitat Capture Locations, and Barriers in Movement, the proposed super levee alignment will eliminate all SMHM refugia and heart of continuity of wildlife corridor (inboard of Pond A 18 and bordering Treatment Plant ponds) that connects New Chicago Marsh SMHM colony to SCVWD Coyote Creek SMHM mitigation area, and to South Bay, eastern shore populations around Newby Island.

Corridor connectivity is imperative for healthy gene pool sustainability of SMHM populations. If COE seeks to comply with NEPA's 'avoidance of impact' criteria then Phase 1 Project's alternatives analysis should include alternative alignment of super levee that would not have a fatal impact on endangered species critical habitat. 1

Both California Coastal Conservancy and Santa Clara Valley Water District have responsibility to ensure that SMHM critical habitat is not degraded or lost and that integrity of SMHM mitigation acreage is fully retained.

I say 'fatal impact' because do not find that super levee can supply sufficient cover to protect SMHM corridor continuity from predation, or provide refugia in times of high water. Height and bulk of levee will leave it arid and barren in rainless California climate and underlying saltwater is too low to sustain salt marsh vegetation.

As alternatives analysis for super levee alignment do reiterate suggestion of an Alviso to Fremont railroad line super levee, with levee best placed outboard, to west, of rail right of way, and with river tide gates on Coyote Creek and Guadalupe River only to be implemented in high intensity storm events. (similar to River Thames). 2

Then in earlier submittal I cited example of Napa River COE flood project design that coordinates river storm flows with high Bay levels using 1200 acres of floodplain and marsh plain as storage during a 100 year flood. Napa River peak flood flows on February 18, 1986 were 37,100 cfs (near double previous high of 20,900 cfs), from a 218 square mile watershed.

This flow level could be considered comparable to combined flows from Guadalupe River and Coyote Creek, although their watershed area is greater at 242 square miles and mountains of Hamilton and Umunhum are closer to outfall in San Francisco Bay. However, due to subsidence in San Jose and Alviso area, believe river reflux of Coyote and Guadalupe is greater flood hazard and the larger floodplain and marsh plain is indicated. 3

The South Bay Salt Ponds inboard of the railroad line located super levee could provide acreage of 1600 acres for sufficient floodplain and marsh plain storage to mute flood flows from high intensity storm systems.

Though earlier 1989 COE shoreline study claimed there was no need to incorporate fluvial considerations into levee design, I would submit that subsequent thirty year interval since design of Coyote and Guadalupe River flood projects, plus at least ten years for implementation of proposed super levee design, in addition to global warming impacts that appear to result in unprecedented weather variability and intense storm systems would dictate otherwise. 4

Afraid find I must interrupt this transmittal at this time but will continue comments tomorrow. So sorry!
Thank you for your continuing kind considerations of these concerns.

Libby Lucas
174 Yerba Santa Ave.
Los Altos, CA 94022

ID	Issue Text	Response Text
018_Lucas_4-1	As evident in South Bay Salt Pond Restoration Project's Figure 3.6-7 of Salt Marsh Harvest Mouse Habitat Capture Locations, and Barriers in Movement, the proposed super levee alignment will eliminate all SMHM refugia and heart of continuity of wildlife corridor (inboard of Pond A 18 and bordering Treatment Plant ponds) that connects New Chicago Marsh SMHM colony to SCVWD Coyote Creek SMHM mitigation area, and to South Bay, eastern shore populations around Newby Island. Corridor connectivity is imperative for healthy gene pool sustainability of SMHM populations. If COE seeks to comply with NEPA's 'avoidance of impact' criteria then Phase 1 Project's alternatives analysis should include alternative alignment of super levee that would not have a fatal impact on endangered species critical habitat. Both California Coastal Conservancy and Santa Clara Valley Water District have responsibility to ensure that SMHM critical habitat is not degraded or lost and that integrity of SMHM mitigation acreage is fully retained. I say 'fatal impact' because do not find that super levee can supply sufficient cover to protect SMHM corridor continuity from predation, or provide refugia in times of high water. Height and bulk of levee will leave it arid and barren in rainless California climate and underlying saltwater is too low to sustain salt marsh vegetation.	The Shoreline project shares the commenter's concern over impacts to the SMHM. One of the key species to benefit from the construction of ecotone (the project includes broad upland transition zones adjacent to the engineered levee) is the SMHM. The ecotone will provide sufficient cover and habitat to protect the SMHM during high tides and storms and allow for migration along the shoreline. When completed, the Shoreline project will create nearly 3,000 acres of SMHM habitat. These acres, combined with the already-restored Pond A17, will result in a continuous band of salt marsh habitat from Alviso Slough Ponds A9-15 through A17 to Coyote Creek's fringing marshes and Pond A18. The only disruption would be the existing Union Pacific Railroad line. This ultimate vision will provide much greater habitat connectivity, and the construction of the ecotone and the phased approach to restoration will help to minimize the direct effects of the initial restoration actions. In terms of specific connections between the New Chicago Marsh and Coyote Creek mitigation area (Reach 1A) populations, the Preferred Alternative should greatly improve SMHM migration opportunities over existing conditions by restoring large tracts of tidal marsh habitat in Pond A18, lowering levees, and creating ecotone (transition zones).
018_Lucas_4-2	As alternatives analysis for super levee alignment do reiterate suggestion of an Alviso to Fremont railroad line super levee, with levee best placed outboard, to west, of rail right of way, and with river tide gates on Coyote Creek and Guadalupe River only to be implemented in high intensity storm events. (similar to River Thames).	Early in the Shoreline Study planning process, options similar to the commenter's suggestion were considered such as hardening outboard levees and installing tide gates strategic locations to hold back tidal flooding. This would convert the former south bay salt ponds to essentially flood detention basins. Such basins can successfully be managed as either tidal and/or riparian flood flows (depending on how they are designed) and create habitat, but they result in highly-altered environments with the need for intensive, long-term management. Consistent with the vision created by the South Bay Salt Pond Restoration Project and consistent with Corps of Engineers ecosystem restoration policy, the Shoreline Study has tried to incorporate more natural, less managed solutions into the project, as much as possible, in order to reduce environmental impacts, costs, and long-term complications from highly-managed systems. Using the railroad line to create tidal basins would also conflict with the Shoreline Study's identified habitat goals of tidal restoration through an adaptive management process. Tidal basins and tide gates usually preclude full tidal restoration. While these muted tidal systems can provide valuable habitat, they do not have all of the geomorphic and ecological functions that existed historically when the South Bay was dominated by unconstrained tidal marshes. Furthermore, the creation of tidal detention basins would conflict with the habitat goals of the South Bay Salt Pond Restoration Project and other regional plans, such as the Baylands Ecosystem Habitat Goals and the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. A central goal of these plans is to create largely unbroken swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations. For these reasons, these types of flood protection solutions were not carried forward for further analysis.
018_Lucas_4-3	Then in earlier submittal I cited example of Napa River COE flood project design that coordinates river storm flows with high Bay levels using 1200 acres of floodplain and marsh plain as storage during a 100 year flood. Napa River peak flood flows on February 18, 1986 were 37,100 cfs (near double previous high of 20,900 cfs), from a 218 square mile watershed. This flow level could be considered comparable to combined flows from Guadalupe River and Coyote Creek, although their watershed area is greater at 242 square miles and mountains of Hamilton and Umunhum are closer to outfall in San Francisco Bay. However, due to subsidence in San Jose and Alviso area, believe river reflux of Coyote and Guadalupe is greater flood hazard and the larger floodplain and marsh plain is indicated. The South Bay Salt Ponds inboard of the railroad line located super levee could provide acreage of 1600 acres for sufficient floodplain and marsh plain storage to mute flood flows from high intensity storm systems.	The effects of riverine flows on the tidally-dominated South San Francisco Bay shoreline were evaluated in Appendix D where the effects of the proposed coastal flood protection levee on riverine hydraulics were quantified. The extents of the tidal influence along the streams are limited to the lower reaches. The extent of the tidal influence is dependent on the relative magnitudes of the flows in the streams and the tide itself. Frequent, low magnitude flows are much more greatly influenced by tides than less frequent, large magnitude events like the 1% annual chance exceedance (100-year) event. For example, water surface elevations in the Guadalupe River during a 1% event will be the same upstream of Highway 237, 1000 feet from the bay, if the tide elevation is 2 ft as they would be if the tide were to be 11 ft. On the other hand, water surface elevations during a 50% annual chance exceedance (2-year) event will measurably higher (greater than 0.1 ft) as far upstream as Trimble Road (about 4 miles) over the same range of tidal conditions.
018_Lucas_4-4	Though earlier 1989 COE shoreline study claimed there was no need to incorporate fluvial considerations into levee design, I would submit that subsequent thirty year interval since design of Coyote and Guadalupe River flood projects, plus at least ten years for implementation of proposed super levee design, in addition to global warming impacts that appear to result in unprecedented weather variability and intense storm systems would dictate otherwise.	Fluvial Flood Frequency statistics and hydraulic analysis was updated for the current study from the 1989 study, and the current design level has incorporated these fluvial considerations. The proposed tidal levee ties into the riverine levees at elevation 16 feet NAVD88, creating a closed system which provided flood risk reduction from both fluvial and tidal flood, including coincident events.

1430

From: Jacobs, Lynn <LJ0@pge.com>
Sent: Monday, February 23, 2015 2:57 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] PG&E's Comments on the South San Francisco Bay Shoreline Study Phase 1 Project Draft Interim Feasibility Study and Draft Environmental Impact Statement/Environmental Impact Report
Attachments: Comments_SCC_Shoreline_Study(2).pdf

To whom it may concern,

Please find attached PG&E's comments on the South San Francisco Bay Shoreline Study Phase 1 Project Draft Interim Feasibility Study and Draft Environmental Impact Statement/Environmental Impact Report.

Thank you
Lynn Jacobs on behalf of Diane Ross-Leech

"Our lives begin to end the day we become silent about things that matter."

L. Lynn Jacobs (Jihad)
Environmental Policy – Diane Ross-Leech
77 Beale Street - B28P
San Francisco, CA 94105
415 973 4453

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Pacific Gas and Electric Company™

Diane Ross-Leech
Director
Environmental Policy

77 Beale Street – B28P
San Francisco, CA 94105

(415) 973-5696
Internal: 223-5696
Fax: 415-973-9052
Email: DPR5@pge.com

February 23, 2015

VIA E-MAIL

Thomas R. Kendall
Chief, Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers San Francisco District
1455 Market St. San Francisco, CA 94103
ATTN: William DeJager

Re: PG&E's Comments on the South San Francisco Bay Shoreline Study Phase 1 Project Draft Interim Feasibility Study and Draft Environmental Impact Statement/Environmental Impact Report

Dear Mr. Kendall,

Pacific Gas and Electric Company (PG&E) appreciates the opportunity to provide comments on the South San Francisco Bay Shoreline Study Phase 1 Project Draft Interim Feasibility Study and Draft Environmental Impact Statement/Environmental Impact Report (Report). We commend the joint efforts of the U.S. Army Corps of Engineers, Santa Clara Valley Water District, and State Coastal Conservancy to identify and recommend flood protection and ecosystem restoration projects in the South San Francisco Bay. PG&E supports consideration of projects that will reduce flood risk, restore ecosystems, and provide benefits to the public. However, PG&E wants to ensure all impacts to existing infrastructure, continued operation, maintenance and access are adequately addressed within all proposed projects and activities.

I. INTRODUCTION

PG&E provides gas and electric service to millions of Californians from a reliable and sustainable energy portfolio. PG&E's portfolio is composed of a diverse mix of technologies including renewable energy and other non-greenhouse gas (GHG) emitting resources. PG&E is actively managing its impact on the environment and works constructively to advance policies that put our state and the country on a cost-effective path toward a low-carbon economy. Climate change adaptation, in particular sea level rise, is an emerging issue that has elicited much engagement from agencies at the federal, state, and local levels. PG&E recognizes the importance of this issue and is supporting local and regional climate adaptation planning efforts, including the San Mateo County Shoreline Vulnerability Assessment and the Silicon Valley 2.0 Climate Adaptation initiative as well as many other efforts. In support of these efforts, PG&E created a cross-departmental climate change operational impact team to understand how PG&E assets and infrastructure may be impacted by future conditions and to facilitate development of appropriate adaptation strategies based on risk.

II. REPORT COMMENTS

Section 4.16 Public Utilities and Service Systems (4-585)
This section lists anticipated project impacts to a variety of utilities including electric. Covered impacts include utility integrity and relocation, electric line clearances, maintenance access, and customer outages. 1 PG&E's ability to effectively mitigate impacts will depend on both financial resources as well as an expeditious permit process to ensure timely utility relocation and decommissioning in the project area.

Table S-8 - Final Array of Alternatives: Features and Costs (S-39)
Cost of electric utility relocation is estimated in Table S-8 - Final Array of Alternatives: Features and Costs with utility relocations listed in alternatives 2 thru 5 at $397,000. This figure appears to be too low and needs to be verified 2

Section 4.16.1.2.2 Utilities (4-589)
PG&E transmission utilities are mentioned. There is no discussion about possible electric distribution utilities, electric substations, or gas transmission and distribution lines. Presence of these utilities in the project area should be verified and if impacts are anticipated, strategies to mitigate those impacts need to be addressed. 3

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Section 4.16.2.2 Methodology for Impact Analysis and Significance Thresholds (4-596)
Relative to the citations below, long-term project impacts resulting in utility access restrictions (such as seasonal limitations, equipment limitations) need to be better understood and clarified. PG&E has valid rights of way and easements that allow us to access our facilities for the safe and reliable operation and serve our customers. Any changes to our access need to involve further discussions with PG&E representatives.

> Detail under Impact UTL-4 states, "When power transmission line maintenance or repair is required, the PG&E overhead lines and towers that are located in Pond A18 and across Artesian Slough are accessed using heavy equipment along or near the existing pond berms. Restoration of tidal habitat in Pond A18 could affect access to the lines and towers due to physical and biological changes in the restored area. Although heavy equipment access points would be largely unaffected, access to interior locations would be reduced by tidal inundation and might require alternative methods to reach the lines and towers. Where the method of access is adversely affected by breached ponds, alternative equivalent access would be provided by the project proponents as part of the project." 4
>
> "In addition to these physical changes, restoration of salt marsh in Pond A18 would reduce access to PG&E towers if maintenance activities would have the potential to result in disturbance, injury, or mortality of Endangered or Threatened wildlife species. Alternate access by PG&E to accommodate maintenance activities could include helicopter access to perform insulator washing; boat and foot patrols to manage problems associated with bird roosting and nesting materials; repairs due to bird electrocutions or collisions; and urgent foundation and structural repairs due to changing tidal flows. The presence of Threatened or Endangered species would restrict access during certain periods or require alternative methods of access, but the City of San José, which owns Pond A18, would continue to allow access for emergency repairs."

Habitat Conservation Plan (4-596)
On page 4-596, the Report includes as mitigation a Habitat Conservation Plan (HCP) that PG&E is developing, subject to approval by U.S. Fish and Wildlife Service (USFWS), for operation and maintenance activities within the nine Bay Area counties. This is not proper mitigation for Project impacts. First, PG&E is not a Project proponent- mitigation must be imposed on the Project proponents to mitigate the impacts of the Project they are proposing. Second, the HCP in question has not been 5

completed, and no permit decisions have been made by USFWS. There is no certainty regarding when - or if - that document will be approved. Finally, the HCP is intended to address routine maintenance and repair work under existing conditions, not under the major physical changes that will be caused by the study's implementation.

For purposes of this DEIS/EIR, we must set aside the issue over who will pay the costs of repairing and protecting these electrical facilities and access-ways. Regardless of who will pay these costs, we need an adequate DEIS/EIR that fully analyzes all foreseeable impacts of the project now - and mitigates them now to the fullest extent feasible - to prevent the need for costly subsequent environmental reviews that will otherwise be necessary. PG&E anticipates that it will need to modify and strengthen tower foundations to protect against rising water levels, raise conductors to maintain safe ground clearances, rebuild boardwalks, and even relocate facilities within the ponds to allow access. Permits will be required for this initial work, as well as additional permits to perform future maintenance in newly-created sensitive species habitats.

6

The EIS/EIR for this Project should provide the environmental review for these directly foreseeable actions so that the cost of piecemeal future reviews and associated delays are avoided. To that end, not only should the DEIS/EIR adequately address the direct and indirect Project impacts to PG&E's transmission facilities and ensure that the existing access is preserved, but the lead agencies should also agree on a permitting strategy for the foreseeable maintenance and repair work that will be necessary going forward, including the issuance of incidental take permits for state and federally listed species. PG&E is not a Project proponent, yet the vaguely defined "mitigation" cited by the DEIS/EIR to reduce impacts on electrical facilities is not imposed on Project proponents, but on PG&E- a third party impacted by the Project. The EIS/EIR then relies on PG&E's future "mitigation" to reduce impacts to less than significant levels. Neither the California Environmental Quality Act (CEQA) nor the National Environmental Protection Act (NEPA) permit lead agencies to impose mitigation on third parties or assess impacts in this way.

Ongoing Impacts

Ongoing impacts to utilities should also be considered after project completion. For example, adding habitat or transitional habitat could impact utility access which will require new permitting or agency notifications. The project should address this need through simplified programmatic approaches that allow utility operation maintenance, inspection, and repairs to be conducted efficiently and expeditiously. 7

III. CONCLUSION

PG&E greatly appreciates your consideration of our comments. We are interested in ensuring the work of the Study is done in unison with PG&E's facility operation maintenance and access needs. PG&E reiterates support of the Study and looks forward to early and continued engagement during the Study's ongoing process. Please feel free to contact me at 415-973-5696 or by e-mail at DPR5@pge.com to discuss any questions you have related to our recommendations proposed for your consideration herein this letter.

Respectfully submitted,

Diane Ross-Leech
Director, Environmental Policy - Safety, Health and Environment
Pacific Gas and Electric Company

ID	Issue Text	Response Text
019_PGE-1	Section 4.16 Public Utilities and Service Systems (4-585)This section lists anticipated project impacts to a variety of utilities including electric. Covered impacts include utility integrity and relocation, electric line clearances, maintenance access, and customer outages.PG&E's ability to effectively mitigate impacts will depend on both financial resources as well as an expeditious permit process to ensure timely utility relocation and decommissioning in the project area.	Your comment is acknowledged.
019_PGE-2	Cost of electric utility relocation is estimated in Table S-8 - Final Array of Alternatives: Features and Costs with utility relocations listed in alternatives 2 thru 5 at $397,000. This figure appears to be too low and needs to be verified.	Costs were determined during the early design estimates and verified during more recent costing reviews. As more detailed plans are developed in final design these costs will be reviewed and updated by the USACE.
019_PGE-3	Section 4.16.1.2.2 Utilities (4-589)PG&E transmission utilities are mentioned. There is no discussion about possible electric distribution utilities, electric substations, or gas transmission and distribution lines. Presence of these utilities in the project area should be verified and if impacts are anticipated, strategies to mitigate those impacts need to be addressed.	A search of the study area for utility features with the potential for impact was made early in the planning process by using the following resources: the Water Pollution Control Plant GIS database from City of San Jose; the City of San Jose Utility database (https://cpms.sanjoseca.gov/emap/); and available aerial and street level photography used to identify approximate locations of utilities not identified by either of the first two databases. No distribution utilities, electric substations, or gas transmission/distribution lines were identified during the record search.
019_PGE-4	Section 4.16.2.2 Methodology for Impact Analysis and Significance Thresholds (4-596) Relative to the citations below, long-term project impacts resulting in utility access restrictions (such as seasonal limitations, equipment limitations) need to be better understood and clarified. PG&E has valid rights of way and easements that allow us to access our facilities for the safe and reliable operation and serve our customers. Any changes to our access need to involve further discussions with PG&E representatives. Detail under Impact UTL-4 states, "When power transmission line maintenance or repair is required, the PG&E overhead lines and towers that are located in Pond A18 and across Artesian Slough are accessed using heavy equipment along or near the existing pond berms. Restoration of tidal habitat in Pond A18 could affect access to the lines and towers due to physical and biological changes in the restored area. Although heavy equipment access points would be largely unaffected, access to interior locations would be reduced by tidal inundation and might require alternative methods to reach the lines and towers. Where the method of access is adversely affected by breached ponds, alternative equivalent access would be provided by the project proponents as part of the project." "In addition to these physical changes, restoration of salt marsh in Pond A18 would reduce access to PG&E towers if maintenance activities would have the potential to result in disturbance, injury, or mortality of Endangered or Threatened wildlife species. Alternate access by PG&E to accommodate maintenance activities could include helicopter access to perform insulator washing; boat and foot patrols to manage problems associated with bird roosting and nesting materials; repairs due to bird electrocutions or collisions; and urgent foundation and structural repairs due to changing tidal flows. The presence of Threatened or Endangered species would restrict access during certain periods or require alternative methods of access, but the City of San José, which owns Pond A18, would continue to allow access for emergency repairs."	The analysis for UTL-4 has been updated to describe in more detail the potential impacts of the project on PG&E's ability to access its facilities. The Shoreline team will continue to consult and work with PG&E, as appropriate, to address PG&E's concerns. The response below to Comment 019-PGE-06 also addresses this comment.
019_PGE-5	Habitat Conservation Plan (4-596)On page 4-596, the Report includes as mitigation a Habitat Conservation Plan (HCP) that PG&E is developing, subject to approval by U.S. Fish and Wildlife Service (USFWS), for operation and maintenance activities within the nine Bay Area counties. This is not proper mitigation for Project impacts. First, PG&E is not a Project proponent- mitigation must be imposed on the Project proponents to mitigate the impacts of the Project they are proposing. Second, the HCP in question has not been completed, and no permit decisions have been made by USFWS. There is no certainty regarding when -or if - that document will be approved. Finally, the HCP is intended to address routine maintenance and repair work under existing conditions, not under the major physical changes that will be caused by the study's implementation.	In response discussion of the PG&E Habitat Conservation Plan (HCP) which is currently being developed with USFWS has been removed from the impacts assessment text. The draft Feasibility Report mentioned PG&E's HCP as a possible avenue for PG&E to obtain endangered species related permit coverage. As the response to Comment 019-PGE-06 indicates, the text has been revised to clarify that the Shoreline team will coordinate with PG&E to obtain necessary permits for identified improvements as well as ongoing operation and maintenance activities.

1435

019_PGE-6	For purposes of this DEIS/EIR, we must set aside the issue over who will pay the costs of repairing and protecting these electrical facilities and access-ways. Regardless of who will pay these costs, we need an adequate DEIS/EIR that fully analyzes all foreseeable impacts of the project now - and mitigates them now to the fullest extent feasible - to prevent the need for costly subsequent environmental reviews that will otherwise be necessary. PG&E anticipates that it will need to modify and strengthen tower foundations to protect against rising water levels, raise conductors to maintain safe ground clearances, rebuild boardwalks, and even relocate facilities within the ponds to allow access. Permits will be required for this initial work, as well as additional permits to perform future maintenance in newly-created sensitive species habitats. The EIS/EIR for this Project should provide the environmental review for these directly foreseeable actions so that the cost of piecemeal future reviews and associated delays are avoided. To that end, not only should the DEIS/EIR adequately address the direct and indirect Project impacts to PG&E's transmission facilities and ensure that the existing access is preserved, but the lead agencies should also agree on a permitting strategy for the foreseeable maintenance and repair work that will be necessary going forward, including the issuance of incidental take permits for state and federally listed species. PG&E is not a Project proponent, yet the vaguely defined "mitigation" cited by the DEIS/EIR to reduce impacts on electrical facilities is not imposed on Project proponents, but on PG&E- a third party impacted by the Project. The EIS/EIR then relies on PG&E's future "mitigation" to reduce impacts to less than significant levels. Neither the California Environmental Quality Act (CEQA) nor the National Environmental Protection Act (NEPA) permit lead agencies to impose mitigation on third parties or assess impacts in this way.	The Draft EIS/EIR noted that the proposed project would result in physical changes to Pond A18 that would reduce access to PG&E towers and that where the method of access is adversely affected by breached ponds, alternative equivalent access would be provided as part of the project. The project description has been modified to clarify the specific upgrades to PG&E infrastructure that would be required as a result of project-related tidal inundation and restoration activities, as well as the operations and maintenance activity associated with PG&E's lines and towers that would take place in and around Pond A18. The discussion in Impact UTL-4 has been revised to clarify that the project proponents will coordinate with PG&E to obtain all necessary permits for the identified improvements as well as for PG&E's ongoing operations and maintenance activities, to ensure that impacts to utility access as well as to biological resources remain less than significant. Consistent with this coordination, these improvements to PG&E facilities will be included in all permits required for the project, including the Regional Water Quality Control Board, Bay Development and Conservation Commission, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife. The project proponents will coordinate with the U.S. Fish and Wildlife Service to ensure that regular PG&E maintenance activities are addressed in the Biological Opinion for the project. The project proponents understand that this strategy was utilized in the SBSP Restoration Project.
019_PGE-7	Ongoing Impacts Ongoing impacts to utilities should also be considered after project completion. For example, adding habitat or transitional habitat could impact utility access which will require new permitting or agency notifications. The project should address this need through simplified programmatic approaches that allow utility operation maintenance, inspection, and repairs to be conducted efficiently and expeditiously.	As noted in Response #6, the project proponents will continue to work with PG&E to address potential impacts to PG&E facilities and operations. Future maintenance may be restricted based on breeding seasons of sensitive species. The project proponents will work with PG&E and the U.S. Fish and Wildlife Service to minimize these restrictions through the inclusion of regular PG&E maintenance in the project area as part of the Biological Opinion for the project.

1436

From: Molseed, Roy <Roy.Molseed@VTA.ORG>
Sent: Monday, February 23, 2015 3:57 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase 1 Project

Bill,

VTA has no comments on the above project. Thanks. 1

Roy Molseed
VTA
(408) 321-5784

ID	Issue Text	Response Text
020_VTA	VTA has no comments on the above project. Thanks.	Your comment is acknowledged; we understand that no revision to the text is requested in this general comment.

From: Eileen McLaughlin <wildlifestewards@aol.com>
Sent: Monday, February 23, 2015 3:57 PM
To: Czekanski, Adam J MAJ SPN

Cc: Shoreline Environment SPN; ian@baykeeper.org; alice@greenfoothills.org; ldrruff@hotmail.com; shani@scvas.org; michaeljferreira@gmail.com
Subject: [EXTERNAL] Comments, Shoreline Phase 1 Study
Attachments: Joint Enviro Grp Comments-Shoreline Phase I Study 022315-ltr.pdf

Dear Major Czekanski,

The attached letter is submitted for your consideration as regards the Shoreline Phase I Study.

Submitted to you jointly by:

San Francisco Baykeeper
Citizens Committee to Complete the Refuge
Committee for Green Foothills
California Native Plant Society, Santa Clara County Chapter
Santa Clara Valley Audubon Society
Sierra Club Loma Prieta Chapter

For all of the groups co-signed,

Eileen McLaughlin
Citizens Committee to Complete the Refuge

February 23, 2015

Major Adam Czekanski
US Army Corps of Engineers, San Francisco Office
1455 Market Street
San Francisco, CA 94103

Via electronic mail to Adam.J.Czekanski@usace.army.mil

RE: Comments on Interim Feasibility Study and Environmental Impact Statement/Environmental Impact Report for the South San Francisco Bay Shoreline Phase I Study, Santa Clara County, CA

Dear Major Czekanski:

San Francisco Baykeeper, the Citizens Committee to Complete the Refuge, the Committee for Green Foothills, the Santa Clara County Chapter of the California Native Plant Society, the Loma Prieta Chapter of the Sierra Club and the Santa Clara Valley Audubon Society appreciate the opportunity to comment on the Interim Feasibility Study and Environmental Impact Statement/Environmental Impact Report for the South San Francisco Bay Shoreline Phase I Study, Santa Clara County, CA (Integrated Document). We recognize the substantial amount of outreach and analysis conducted by the US Army Corp of Engineers with the Santa Clara Valley Water District and the California State Coastal Conservancy to develop the Integrated Document and understand the significant consequences of the project, in terms of flood protection, sea level rise adaptation, and habitat conservation.

We wish to draw your attention to one particular omission and to echo elected officials who request changes in the Integrated Document consistent with San José plans for options that can enhance connectivity between San Francisco Bay and the watersheds of Coyote Creek and Lower Penitencia Creek.

Coyote Creek, home to the federally threatened Central California Coast Steelhead and Fall-Run Chinook Salmon, is one of the most significant waterways in Santa Clara Valley. Restoration of this creek is the subject of multiple on-going planning processes, including the Fish and Aquatic Habitat Collaborative Effort (FAHCE) Program and Fish Habitat Restoration Plan, and the Three Creeks Habitat Conservation Plan (HCP). Restoration activities affecting Coyote Creek were also contemplated in the Santa Clara/San José Regional Wastewater Facility's Master Plan (RWF MP), adopted by the City Council in 2013. Levee alignment alternatives currently presented in the Integrated Document constrain restoration options near the mouth of Coyote Creek and Lower Penitencia Creek, and reduce options available for multi-benefit fluvial flood mitigation and habitat enhancement efforts.

The RWF MP identified a conceptual alternative levee alignment, a diagram of which is attached herein. We request formal analysis of this concept in subsequent revisions to the Integrated Document, to preserve and enhance restoration and flood control options throughout the Coyote and Lower Penitencia Creek catchment areas. This alignment remains consistent with proposed restoration of Pond A18, in conjunction with the South Bay Salt Pond Restoration Project. We share the vision of local and regional decision makers that if the eastern-most section of the levee can be left for further consideration, restoration could one day connect Bay marshes and riparian habitats, enriching throughout that reach to achieve water quality, habitat and flood control benefits. 1

Sincerely,

Ian Wren
Staff Scientist
San Francisco Baykeeper

Eileen McLaughlin
Board Member, Citizens Committee to Complete the Refuge

Alice Kaufman
Legislative Advocate
Committee for Green Foothills

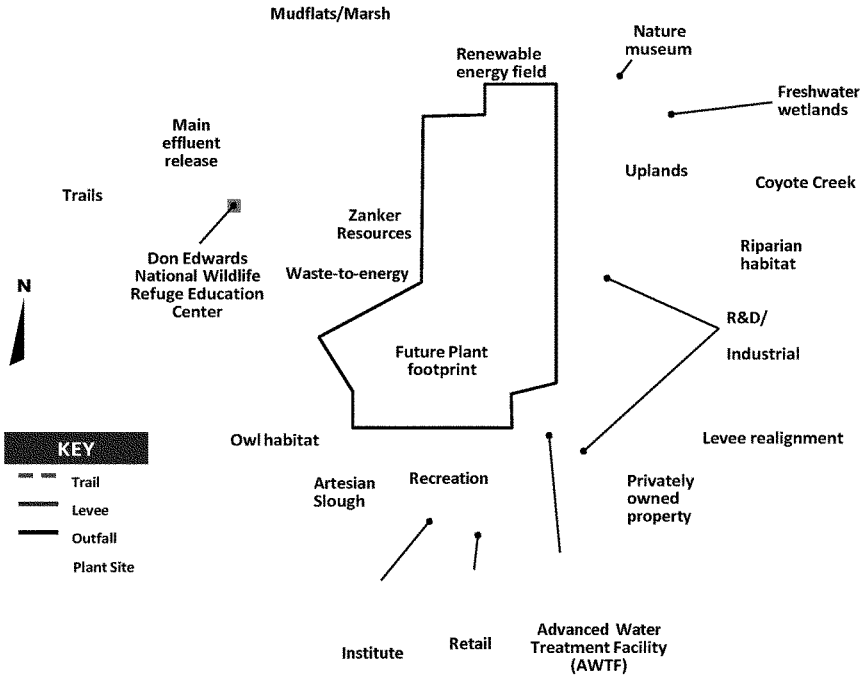
Linda D. Ruthruff
Conservation Chair,
California Native Plant Society,
Santa Clara County Chapter

Shani Kleinhaus, Ph.D
Environmental Advocate
Santa Clara Valley Audubon Society

Michael Ferreira
Executive Committee Member
Sierra Club Loma Prieta Chapter

Draft Recommended Alternative

Plant Master Plan



Draft Recommended Alternative

Plant Master Plan

Main Features

- Development area is located along Highway 237
- Shoreline levee is placed closest to the Plant operations with salt marsh and mudflats on the Bay side to provide flood protection
- Park with sports fields and connection to Artesian Slough and retail areas
- An institute is visible from Highway 237 and connected to recreation, habitat, and retail areas

Economic Benefit

- Lease revenue could be used to defray Plant operational costs (subject to city council approval)
- Estimated jobs potential: 17,800

Phasing

- The alternative is contingent upon implementing odor control measures and relocating the biosolids processing area
- An odor study will identify which lands can be developed with current odor controls, which lands are suitable for uses that are not odor-sensitive (e.g., solar fields), and which lands require additional odor controls prior to development

Funding

- Sanitary sewer rate fees only support Plant projects and will not be used to fund other uses
- Costs for the operational improvements have been identified and the Plant's co-owners and tributary agencies are evaluating financing options

Land Uses	Proposed Area
Future Plant footprint (AWTF, waste-to-energy, main effluent release, and biosolids processing area)	600 acres (currently 1,130 acres)
Advanced water treatment facility (AWTF)	31 acres
Freshwater wetlands	60 acres
Institute	45 acres
Main effluent release	75 acres
Mudflats/Marsh (includes current Pond A18)	920 acres
Nature museum	2 acres
Owl habitat	190 acres
R&D/Industrial	220-235 acres
Recreation	40 acres
Renewable energy field	60 acres
Retail	20-35 acres
Riparian habitat	188 acres
Trails	16 miles
Uplands	160 acres
Waste-to-energy	40 acres

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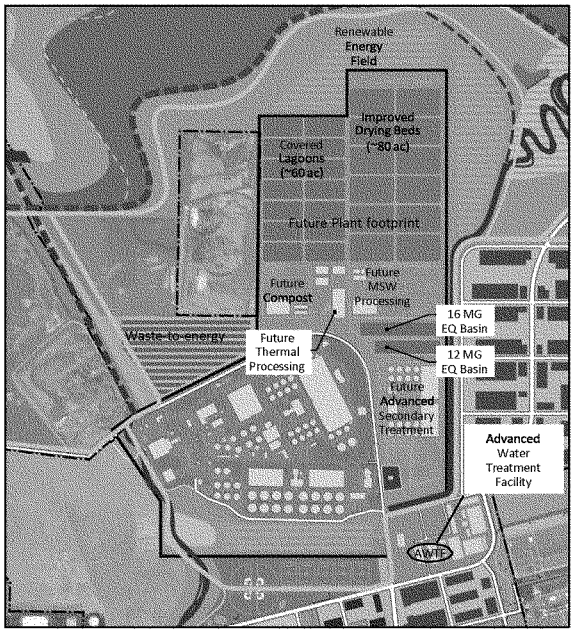
Operational Land Uses



LIQUIDS

- Primary sedimentation basins will be upgraded for reliability.
- Activated biosolids aeration basins will be modified to help meet future regulations.
- Filtration and disinfection processes will be modernized and expanded to increase the treated effluent that can be reused for beneficial purposes.

Recycled water

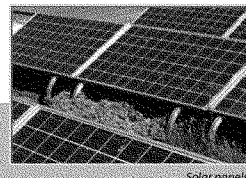
UV disinfection

Covered tanks

SOLIDS

- Improvements to the anaerobic digesters will increase the efficiency of the digestion process.
- Options for biosolids dewatering and drying are being considered, potentially freeing up hundreds of acres of land for other uses.

Greenhouses



Solar panels

Fuel cell

ENERGY

- Technologies such as fuel cells and gas turbines will be introduced to better use the methane gas produced as part of the anaerobic digestion process.
- Renewable energy technologies, such as solar panels, will be used to further reduce the Plant's demand for electricity produced off site.

Plant Master Plan

September 2015

rebuildtheplant.org

ID	Issue Text	Response Text
021_CCCR.etal_2-1	The RWF MP identified a conceptual alternative levee alignment, a diagram of which is attached herein. We request formal analysis of this concept in subsequent revisions to the Integrated Document, to preserve and enhance restoration and flood control options throughout the Coyote and Lower Penitencia Creek catchment areas. This alignment remains consistent with proposed restoration of Pond A18, in conjunction with the South Bay Salt Pond Restoration Project. We share the vision of local and regional decision makers that if the eastern-most section of the levee can be left for further consideration, restoration could one day connect Bay marshes and riparian habitats, enriching throughout that reach to achieve water quality, habitat and flood control benefits.	See Master Response regarding Coyote Creek Levee Alignment

1446

From: shani kleinhaus <shani@scvas.org>
Sent: Monday, February 23, 2015 4:04 PM
To: Czekanski, Adam J MAJ SPN
Cc: Shoreline Environment SPN

Subject: [EXTERNAL] SCVAS comments: Shoreline Draft EIR/S
Attachments: 150223_SCVAS_Shoreline Levee.pdf

FYI

Begin forwarded message:

From: shani kleinhaus <shani@scvas.org>
Subject: Shoreline EIR/S
Date: February 23, 2015 at 1:12:56 PM PST
To: "Buxton, Brenda@SCC" <Brenda.Buxton@scc.ca.gov>, Michael Martin <MichaelMartin@valleywater.org>, "DeJager, William R SPN" <William.R.DeJager@usace.army.mil>
Cc: jlabozetta@scvas.org

Good Day,

Santa Clara Valley Audubon Society (SCVAS) is pleased to submit comments on the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA. Please see our letter attached

Thank you,
Shani Kleinhaus, Ph.D.

Environmental Advocate
Santa Clara Valley Audubon Society
22221 McClellan Rd. Cupertino 95014
Tel. (650) 868 2114
shani@scvas.org

Santa Clara Valley
Audubon Society

February 23rd, 2015

To:

Commander John C. Morrow
U.S. Army Corps of Engineers San Francisco District
1455 Market St.
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

Brenda Buxton
California Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, California 94612
Brenda.Buxton@scc.ca.gov

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 94118-3686
MichaelMartin@valleywater.org

via email

Re: Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study Santa Clara County, CA

Representing over 3000 Audubon members in the region, Santa Clara Valley Audubon Society (SCVAS) aims to preserve, to enjoy, to restore and to foster public awareness of native birds and their ecosystems, mainly in Santa Clara County. We are interested in the Shoreline levee since it is expected to impact to birds and their habitat along the South Bay's Salt Ponds, marshes and estuaries. We submits the following comments on the Draft Interim Feasibility Report and Environment Impact Statement (EIS)/ Report (EIR), South San Francisco Bay Shoreline Phase I Study project (Project).

1. Please provide information on any rodent management activities if any such activities will be required on the Shoreline Levee. We are interested because California Ground Squirrels are a keystone species of the Bay upland / transition zone habitat (and needed to provide burrows for burrowing owls, a California Species of Special Concern), and other rodents are at the base of the food chain for many raptors. Whether or not burrowing animals will be allowed on the 1

p. 1 of 2

22221 McClellan Road, Cupertino, CA 95014 Phone: (408) 252-3748 * Fax: (408) 252-2850
email: scvas@scvas.org * www.scvas.org

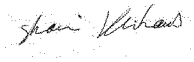
Ecotone Levee is thus critical to the success of this levee in supporting habitat for birds. Please provide a discussion and provide information on whether or not rodent management will be implemented to eradicate from the levee's transition zone. If Management is expected, please provide details on methodology, and please specify that no rodenticides of any type will be permitted. If use of rodenticides is considered an option, please analyze potential impacts to local wildlife and bird species, including the salt-marsh harvest mouse. 1

2. Please provide additional information on the expected impacts to shorebirds at New Chicago Marsh, in reference to a apparent decline in shorebird populations and available shorebird habitat in the South Bay (http://data.prbo.org/sfstateofthebirds/index.php?page=habitats-tidal-flats). 2

3. Alignment of the Levee at the mouth of Coyote Creek / pond 18 is inconsistent with the alignment selected by City of San Jose's Plant Master Plan (http://www.sanjoseca.gov/DocumentCenter/View/38425). The Project alignment has the potential to preclude future improvements and resilient fluvial flood management and habitat improvements. 3

4. The analysis of the impacts of the flow control structure across Artesian Slough is inadequate. Multiple environmental impacts can be expected, including but not limited to: a) isolating part of the slough; b) placing a levee between the existing mitigation wetlands to the east of Outfall Road and a restored A18; and c) potentially affecting the San Jose Santa Clara Regional Wastewater Facility plant discharge. It is not clear how the proposed structure would function, and whether tidal flows still be allowed in the part of the slough that is being separated from the Bay so as to not impact the slough's habitat. Furthermore, will tidal amplitudes be damped on the interior side of the structure resulting in loss of tidal marsh vegetation? Is there a possibility of fish entrapment (salmonids have been seen in Artesian Slough)? 4
The exact location and function of the structure should be disclosed and justified, alternative locations should be evaluated, and full analysis and evaluation of impacts is needed.

Thank you,



Shani Kleinhaus, Ph.D.
Environmental Advocate

p. 2 of 2

22221 McClellan Road, Cupertino, CA 95014 Phone: (408) 252-3748 * Fax: (408) 252-2850
email: scvas@scvas.org * www.scvas.org

ID	Issue Text	Response Text
022_SCVAS_2-1	1. Please provide information on any rodent management activities if any such activities will be required on the Shoreline Levee. We are interested because California Ground Squirrels are a keystone species of the Bay upland / transition zone habitat (and needed to provide burrows for burrowing owls, a California Species of Special Concern), and other rodents are at the base of the food chain for many raptors. Whether or not burrowing animals will be allowed on the Ecotone Levee is thus critical to the success of this levee in supporting habitat for birds. Please provide a discussion and provide information on whether or not rodent management will be implemented to eradicate from the levee's transition zone. If Management is expected, please provide details on methodology, and please specify that no rodenticides of any type will be permitted. If use of rodenticides is considered an option, please analyze potential impacts to local wildlife and bird species, including the salt-marsh harvest mouse.	Rodent abatement is envisioned to be limited to the footprint of the levee prism and not exceed significantly (no more than 35 feet) onto the ecotone. This would presumably impact the ecotone between approximately elevation 14.5 and 15.5. ft NAVD88. A final decision has not been developed for rodent abatement; this will be addressed during the detailed design process . Leading strategies discussed have been bait and trap, and buried stone in the face of the levee slope to prevent substantial burrowing. Poison bait stations are not considered a viable alternative due to risk to other wildlife.
022_SCVAS_2-2	2. Please provide additional information on the expected impacts to shorebirds at New Chicago Marsh, in reference to a apparent decline in shorebird populations and available shorebird habitat in the South Bay (http://data.prbo.org/sfstateofthebirds/index.php?page=habitats-tidal-flats).	Monitoring of bird use of New Chicago Marsh is ongoing as part of the SBSP Restoration Project. The Shoreline Project will restore only Ponds A12 and A18 to tidal wetlands in the first phase of the Shoreline Study. The conversion of subsequent ponds will be contingent upon the Shoreline Study Monitoring and Adaptive Management Plan, as well as the SBSP Restoration Project Adaptive Management Plan, to ensure adequate regional habitat for shorebirds exists before proceeding with additional breaching. Ponds A9-11 are scheduled five years after the initial phase, and Ponds A13-15 five years after that. These future actions will be guided by the monitoring data collected to limit adverse impacts to shorebird roosting.
022_SCVAS_2-3	3. Alignment of the Levee at the mouth of Coyote Creek / pond 18 is inconsistent with the alignment selected by City of San Jose's Plant Master Plan (http://www.sanjoseca.gov/DocumentCenter/View/38425). The Project alignment has the potential to preclude future improvements and resilient fluvial flood management and habitat improvements.	In the final adopted version of the San Jose/Santa Clara Water Pollution Control Plant's Plant Master Plan (PMP, November 2013), the City did not adopt a specific levee alignment. Rather, the Plan outlines a vision of flood protection and restoration to be implemented in partnership with other agencies. The PMP can be found here: http://www.sanjoseca.gov/DocumentCenter/View/38425 The PMP document states that the alignment of the Shoreline Levee shown with a dotted line on the PMP Land Use Plan diagram (Page 50) is tentative. In this document, the alignment shown follows the alignment of Alternatives 2 and 3 in the Shoreline Study. On Page 52 of the PMP document, under "Levee Concept", the Shoreline Study is discussed and it is mentioned that "a final levee alignment would be developed through this process". The potential levee alignment that commenters' are referring to is shown in Section 3.6.3 of the PMP's Environmental Impact Report (PMP EIR, October 2013). Figure 3-1 in the PMP EIR shows the final segment of the Pond A18 levee going through the biosolid lagoons and tying into the Coyote Creek Flood Protection Levee further upstream than the Shoreline Study's Alternative 2 and 3. However, the Project Description section of the PMP EIR, states "The levee alignment shown in the proposed site plan is subject to change as the Shoreline study is in the planning phase. Therefore, the levee alignment segment traversing the active biosolids lagoons is identified as tentative in Figure 3-1.... The role of the PMP is to accommodate the levee, which will be designed and constructed by other agencies. City staff will continue to work with the Shoreline Study agencies in the development of the levee." Since the City of San Jose adopted a very conceptual levee alignment and deferred final location to the Shoreline Study process, the Shoreline Study is not in conflict with the City's adopted alternative. See Master Response to Coyote Creek Levee
022_SCVAS_2-4	4. The analysis of the impacts of the flow control structure across Artesian Slough is inadequate. Multiple environmental impacts can be expected, including but not limited to: a) isolating part of the slough; b) placing a levee between the existing mitigation wetlands to the east of Outfall Road and a restored A18; and c) potentially affecting the San Jose Santa Clara Regional Wastewater Facility plant discharge. It is not clear how the proposed structure would function, and whether tidal flows still be allowed in the part of the slough that is being separated from the Bay so as to not impact the slough's habitat. Furthermore, will tidal amplitudes be damped on the interior side of the structure resulting in loss of tidal marsh vegetation? Is there a possibility of fish entrapment (salmonids have been seen in Artesian Slough)? The exact location and function of the structure should be disclosed and justified, alternative locations should be evaluated, and full analysis and evaluation of impacts is needed.	The project team is continuing to analyze and refine the design configuration and operations of the proposed closure on Artesian Slough to minimize impacts to the existing tidal flow regime while providing reliable flood risk management. The analysis provided in the Draft FS/EIS/EIR is based on information existing at the time of review. More details would be developed based on continuing technical discussions with City of San Jose staff as to how the WPCP is expected to operate in the future. However, the basic premise of the tide gate is a technically sound method to allow regular flows in Artesian Slough and secondary channel while blocking extreme tides that could flood adjacent upland areas. In general, the closure would remain in the "open" position until a high water event requiring flood control actions is forecast and/or experienced. The proposed tide gates across the Artesian Slough are based on top-hinged traditional tide gates similar to the structure in place at the Palo Alto flood basin. This type of tide gates open when the force on the gate's upstream side, exceeds the force on the downstream side of the gate. Under varying tide and storm conditions (i.e., normal, the 10 and 100 year tide conditions), the proposed tide gates are open fully during low tides and nearly closed during high tide conditions. During low tide, the tide gates would remain fully open and the water surface elevation in Artesian Slough would reach an equilibrium level, such that the flow through the gates balanced the WPCP effluent. During high tide, the gates would remain only partially open because the water surface elevation on the downstream side of the gates would be greater than the water surface elevation on the upstream side of the gates, allowing less effluent flow through the gates;(i.e., during high tide some of the WPCP effluent would be stored temporarily in Artesian slough until the tide began to drop). The proposed tides gate across the secondary channel, are based on traditional flap gates, whereby the gates remain open under normal, low tide and high tide conditions, to allow flows in and out of the channel. During an extreme tidal or storm event, the gates would be closed because the downstream tidal water surface elevation would be greater than the upstream side and would prevent tidal flows from flowing inland. As flow through the tide gate closure system would be maintained under all but extreme scenarios it will not impact

		habitat in the Slough. Even under the more extreme scenarios where the gate would be completely closed, the closure would be temporary and of short duration, as the tide gates would re-opened when lower tides and/or receding flood waters decrease the pressure on the gates. Thus it is unlikely that aquatic species would be entrained for more than a single tide cycle. See Master Response for Artesian Slough

1451

From: Patrick Band <pband@savesfbay.org>
Sent: Monday, February 23, 2015 4:32 PM
To: Shoreline Environment SPN
Cc: Paul Kumar

Subject: [EXTERNAL] Comments re: Shoreline Study EIR/S
Attachments: LT - South Bay Shoreline Study DEIR Comments FINAL.pdf

Attached, please find comments from Save The Bay on the South Bay Shoreline Study Draft EIR.

--
Patrick Band
Campaign Manager, Save The Bay
Office: (510) 463-6811 | Cell: (707) 319-1538
pband@saveSFbay.org | @SaveSFbay_wonks

Call on the EPA to stand up for the Clean Water Act and protect San Francisco Bay!

William DeJager
U.S. rmy Corps of Engineers
San Francisco District
1455 Market St
San Francisco, CA 94103

RE: Comments on Draft Integrated Feasibility Report / Environmental Impact Statement / Environmental Impact Report for the South San Francisco Bay Shoreline Phase 1 Project

Dear Mr. DeJager,

As the oldest and largest regional organization working to protect, restore, and enhance San Francisco Bay, Save The Bay submits these comments on the South San Francisco Bay Shoreline Phase 1 Study. Save The Bay has a long history of support for the South Bay Salt Pond Restoration Project, and appreciates the opportunity afforded by the extension of the comment period to review and respond to the DEIR.

Save The Bay continues to support strongly the habitat restoration goals and processes recommended in the study. Conversion of former salt ponds in the study area to tidal habitat will augment greatly the regional restoration efforts already underway, and improve habitat quality throughout the Bay's former salt pond network.

We would like to highlight areas of the study which are of particular interest, and in which Save The Bay believes improvements could further strengthen alignment with Planning Goals and Objectives, including "[r]estoration of ecological function and habitat quantity, quality and connectivity," as identified in section S-9.

1. Artesian Slough Crossing & Wetlands Connectivity
   Save The Bay is disappointed that the study does not address an alternative to the Artesian Slough alignment (Figure 3.5-2) that would provide ongoing connectivity between mitigation wetlands to the northeast of the slough and Pond A18. The roughly 30 acres of mitigation wetland are known habitat for populations of the Salt Marsh Harvest Mouse, as well as dozens of other species of wildlife. The alignment as currently proposed would permanently separate this critical habitat from the adjacent wetlands, thus directly contradicting Project Planning Objectives (Section 2.5) and Opportunity 3 (Section 2.4.4.1) of the study. 1

   Additionally, we are concerned about the lack of analysis in the study of likely impacts on the Water Pollution Control Plant (WPCP) infrastructure and pumping operations from projected sea level rise at the proposed Artesian Slough flood wall & tide gate. Additional consideration and analysis should be conducted on this issue, including development of an option for a more southern alignment of the flood wall. A more southern flood wall, and a levee alignment to run adjacent to Nine Par and Zanker Road landfills before connecting with the WPCP Segment Levee Alignment, would appear to be a significantly more environmentally beneficial and potentially less costly alternative to the current proposal. 2

oadway, Suite 1800 Oakland CA 94612 510.463.6850 www.saveSFbay.org

2. WPCP Segment Levee Alignment
   Save The Bay is supportive of alignment WPCP South, which while not considered in the study is consistent with the alignment outlined in the City of San Jose's Plant Master Plan. This alignment avoids the significant environmental impacts and reduction in restoration potential for Pond A18 that would occur with either of the two northern alignments, while providing increased habitat potential along that section of Coyote Creek. Expanding on our comments above, we also believe that it is necessary to evaluate fully an option for a more southern terminus of this segment that would provide connectivity between existing mitigation wetlands to the west of Zanker Road landfill and Pond A18. 3 4

3. Expanded Transition Zone
   Save The Bay strongly supports the creation of vital transition zone habitat between tidal wetlands and upland areas. Historically, transition zones in the Bay would extend for as much as a mile or more, providing substantial habitat for native wildlife populations.

   As noted in Section 3.6.2 of the study, establishment of transition zone on the outboard levee at an optimal 30:1 slope will provide significantly more refuge for wildlife than the "bench" alternative, and offer additional and ongoing ecosystem service, including providing a buffer from storm surges and aid in resiliency through gradual sediment accretion to help wetlands keep pace with rising tides. While Save The Bay remains cautious with regard to the implementation process and the composition of any fill material used, we are strongly supportive of the creation of additional transition zone habitat on outboard levees as outlined in the Study. 5

Thank you for the opportunity to share our thoughts and for consideration of our comments on Phase 1 of the South San Francisco Bay Shoreline Study.

Sincerely,

Paul R. Kumar
Political Director, Save The Bay

ID	Issue Text	Response Text
023_STB-1	1. Artesian Slough Crossing & Wetlands Connectivity Save The Bay is disappointed that the study does not address an alternative to the Artesian Slough alignment (Figure 3.5-2) that would provide ongoing connectivity between mitigation wetlands to the northeast of the slough and Pond A18. The roughly 30 acres of mitigation wetland are known habitat for populations of the Salt Marsh Harvest Mouse, as well as dozens of other species of wildlife. The alignment as currently proposed would permanently separate this critical habitat from the adjacent wetlands, thus directly contradicting Project Planning Objectives (Section 2.5) and Opportunity 3 (Section 2.4.4.1) of the study.	See Master Response for Artesian Slough
023_STB-2	Additionally, we are concerned about the lack of analysis in the study of likely impacts on the Water Pollution Control Plant (WPCP) infrastructure and pumping operations from projected sea level rise at the proposed Artesian Slough flood wall & tide gate. Additional consideration and analysis should be conducted on this issue, including development of an option for a more southern alignment of the flood wall. A more southern flood wall, and a levee alignment to run adjacent to Nine Par and Zanker Road landfills before connecting with the WPCP Segment Levee Alignment, would appear to be a significantly more environmentally beneficial and potentially less costly alternative to the current proposal.	The Regional Wastewater Facility is anticipating the need to pump effluent in the future as a response to sea level rise with or without the proposed project. The project team is continuing to analyze the configuration and operations of the proposed closure on Artesian Slough to avoid the need to install pumping sooner than would otherwise occur in a "without-project" condition. Alternative alignments along the border of Artesian Slough were determined to be substantially more costly, impact substantially more existing utilities, and encroach upon, or near, existing landfills. Therefore, the proposed closure was selected as the preferred alternative.
023_STB-3	2. WPCP Segment Levee Alignment Save The Bay is supportive of alignment WPCP South, which while not considered in the study is consistent with the alignment outlined in the City of San Jose's Plant Master Plan. This alignment avoids the significant environmental impacts and reduction in restoration potential for Pond A18 that would occur with either of the two northern alignments, while providing increased habitat potential along that section of Coyote Creek.	See Master Response regarding Coyote Creek Levee Alignment
023_STB-4	Expanding on our comments above, we also believe that it is necessary to evaluate fully an option for a more southern terminus of this segment (WPCP South) that would provide connectivity between existing mitigation wetlands to the west of Zanker Road landfill and Pond A18.	See Master Response regarding Coyote Creek Levee Alignment
023_STB-5	3. Expanded Transition Zone Save The Bay strongly supports the creation of vital transition zone habitat between tidal wetlands and upland areas. Historically, transition zones in the Bay would extend for as much as a mile or more, providing substantial habitat for native wildlife populations. As noted in Section 3.6.2 of the study, establishment of transition zone on the outboard levee at an optimal 30:1 slope will provide significantly more refuge for wildlife than the "bench" alternative, and offer additional and ongoing ecosystem service, including providing a buffer from storm surges and aid in resiliency through gradual sediment accretion to help wetlands keep pace with rising tides. While Save The Bay remains cautious with regard to the implementation process and the composition of any fill material used, we are strongly supportive of the creation of additional transition zone habitat on outboard levees as outlined in the Study.	We thank you for your input and your comment is acknowledged. The proposed project includes the transition zone, and the project partners are in discussions with the agencies with jurisdiction over bay fill. Any fill would meet wetland standards established by the RWQCB.

1455

From: Laura Thompson <LauraT@abag.ca.gov>
Sent: Monday, February 23, 2015 4:46 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Francisco Bay Shoreline Study Phase 1 Project DEIS/DEIR
Attachments: South SF Bay Shoreline Study DEIR.pdf

ATTN: William DeJager
Environmental Section A

Attached are comments from the San Francisco Bay Trail Project regarding the South San Francisco Bay Shoreline Study Phase 1 Project DEIS/DEIR.

Please let me know if you have any questions.

Thanks,
Laura

Laura Thompson
Bay Trail Project Manager
Association of Bay Area Governments
101 Eighth Street
Oakland, CA 94607
p. 510-464-7935
f. 510-433-5535
laurat@abag.ca.gov
www.baytrail.org

February 23, 2015

Thomas R. Kendall
Chief, Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103

ATTN: William DeJager
Environmental Section A

Subject: **South San Francisco Bay Shoreline Phase 1 Study, Draft Interim Feasibility Report and Environmental Impact Report/Statement**

Dear Mr. DeJager:

On behalf of the San Francisco Bay Trail Project, thank you for the opportunity to comment on the Draft Interim Feasibility Report and Environmental Impact Report/Statement for the South San Francisco Bay Shoreline Phase 1 Study. The San Francisco Bay Trail is a visionary plan for a bicycle and pedestrian path that will one day allow continuous travel around San Francisco Bay. Currently, 340 miles of trail have been completed. Eventually, the Bay Trail will extend over 500 miles to link the shoreline of nine counties, passing through 47 cities and crossing seven toll bridges.

The following comments focus on the Bay Trail alignment, safety, continuity and experience as analyzed in the DEIR/DEIS:

S-8.4 **Problem 4 – Recreational Access**
The problem should be characterized not as recreational access but as a growing need for expanded recreational access in the South Bay. 1

Opportunity 4
Describe how this project will expand recreational access rather than referring to the broader South Bay Salt Pond Restoration Project outside the project study area. 2

S-9 **Planning Goals and Objectives**
In the fourth planning objective, refer to the *San Francisco Bay Trail Plan* (not the California Bay Trail Plan). 3

Administered by the Association of Bay Area Governments
P.O. Box 2050 • Oakland, CA 94604-2050
Phone: 510-464-7900 • Fax: 510-464-7970
Web: www.baytrail.org

Section 3.7.1	**Recreation Measures** Figure 3.7-5 shows a dashed red line along the northern side of Highway 237 between Zanker Road and Guadalupe Slough that is described in the legend as an existing surface street trail. The figure should be revised to show this on-street facility located on the south side of Highway 237. The location of the red dashed line in this figure is the proposed trail that will be completed as part of this project. These comments also apply to Figure 4.11-1.	4
Section 4.1.3.3.3.6	**Recreational Resources** Revise the last sentence in the first paragraph to read: "In total, the trail will be altered from its current ~~330~~ 340-mile length to a ~~400~~ 500-milelong trail."	5
Section 4.9.1	The existing bicycle/pedestrian trail adjacent to Highway 237 between Zanker Road and Coyote Creek is part of the Bay Trail and the National Recreation Trail	6
Section 4.11.1.1.2.3	Currently, there are 340 miles of existing Bay Trail in the 500-mile planned system.	7

Thank you for considering these comments and please contact me at 510-464-7935 or laurat@abag.ca.gov if you have questions.

Sincerely,

Laura Thompson

Laura Thompson
Bay Trail Project Manager

ID	Issue Text	Response Text
024_SFBTr-1	The following comments focus on the Bay Trail alignment, safety, continuity and experience as analyzed in the DEIR/DEIS: S-8.4 Problem 4 – Recreational Access The problem should be characterized not as recreational access but as a growing need for expanded recreational access in the South Bay.	We acknowledge that the problem is better described as an increased need for recreational access. The executive summary was substantially shortened and no longer includes this text, but Section 2.4.5 in the Integrated Document was revised to address the comment as follows (strikeout deleted, underline added). 2.4.5 Problem 4 –Increased Need Recreational access
024_SFBTr-2	Opportunity 4 Describe how this project will expand recreational access rather than referring to the broader South Bay Salt Pond Restoration Project outside the project study area.	Thank you for your comment. To address this comment Section 2.4.5.1 of the Integrated Document text was changed as follows (underline added, strikeout deleted): 2.4.5.1 Opportunity 4 There is an opportunity to provide public access, education, and recreational opportunities in the Study Area. Most of the non-urbanized lands and diked ponds within the Study Area are now part of the Refuge. National wildlife refuge lands and waters may be used for wildlife-related recreation to the extent that it is compatible with the primary purpose of the refuge system, which is protecting and enhancing wildlife habitat values. Because of the sensitivity of wildlife to active recreational use, these uses are expected to be expanded only on a limited basis ~~as discussed in the 2007 Final EIS/Environmental Impact Report (EIR) for the SBSPRP~~. Opportunities to provide public access, education, and recreation ~~for the broader SBSPRP project area~~ include development of multi-use trails for walking, jogging, cycling, hiking, and nature observation; facilitating education and photography by constructing viewing platforms ~~and education and interpretive centers~~ along multi-use trails ~~and building viewing platforms~~ overlooking the ~~remnants of the historical salt works~~ evolving marshes.
024_SFBTr-3	S-9 Planning Goals and Objectives In the fourth planning objective, refer to the San Francisco Bay Trail Plan (not the California Bay Trail Plan).	Thank you for your clarification. The list of specific goals has been removed from the Executive Summary in an effort to reduce the size of that portion of the document. However, the suggested revision was made to the goals list in Chapter 2, Section 2.5; the 4th bullet has been changed to reference the San Francisco Bay Trail Plan.
024_SFBTr-4	Section 3.7.1 Recreation Measures Figure 3.7-5 shows a dashed red line along the northern side of Highway 237 between Zanker Road and Guadalupe Slough that is described in the legend as an existing surface street trail. The figure should be revised to show this on-street facility located on the south side of Highway 237. The location of the red dashed line in this figure is the proposed trail that will be completed as part of this project. These comments also apply to Figure 4.11-1.	We agree the Existing Trails Maps (Figures 3.7-5 and 4.11-1) should be corrected. The dashed red line adjacent to Highway 237 in the map has been deleted as this is a proposed, not an existing, trail. However, the existing bike lanes on street south of Highway 237 was not added to map as the Shoreline Study is focused on improving the trail networks closer to the project area, north of Highway 237.
024_SFBTr-5	Section 4.1.3.3.3.6 Recreational Resources Revise the last sentence in the first paragraph to read: "In total, the trail will be altered from its current 340-mile length to a 500-mile long trail."	The suggested revision to Section 4.1.3.3.3.6 has been made and the revised sentence is as follows: "In total, the trail will be altered from its current 340-mile length to a 500-mile-long trail."
024_SFBTr-6	Section 4.9.1 The existing bicycle/pedestrian trail adjacent to Highway 237 between Zanker Road and Coyote Creek is part of the Bay Trail and the National Recreation Trail.	Your comment is acknowledged and the text in Section 4.9.1 has been revised. Please refer to the response to Comment ID #010_SJPRNS-5 to see the full text added to the section.
024_SFBTr-7	Section 4.11.1.1.2.3 Currently, there are 340 miles of existing Bay Trail in the 500-mile planned system.	The suggested revision to Section 4.11.1.1.2.3 has been made and the revised sentence is as follows: "Currently, 340 miles of trail have been completed; eventually, the Bay Trail will extend for 500 miles to link the shoreline of nine counties, passing through 47 cities and crossing seven toll bridges.

1459

From: esp_jkclaw@yahoo.com
Sent: Monday, February 23, 2015 4:50 PM
To: Shoreline Environment SPN

Cc: Richard Santos; Bea Leija; jill smith; district4@sanjoseca.gov; Diego Barragan
Subject: [EXTERNAL] Re: comments for the shoreline study

There are two concerns that I would like to be put into the record.

First, the proposed levee will distort the community's horizon; there may need to be some research on how that will affect the residents. Does the sharp incline pose a threat to people on the trail? Could there be effects that may pose a threat to people and children at Don Edwards? Does having a horizon that is not natural by nature have an affect on a persons mind? 1

Second, its my understanding that we will lose several miles of a popular bike and walking trail traditionally used by residents, visitors and that the lead agency responsible for the project will replace these trails with a new trail that will be developed along side the Newby Island Landfill. As you may be aware, citizens have complained that the Newby Island Landfill emits a foul odor among other issues and may discourage bicyclists and pedestrians from using the trail in that location. 2

In my opinion, a better solution for the bike path relocation would be to enhance the recreational experience by acquiring the land, for example property north of State St. There your agency can construct trails, open parkland and activities that people can enjoy. Currently, in the area north of State Street, there are several businesses that are a nuisance to the public and wildlife preserve.

Please consider this area.
This area is currently zoned Industrial, but is butted up against some sensitive areas. These companies are notorious for business practices that are not the kind you would like to have next to the bay marshes and wildlife. 3

Many of these business operators have been observed violating operational permit regulations, filling in areas to widen their lots into the marsh, etc.

Community members are interested in a solution that would address this area, reduce the Industrial and heavy truck aspect.

At the end of the day, many of our Alviso residents want to keep this area open and close to nature, not heavy trucks. We have trucks from the north, trucks from the south and they travel along the east and west. This has all encroached upon residents without the concern of our Council Members or Mayor. 4

Is there any way this project can incorporate or address this north of State Street area? Is there any part of the project focused to improve/address this type of zoning next to these wetlands?

Thank you,

Mark Espinoza

ID	Issue Text	Response Text
025_Espinoza-1	First, the proposed levee will distort the community's horizon; there may need to be some research on how that will affect the residents. Does the sharp incline pose a threat to people on the trail? Could there be effects that may pose a threat to people and children at Don Edwards? Does having a horizon that is not natural by nature have an affect on a persons mind?	Unlike the existing berms around the ponds, the proposed flood protection levees will not feature steeply sloping sides. The levee will be much wider and have a gentler slope. The trails on top of the constructed levee will be wider than the existing trails on top of the salt pond berms and are not expected to pose any public safety concerns. The Shoreline Study team is interpreting the question regarding effects of the horizon on one's mind as a comment/concern relating to aesthetic impacts on local residents. The flood protection levee is not expected to noticeably affect the views of the surrounding landscape and the horizon from the town of Alviso. It will be more noticeable at the Alviso Marina County Park and at the US FWS's Environmental Education Center because these visitor destinations will be much closer to the levee; but even there it is not expected to be significant as discussed in Section 4.12. Please see Chapter 4.12 Aesthetics for additional discussion of the levee appearance and visual simulations of the proposed levees from various points in Alviso. Please also note that the levee will feature a trail on top which will provide enhanced (from slightly higher up) views of the surrounding landscape. In addition, the ponds will be restored to tidal marshes, bringing back more of what was originally the natural landscape in the Alviso area.
025_Espinoza-2	Second, its my understanding that we will lose several miles of a popular bike and walking trail traditionally used by residents, visitors and that the lead agency responsible for the project will replace these trails with a new trail that will be developed along side the Newby Island Landfill. As you may be aware, citizens have complained that the Newby Island Landfill emits a foul odor among other issues and may discourage bicyclists and pedestrians from using the trail in that location.	The commenter is correct to note that the approximately nine mile Alviso Slough Trail around Ponds A9-A15 will be removed as wetland restoration of the ponds is phased in over time. Please see Chapter 4.11 Recreation for additional information about the trails. As the comment notes, the new, additional trail will be constructed as part of the project on the Pond A18 levee (WPCP South alternative) which is adjacent to landfills and biosolid lagoons and there is a history of nuisance odors in this area (see Section 4.10.1.2.6 for a discussion of baseline odor conditions in the Project area). CEQA only requires analysis of project impacts on the environment, but not vice versa. See, for example, *Ballona Wetlands Land Trust v. City of Los Angeles*, 201 Cal. App. 4th 455, 474 (2011); *South Orange County Wastewater Authority v. City of Dana Point*, 196 Cal. App. 4th 1604 (2011); *City of Long Beach v. Los Angeles Unified School District*, 176 Cal. App. 4th 889 (2009). Thus, the EIR/EIS is not required to consider impacts of existing odor on the proposed new trail and trail users.
025_Espinoza-3	In my opinion, a better solution for the bike path relocation would be to enhance the recreational experience by acquiring the land, for example property north of State St. There your agency can construct trails, open parkland and activities that people can enjoy. Currently, in the area north of State Street, there are several businesses that are a nuisance to the public and wildlife preserve. Please consider this area. This area is currently zoned Industrial, but is butted up against some sensitive areas. These companies are notorious for business practices that are not the kind you would like to have next to the bay marshes and wildlife. Many of these business operators have been observed violating operational permit regulations, filling in areas to widen their lots into the marsh, etc. Community members are interested in a solution that would address this area, reduce the Industrial and heavy truck aspect.	The Shoreline Study proposes to put public access trails on top of the levees since the levee tops will be wide and flat for maintenance vehicle access and easily incorporated into the project and are publically owned. The levees will be constructed on top of existing trails in many places and to minimize the loss of these trails, the project proposes to restore the previous trail in virtually the same location. CEQA/NEPA requires mitigation of significant impacts directly or indirectly caused by a proposed action. The land use zoning issue as stated in the comment, even if true, is an existing condition that the project is not required to address. Acquiring land in the town of Alviso could provide additional trail options but it wouldn't replace the advantage of creating a trail through the City property (WPCP South Alternative) which allows the project to connect with the Bay Trail/Coyote Creek Trail and would not meet the objectives of the proposed project. Acquiring these lands may reduce land use conflicts but is not consistent with the purpose of the Shoreline Study which is to provide flood protection, ecosystem restoration, and public recreation. Acquiring these lands for just public recreation purposes would not meet the USACE's criteria for cost-sharing, as any recreational values must be specifically associated with the proposed ecosystem restoration features, and USACE policy forbids the acquisition of lands solely for recreation.
025_Espinoza-4	At the end of the day, many of our Alviso residents want to keep this area open and close to nature, not heavy trucks. We have trucks from the north, trucks from the south and they travel along the east and west. This has all encroached upon residents without the concern of our Council Members or Mayor. Is there any way this project can incorporate or address this north of State Street area? Is there any part of the project focused to improve/address this type of zoning next to these wetlands?	The Shoreline Study notes the commenter's desire to minimize truck traffic. The Shoreline Study's approach to minimizing Project related trucks trips on Alviso streets is to locate the main staging areas on Regional Waste Facility (RWF) and landfill lands and to utilize haul routes that are either outside of the town or are confined to the edges of town. Haul routes are identified on pp. 4-425-6 in the Integrated Document. Truck trips will be directed through the RWF lands as much as possible, but trucks will need to utilize North First, Gold and Elizabeth Streets to access the County Marina for portions of the Project. The current truck traffic and land use already in Alviso is part of the baseline for purpose of environmental review; CEQA and NEPA only requires mitigation of significant impacts caused by a proposed project/proposed action.

1461

026_BCDC

From: Richmond, Sarah@BCDC <sarah.richmond@bcdc.ca.gov>
Sent: Monday, February 23, 2015 4:54 PM

To: Shoreline Environment SPN; Buxton, Brenda@SCC; MichaelMartin@valleywater.org
Subject: [EXTERNAL] BCDC Comments on South San Francisco Bay Shoreline Study Phase 1 Project
Attachments: BCDC Shoreline Study Comment Letter 022315_Final.pdf

Hi all,

Please find BCDC's comments on the South San Francisco Bay Shoreline Study Phase 1 Project attached.

Let me know if you have any trouble accessing the file.

Thank you,

--
Sarah Richmond, P.G.
Coastal Planner
San Francisco Bay Conservation and Development Commission
455 Golden Gate Ave., Suite 10600, San Francisco, CA 94102
O. (415) 352-3660
C. (858) 869-5181
sarah.richmond@bcdc.ca.gov

San Francisco Bay Conservation and Development Commission
455 Golden Gate Avenue, Suite 10600, San Francisco, California 94102 tel 415 352 3600 fax 415 352 3606

February 23, 2015

Mr. Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118
(408) 630-3095
michaelmartin@valleywater.org

SUBJECT: South San Francisco Bay Shoreline Phase 1 Study Draft Interim Feasibility Report and Environmental Impact Statement/Report; SCH#2006012020

Dear Mr. Martin:

Thank you for the opportunity to comment on the South San Francisco Bay Shoreline Phase 1 Study Draft Interim Feasibility Report and Environmental Impact Statement/Report, which our office received on December 23, 2014. Although the Commission has not had an opportunity to review this document, the following staff comments are based on the Commission's law, the McAteer-Petris Act, and the policies of the *San Francisco Bay Plan* (Bay Plan). This is a complex study addressing flood risk for the community of Alviso and State Route 237 as well as allow for completion of a significant portion of the South Bay Salt Pond Restoration (SBSPR) effort in the Alviso area. The document's authors have done a tremendous job of synthesizing and presenting an informative and clear body of material describing the project, its potential impacts, and mitigation measures. This multi-purpose flood risk management and ecosystem restoration initiative is one of the first of its kind in the Bay Area to consider sea level rise.

Project Description. The locally preferred plan (LPP) recommended for implementation and identified as the tentatively selected plan (TSP) is Alternative 3, which would include engineered levees along the western and northern outer levees of the New Chicago Marsh along the existing margins of Ponds A12, A13, and A16 (Alviso North alignment) and follow the San Jose-Santa Clara Water Pollution Control Plant (WPCP) levee that runs west to east in a stair-step pattern along the north border (WPCP South alignment) to protect against the 1-percent tidal event with anticipated sea level rise; a tide gate across Artesian Slough; restoration of Ponds A9, A10, A11, A12, A13, A14, A15, and A18; a transition habitat ('ecotone') slope of 30:1 in Ponds A12 and A18; and multi-use trails on top of the new proposed flood risk management levee with connection to the Bay Trail network, viewing platforms and benches, and trail upgrades to be made to an existing segment of the Bay Trail system along State Route 237.

Generally, the Commission's policies encourage the integration of shoreline protection and Bay ecosystem enhancement using adaptive management. Based on review of Alternative 3, it appears that the key policy issues will likely include an analysis of the project's consistency with the Commission's laws and policies on fill in salt ponds, climate change, shoreline protection, safety of fills, tidal marshes and tidal flats, and public access. A short discussion of the Commission's jurisdiction and these laws and policies follows.

Mr. Michael Martin
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Jurisdiction. Commission permits are required for filling, dredging, and substantial changes in use of a structure or an area within the Commission's jurisdiction. Based on the project description, the majority of the proposed work would occur within the Commission's salt pond jurisdiction. The Commission has salt pond jurisdiction in Ponds A9, A10, A11, A12, A13, A14, A15, and A18 and the levees that surround and create the salt ponds. The Commission has Bay jurisdiction to the railroad crossing in Artesian Slough and shoreline band jurisdiction 100 feet inland from and parallel to its Bay jurisdiction. Future applications will need to delineate the Commission's salt pond, Bay, and shoreline band jurisdictions because different factors are considered for authorizations in different locations. Jurisdiction in and around salt ponds can be complicated. We suggest that you work with BCDC staff to ensure that the delineations are accurate. In addition, federal actions, permits, and financial grants affecting the coastal zone are subject to review by the Commission, pursuant to the federal Coastal Zone Management Act, for their consistency with the Bay Plan.

McAteer-Petris Fill Requirements. Section 66605(c) of the McAteer-Petris Act requires that any fill placed in salt ponds (and the Bay) must be the minimum necessary to achieve the purpose of the fill. Alternative 3 involves approximately 165 acres of fill in the Commission's salt pond jurisdiction for the ecotone slope and levee (97 and 68 acres, respectively). The broadly, gently sloping 30:1 ecotone would be constructed on the bay side of the levee, and the slope would encroach about 345 feet into the ponds, taking up about 97 acres of Ponds A12/A13 and Pond A18 in the overall approximately 2900 acre restoration footprint. The Commission has authorized fill in salt ponds for restoration in the past. For example, for the Napa-Sonoma Salt Pond Restoration project (BCDC Permit No. 2004.008), the Commission authorized 93,920 cubic yards (cy) of fill over 79 acres in Pond 10 to raise pond elevation towards marsh plain, and 14,506 cy of fill over 6.5 acres at the Napa Plant Site to create transition zone habitat. The document does not indicate how much of the fill for the ecotone slope would be at marsh versus upland elevations.

The document describes how the ecotone is anticipated to provide short-term and long term-benefits. In the short term, the ecotone would provide wave attenuation and buffer the levee behind it from wave erosion, presumably reducing maintenance needs. In the long term, the ecotone would provide space for marshes to retreat inland in the face of sea level rise, increasing the resilience of the outboard tidal wetlands and the incidental flood benefits they provide. While the document explains that a narrower and steeper slope, e.g., 'bench' in Alternative 2, would provide only a few of these benefits, it could be more clear about how variations in slope between alternatives affects the level of benefits, especially in light of the fact that the non-Federal sponsor may increase the slope of the ecotone (to perhaps 20:1), fluctuate the slope of the ecotone along the length of the levee, and/or not build the ecotone along sections of the levee if a slope of 30:1 is cost-prohibitive and/or there is not adequate free fill material (page 9-3). Final environmental analysis should discuss how the preferred slope is the minimum amount of fill necessary to achieve restoration objectives both under current conditions and as sea level rises. In particular, this discussion should include an explanation of how increased fill for transition zone habitat will achieve restoration objectives because this project appears to propose more upland fill than past restoration projects.

Mr. Michael Martin
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In addition, Section 66605(d) states that the nature, location, and extent of fill should "minimize harmful effects to the bay area, such as the reduction or impairment of the volume surface area or circulation of water, water quality, fertility of marshes or fish or wildlife resources, or other conditions impacting the environment". The document describes in detail how harmful effects to natural resources will be minimized. Final environmental analysis should also discuss geotechnical considerations, such as how the fill could be affected by scour and erosion, influencing the overall durability of the slope and its ability to provide benefits over time. Furthermore, Section 66605(e) states fills must be "constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters". The document thoroughly assesses hazards associated with geology, seismicity, and flooding. Alternative 3 includes a high enough levee to keep the study area out of the Federal Emergency Management Agency floodplain during the 50-year planning horizon (2017 – 2067, with 2.59 feet of sea level rise 'USACE High Sea Level Change Scenario').

Lastly, Section 66605(f) requires that applicants have valid title "to the properties in question [so] that he or she may fill them in the manner and for the uses to be approved." Property ownership also affects Commission authorization type. The USFWS owns and manages A9, A10, A11, A12, A13, A14, and A15 as part of the Don Edwards San Francisco Bay National Wildlife Refuge. As the landowners of Ponds A9–A15, the USFWS would implement ecosystem restoration and wildlife-dependent recreation improvements on their lands. The USACE would be the Federal implementing agency for all flood risk management features and for ecosystem restoration conducted in Pond A18 owned by the City of San Jose (and not included in the SBSPR study area). All levee segments would be maintained by the SCVWD as a non-Federal sponsor, but it is unclear what entity would manage A18 post-restoration. Given the patchwork of Federal and non-Federal landowners, funding sources, and maintenance responsibilities, the Commission will need to determine whether a permit and/or consistency determination is appropriate during the permitting process.

Bay Plan Salt Pond Policies. The Bay Plan Salt Pond policies encourage the restoration, enhancement, and conversion of former salt ponds to subtidal and wetland habitats, and require that such projects include clear and specific long-term and short-term biological and physical goals, success criteria, a monitoring program, and provisions for long-term maintenance and management needs (see Policy 3). The document describes how the project includes an extensive adaptive management plan (Shoreline Study Monitoring and Adaptive Management Plan for Ecosystem Restoration, Appendix I) that will guide the selection of the final mix of habitats. This plan should include an analysis of anticipated habitat types and their effects on abundance and distribution of fish and wildlife, effects of any proposed fill, flood management measures, protection of public facilities and utilities, and public access (expanded upon below).

Mr. Michael Martin
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Bay Plan Climate Change, Shoreline Protection, and Safety of Fills Policies. The Bay Plan Climate Change policies require a risk assessment for larger projects (Policy 2), and that such projects be designed to be resilient to mid-century sea level rise projection with an adaptive management plan to address impacts from sea level rise at the end of the century (Policy 3). Bay Plan Shoreline Protection policies also require that shoreline protection projects be properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account. Moreover, the Bay Plan Safety of Fills policies state, in part, that "rights-of-way for levees or other structures protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay." The analysis in the document extends to 2067. Final environmental analysis should discuss how the project would be consistent with these requirements, including analysis of adaptability through end of century.

Bay Plan Tidal Marsh and Tidal Flats Policies. The Bay Plan Tidal Marsh and Tidal Flats policies state in part, that, "where a transition zone does not exist and it is feasible and ecologically appropriate, shoreline projects should be designed to provide a transition zone between tidal and upland habitats." The document describes the feasibility of constructing a transition zone and how it is ecologically appropriate because it "mimics the natural landform that once existed around the perimeter of San Francisco Bay" (S-51).

Bay Plan Public Access Policies. The Bay Plan Public Access policies require that a proposed fill project increase public access to the Bay to the maximum extent feasible. The policies also state "public access should be sited, designed, and managed to prevent significant adverse effects on wildlife... [and] avoid significant adverse impacts from sea level rise and shoreline flooding." Overall, ecosystem restoration would result in a reduction of about 7.4 miles of trails, however, with the addition of trail along Pond A18 (3.6 miles) and a proposed trail enhancement at SR 237 (1.6 miles), the net loss would be about 2.2 miles. Final environmental analysis should describe how the proposed trail system would be the maximum feasible public access for the project, and how the trail system would reduce or avoid adverse impacts from human/wildlife interactions, temporary flooding, and permanent inundation.

Thank you for providing staff with the opportunity to review the document. We look forward to continuing a dialogue with the project proponents on this very important project. Please feel free to contact me at (415) 352-3660 or email me at sarah.richmond@bcdc.ca.gov if you have any questions regarding this letter.

Sincerely,

SARAH RICHMOND
Coastal Planner

SR/go

cc: State Clearinghouse

ID	Issue Text	Response Text
026_BCDC-1	Jurisdiction. Commission permits are required for filling, dredging, and substantial changes in use of a structure or an area within the Commission's jurisdiction. Based on the project description, the majority of the proposed work would occur within the Commission's salt pond jurisdiction. The Commission has salt pond jurisdiction in Ponds A9, A10, A11, A12, A13, A14, A15, and A18 and the levees that surround and create the salt ponds. The Commission has Bay jurisdiction to the railroad crossing in Artesian Slough and shoreline band jurisdiction 100 feet inland from and parallel to its Bay jurisdiction. Future applications will need to delineate the Commission's salt pond, Bay, and shoreline band jurisdictions because different factors are considered for authorizations in different locations. Jurisdiction in and around salt ponds can be complicated. We suggest that you work with BCDC staff to ensure that the delineations are accurate. In addition, federal actions, permits, and financial grants affecting the coastal zone are subject to review by the Commission, pursuant to the federal Coastal Zone Management Act, for their consistency with the Bay Plan.	The comment is noted. The project proponents have already started working with BCDC staff on permitting issues.
026_BCDC-2	McAteer-Petris Fill Requirements. Section 66605(c) of the McAteer-Petris Act requires that any fill placed in salt ponds (and the Bay) must be the minimum necessary to achieve the purpose of the fill. Alternative 3 involves approximately 165 acres of fill in the Commission's salt pond jurisdiction for the ecotone slope and levee (97 and 68 acres, respectively). The broadly, gently sloping 30:1 ecotone would be constructed on the bay side of the levee, and the slope would encroach about 345 feet into the ponds, taking up about 97 acres of Ponds A12/A13 and Pond A18 in the overall approximately 2900 acre restoration footprint. The Commission has authorized fill in salt ponds for restoration in the past. For example, for the Napa-Sonoma Salt Pond Restoration project (BCDC Permit No. 2004.008), the Commission authorized 93,920 cubic yards (cy) of fill over 79 acres in Pond 10 to raise pond elevation towards marsh plain, and 14,506 cy of fill over 6.5 acres at the Napa Plant Site to create transition zone habitat. The document does not indicate how much of the fill for the ecotone slope would be at marsh versus upland elevations.	The ecotone would fill approximately 97 acres of pond habitat as stated in your comment, resulting in an overall 2,900 acre restoration of tidal marsh habitat. The areas of fill calculated for ecotone vs. levee areas are included in the 404 (b)(1) analysis (Appendix B10). A portion of the 97 acres of fill in the ponds will be bay / marsh, and this amount will increase over time with sea level rise. The area of the ecotone slope that will be at tidal elevation will be calculated during design and provided to BCDC.
026_BCDC-3	The document describes how the ecotone is anticipated to provide short-term and long term-benefits. In the short term, the ecotone would provide wave attenuation and buffer the levee behind it from wave erosion, presumably reducing maintenance needs. In the long term, the ecotone would provide space for marshes to retreat inland in the face of sea level rise, increasing the resilience of the outboard tidal wetlands and the incidental flood benefits they provide. While the document explains that a narrower and steeper slope, e.g., 'bench' in Alternative 2, would provide only a few of these benefits, it could be more clear about how variations in slope between alternatives affects the level of benefits, especially in light of the fact that the non-Federal sponsor may increase the slope of the ecotone (to perhaps 20: 1), fluctuate the slope of the ecotone along the length of the levee, and/or not build the ecotone along sections of the levee if a slope of 30:1 is cost-prohibitive and/or there is not adequate free fill material (page 9-3). Final environmental analysis should discuss how the preferred slope is the minimum amount of fill necessary to achieve restoration objectives both under current conditions and as sea level rises. In particular, this discussion should include an explanation of how increased fill for transition zone habitat will achieve restoration objectives because this project appears to propose more upland fill than past restoration projects.	The question of the minimum fill needed to achieve the project purpose is discussed in the Consistency Determination for the Coastal Zone Management Act.
026_BCDC-4	In addition, Section 66605(d) states that the nature, location, and extent of fill should "minimize harmful effects to the bay area, such as the reduction or impairment of the volume surface area or circulation of water, water quality, fertility of marshes or fish or wildlife resources, or other conditions impacting the environment" . The document describes in detail how harmful effects to natural resources will be minimized. Final environmental analysis should also discuss geotechnical considerations, such as how the fill could be affected by scour and erosion, influencing the overall durability of the slope and its ability to provide benefits over time.	Considerations for erosion protection are discussed in the Geotechnical Investigation Appendix. It is believed that moderately vegetated levee side slopes will be appreciably resistant to erosion during high water (i.e. tidal) events. Transitional habitat fills provide added protection against erosion during both normal and high water events. It is anticipated that erosion/scour damage will be limited and small enough to either "self-repair" or require minimal action/adaptive management given the soil types to be used for the project fills. Scour related impacts are discussed in Section 4.2.
026_BCDC-5	Furthermore, Section 66605(e) states fills must be "constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters". The document thoroughly assesses hazards associated with geology, seismicity, and flooding. Alternative 3 includes a high enough levee to keep the study area out of the Federal Emergency Management Agency floodplain during the 50-year planning horizon (2017- 2067, with 2.59 feet of sea level rise 'USACE High Sea Level Change Scenario').	Thank you for your input and your comment is acknowledged; no revision to the text is required.

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026_BCDC-6	Lastly, Section 66605(f) requires that applicants have valid title "to the properties in question [so] that he or she may fill them in the manner and for the uses to be approved." Property ownership also affects Commission authorization type. The USFWS owns and managesA9, AIO, AII, AI2, A13, A14, and AIS as part of the Don Edwards San Francisco Bay National Wildlife Refuge. As the landowners of Ponds A9-A15, the USFWS would implement ecosystem restoration and wildlife-dependent recreation improvements on their lands. The USACE wouldbe the Federal implementing agency for all flood risk management features and for ecosystem restoration conducted in Pond A18 owned by the City of San Jose. (and not included in the SBSPR study area). All levee segments would be maintained by the SCVWD as a non-Federal sponsor, but it is unclear what entity would manage A18 post-restoration. Given the patchwork of Federal and non-Federal landowners, funding sources, and maintenance responsibilities, the Commission will need to determine whether a permit and/or consistency determination is appropriate during the permitting process.	The Nonfederal Sponsors (NFS), the SCVWD and the SCC, are both working with the City of San Jose to lay out future ownership and operations and maintenance responsibilities for Pond A18 in more detail. By the end of 2015, the NFS are anticipated to enter into a MOU with the City outlining the process for transferring Pond A18 and the adjacent areas associated with the levee to the NFS. It is likely that the SCVWD will acquire fee-title to Pond A18 and the associated levee area as well as the levee-top trail. The SCVWD will likely enter into a joint-use agreement with the City of San Jose for trail management and operation. All FWS properties (Ponds A9-A15 and New Chicago Marsh) will remain in FWS ownership. There are some areas of the project where very small parcels are held by private individuals or state agencies (such as State Lands Commission) and until the project is more advanced in design, the exact determination of lands that need to be acquired cannot yet be made. This does not significantly affect the project, however, as the majority of the lands would be included in the process described above. Before construction commences, the NFS is obliged to furnish all "Lands, Easements, Right-of-Ways, Relocation, and Disposal (LERRDs)" to the Corps for construction. Well prior to that, the detailed lands ownership information will be furnished to BCDC as part of completing the permitting process. Based on land ownership, it is expected that BCDC would issue a Consistency Determination for Ponds A9-A15 and associated levees and lands, and a permit to the NFS for Pond A18 and associated levees and lands (unless BCDC determines that a CD is more appropriate for the entire project because it is a Corps project).
026_BCDC-7	Bay Plan Salt Pond Policies. The Bay Plan Salt Pond policies encourage the restoration, enhancement, and conversion of former salt ponds to subtidal and wetland habitats, and require that such projects include clear and specific long-term and short-term biological and physical goals, success criteria, a monitoring program, and provisions for long-term maintenance and management needs (see Policy 3). The document describes how the project includes an extensive adaptive management plan (Shoreline Study Monitoring and Adaptive Management Plan for Ecosystem Restoration, Appendix I) that will guide the selection of the final mix of habitats. This plan should include an analysis of anticipated habitat types and their effects on abundance and distribution of fish and wildlife, effects of any proposed fill, flood management measures, protection of public facilities and utilities, and public access (expanded upon below).	The proposed project will follow the SBSP Restoration Project's adaptive management program and rely on this already-established process to guide the selection of the final mix of habitats as suggested by the comment. The Shoreline Study monitoring and adaptive management plan included with the integrated feasibility report and EIS/R was written more narrowly, per Corps requirements, to describe activities that can be cost shared by the Corps, namely those that fall within the project footprint and will determine whether the project has met its ecosystem restoration objectives. Other monitoring and adaptive management activities will be implemented by the SBSP Restoration Project's adaptive management program, such as those that occur outside of the project footprint or are associated with meeting permit requirements, other project purposes (flood risk management and recreation), or mercury issues. Information is provided in the main report regarding anticipated habitat types (Section 4.6.2.3.2 Action Alternatives, Figure 4.6-2 Shoreline Phase I Study Area and Biological Study Area Habitat, Table 4.6-7 Post-Restoration Conditions in the Study Area, Table 4.6-8 Post-Construction Tidal Marsh Totals in the Study Area, and) and their effects on abundance and distribution of fish and wildlife (Section 4.6.2.3.2 Action Alternatives [subsection General Aquatic Habitat Effects], Table 4.6-10 Aquatic Habitat Restoration Targets, Potential Adaptive Management Actions, and Effects on Aquatic Species and Habitat if Actions Are Implemented, Section 4.6.5 Summary, and Section 4.7.2.4.2 Action Alternatives (within Terrestrial Biological Resources section), Section 4.7.2.4.2.3 Operation and Maintenance Effects), the effects of proposed fill (Table 4.6-9 Summary of Impacts on Aquatic Habitats and Species from the Action Alternatives, Section 4.7.2.4.2.2 Ecosystem Restoration Construction Effects (Transitional Habitat subsection and Table 4.7-4 Transitional Habitat Impacts)), and protection of public facilities, utilities, and public access (Sections 4.11 Recreation (subsection 4.11.2.3.2 Action Alternatives) and 4.16 Public Utilities and Service Systems (subsection 4.16.2.3.2 Action Alternatives)).
026_BCDC-8	Bay Plan Climate Change, Shoreline Protection, and Safety of Fills Policies. The Bay Plan Climate Change policies require a risk assessment for larger projects (Policy 2), and that such projects be designed to be resilient to mid-century sea level rise projection with an adaptive management plan to address impacts from sea level rise at the end of the century (Policy 3). Bay Plan Shoreline Protection policies also require that shoreline protection projects be properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account. Moreover, the Bay Plan Safety of Fills policies state, in part, that "rights-of-way for levees or other structures protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay." The analysis in the document extends to 2067. Final environmental analysis should discuss how the project would be consistent with these requirements, including analysis of adaptability through end of century.	Consistency with BCDC polices is discussed in the Coastal Zone Management Act Consistency Determination (Appendix A8).
026_BCDC-9	Bay Plan Tidal Marsh and Tidal Flats Policies. The Bay Plan Tidal Marsh and Tidal Flats policies state in part, that, "where a transition zone does not exist and it is feasible and ecologically appropriate, shoreline projects should be designed to provide a transition zone between tidal and upland habitats." The document describes the feasibility of constructing a transition zone and how it is ecologically appropriate because it "mimics the natural landform that once existed around the perimeter of San Francisco Bay" (S-51).	The comment summarizes the intent and purpose of the ecotone proposed in the Shoreline Study Phase I project and that this is consistent with the Bay Plan's Tidal Marsh and Tidal Flat policies. The ecotone is also consistent with the recommendations of the draft Baylands Ecosystem Habitat Goals Update and the final USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California.
026_BCDC-10	Bay Plan Public Access Policies. The Bay Plan Public Access policies require that a proposed fill project increase public access to the Bay to the maximum extent feasible. The policies also state "public access should be sited, designed, and managed to prevent significant adverse effects on wildlife ... [and] avoid significant adverse impacts from sea level rise and shoreline flooding." Overall, ecosystem restoration would result in a reduction of about 7.4 miles of trails, however, with the addition of trail along Pond A18 (3.6 miles) and a proposed trail enhancement	The project's consistency with Bay Plan Public Access Policies is discussed in the Coastal Zone Management Act Consistency Determination (Appendix A8).

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	at SR 237 (1 .6 miles), the net loss would be about 2.2 miles. Final environmental analysis should describe how the proposed trail system would be the maximum feasible public access for the project, and how the trail system would reduce or avoid adverse impacts from human/wildlife interactions, temporary flooding, and permanent inundation.	

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CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Francisco Bay Regional Water Quality Control Board

Sent via electronic mail: No hard copy to follow

February 23, 2015
CIWQS Place ID No. 813084

Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers
San Francisco District
1455 Market St. San Francisco, CA 94103

Attn: William DeJager, Environmental Section A (ShorelineEnvironment@usace.army.mil)

Subject: Draft Interim Feasibility Report and Environmental Impact Statement / Report for the South San Francisco Bay Shoreline Phase I Project, Santa Clara County, CA
SCH No. 2006012020

Dear Mr. DeJager:

San Francisco Bay Regional Water Quality Control Board (Water Board) staff appreciates the opportunity to comment on the *Draft Interim Feasibility Report and Environmental Impact Statement / Report for the South San Francisco Bay Shoreline Phase I Study, Santa Clara County, CA* (SCH No. 2006012020) (F/EIS/EIR). The F/EIS/EIR is a combined Interim Feasibility Study and Environmental Impact Statement/Environmental Impact Report (Integrated Document) complying with Feasibility Study guidance of the U.S. Army Corps of Engineers (USACE), the National Environmental Policy Act of 1969, as amended (NEPA), and the California Environmental Quality Act of 1974, as amended (CEQA), and is intended to reduce duplication and paperwork.

Project Description and DEIS/DEIR Summary

The South San Francisco Bay Shoreline Study is an Interim Feasibility study that evaluates flood risk management an ecosystem restoration in the Alviso Salt Ponds complex and adjacent community of Alvis , Santa Clara County, California. The locally preferred plan (LPP)

recommended for implementation and identified as the tentatively selected plan (TSP) would provide a higher level of flood risk resiliency over the Tentative National Economic Development/National Ecosystem Restoration (NED/NER) plan and would allow for continued Federal Emergency Management Agency (FEMA) accreditation at the end of the study's period of analysis (2017-2067). It would also provide a broad transition zone between upland and tidal

marsh areas with the addition of an ecotone adjacent to some portions of the Flood Risk Management (FRM) levees. This ecotone would benefit the levee structure and provide significantly more acreage for marshes to retreat inland in the face of sea level change. A request for an exception to recommending the NED and NER Plan needs to be approved by the Assistant Secretary of the Army (ASA)'s office at Headquarters United States Army Corps of Engineers (HQUSACE) prior to completion of the draft Feasibility Study/Environmental Impact Statement (F/EIS).

The Santa Clara Valley Water District (SCVWD) and California State Coastal Conservancy (CSCC) are the non-Federal sponsors. They and the U.S. Army Corps of Engineers (USACE), the federal sponsor, initiated the feasibility phase of this study in 2005. The U.S. Fish and Wildlife Service (USFWS), while not a cost-sharing sponsor of the Shoreline Phase I Study, is a major landowner and significant stakeholder in the study area. The USFWS is also a co-Federal lead for the Shoreline Phase I National Environmental Policy Act (NEPA) process. The USFWS will be responsible for implementing ecosystem restoration actions and recreation improvements on lands that they own within the project boundaries – namely the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). With the passage of the Water Resources Reform and Development Act (WRRDA) of 2014 and language in Section 1025 relevant to the Shoreline Study, however, there may be an opportunity (pending Implementation Guidance) to include the ecosystem restoration of the USFWS lands as part of the Tentative NED/NER Plan or potential LPP, to be cost shared between the USACE and the non-Federal sponsor.

The study area has considerable risk for tidal flooding due to having large areas of low-lying terrain protected by non-engineered dikes. While there is currently some flood risk, the flood risk will substantially increase over the next several decades due to potential sea level change. Because of the substantial flood depths anticipated, the flood risk is high both from a public health and safety perspective as well as damage. In addition to the increased flood risk, the area has lost substantial amounts of coastal wetlands. In the study area, the creation of commercial salt harvesting ponds along southern San Francisco Bay resulted in a loss of most of the tidal salt marsh habitat. These local tidal marsh losses are in addition to San Francisco estuary-wide losses of approximately 90 percent of all tidal wetlands. The flood risk management and ecosystem restoration problems and opportunities are interrelated; implementing flood risk management features now, rather than after sea level rises, allows earlier implementation of the salt marsh restoration. Delaying the restoration may result in a sediment supply that cannot keep up with sea level change and a project that would require imported sediments in order to create marsh rather than rely on natural sedimentation.

The Tentatively Selected Plan (named Proposed Project under CEQA), is also a Locally Preferred Plan (LPP), and is identified as Alternative 3 in the F/EIS/EIR. The components of Alternative 3 include a Alviso North levee alignment, San José–Santa Clara Regional Wastewater Facility (WPCP) South levee alignment, a 30:1 (1 foot of elevation rise for each 30 feet of horizontal distance) ecotone adjacent to Pond A12/13 and A18, restoration of ponds A9-15 and A18, and a tidal flood gate at Artesian Slough. The combined Tentative National Economic Development (NED) / National Ecosystem Restoration (NER) plan is Alternative 2 – Alviso North levee alignment with an associated bench, WPCP South levee alignment, tidal flood gate at Artesian Slough, and restoration of ponds A9-15 and A18. Pending Water Resources Development Act (WRRDA 2014) implementation guidance regarding restoration on USFWS lands, the USACE action will currently be limited to implementing restoration within

Pond A18 and an ecotone adjacent to Pond A18. Therefore, a separate recommendation is made for the USFWS to implement restoration actions on USFWS- owned lands (Ponds A9–A15, and ecotone on A12/13, west of Artesian Slough and north of the community of Alviso).

The Tentatively Selected Plan includes an engineered levee, approximately 15.2 feet high, along existing salt pond berms—the eastern border of Pond A12 and southern borders of Ponds A16 and A18. This levee would provide protection against a 1-percent ACE storm event. The restoration at Pond A18 would consist of breaching existing salt pond berms, guided by the results of monitoring and adaptive management from other restoration efforts in the South Bay, to establish connection with San Francisco Bay, and construction of a 30:1 ecotone transitional habitat feature adjacent to the new levees in Pond A18.

Water Board Staff Comments

Water Board staff has the following General and Individual Comments on the F/EIS/EIR. Overall, we support the Project and recognize that it is needed both for flood protection and to enable the restoration of salt marsh and related habitats in about 2,800 acres of historically diked salt ponds in South San Francisco Bay. The Project presents permitting challenges, in that it would place fill into up to about 137.6 acres of waters of the State, consisting of 16.8 acres of wetlands and 120.8 acres of other waters. This is a significant amount of Bay fill. The Project would facilitate salt marsh restoration and would be part of a long-term adaptive management strategy to address the potential impacts of sea level rise in the Bay. However, the current proposal could have a significant delay between the placement of levee fill (i.e., the impacts) and the salt marsh restoration work (i.e., the mitigation), and other factors lead to uncertainty regarding the timing and potential success of the restoration. We urge the USACE to consider the information below, including our comments on Project design, timing, and funding, which are intended to identify specific permitting challenges and opportunities to address them up-front.

General Comment 1. Water Board staff supports the development of a combined flood control and habitat enhancement project.

We are encouraged by the evaluation of the flood control project as a component of the complete Project to both provide flood protection to communities in the south end of San Francisco Bay and to restore about 2,800 acres of tidal salt marsh in the former Alviso Salt Pond Complex Ponds A9 through A15 and A18. Water Board staff concur with the following text in Section 2.1, *Need for the Project.*

> Both flood risk management and ecosystem restoration are important to both the local community and the larger South Bay area. By formulating a multipurpose flood risk management and ecosystem restoration project, the project partners can both reduce flood risk in the area and facilitate tidal marsh restoration. 1

Reviewed in isolation, the flood control project would place fill into between 57 and 137 acres of waters of the State, consisting of wetlands and open water. This impact is unusually large for a single project and would require significant mitigation to be consistent with the *San Francisco Bay Basin Water Quality Control Plan* (Basin Plan), which incorporates the State of California's no net loss policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28). Therefore, the inclusion of tidal marsh restoration, along with the habitat enhancement provided by the proposed ecotone in the LPP, is valuable to expediting the Water Board's

permitting of the Project with a Clean Water Act (CWA) Section 401 water quality certification (Certification) and Waste Discharge Requirements (WDRs) issued pursuant to the California Water Code.

General Comment 2. Proposed mitigation for the impacts associated with the flood control elements of the project may result in a net loss of waters of the State and there is considerable uncertainty associated with full attainment of the Project's restoration goals.

The mitigation proposed for the Project's significant impacts to waters of the State consists of restoring open waters (former salt production ponds) to tidal marshes. This type of mitigation consists of transforming one type of jurisdictional water into a different type of jurisdictional water. The Water Board has not traditionally accepted this type of mitigation for significant impacts to waters of the State, since no new waters of the State are created as mitigation for the acres of waters of the State that will be lost to fill in the course of project implementation.

However, the Basin Plan directs the Water Board to consider specific guidelines and requirements, including the following, as a part of its mandated duty to protect waters of the State:

- The California Wetlands Conservation Policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28), requiring no net loss and a long-term net gain in the quantity, quality, and permanence of wetlands in California, including the San Francisco Bay region.
- The *Baylands Ecosystem Habitat Goals* (1999) (*Habitat Goals*), and the *Baylands Ecosystem Species and Community Profiles* (2000) (referred to collectively as the "Habitat Goals Reports"), which are to be used as guides for wetlands restoration in the vicinity of San Francisco Bay. 2

The Habitat Goals Reports envision the restoration of tidal marsh and similar habitat throughout the South Bay region, including the Project area, and contain recommendations for enlarging tidal marshes and protecting and enhancing marsh transition areas.

The Basin Plan recommends that the Habitat Goals Reports, which were written by over 100 local scientists and resource managers, be used as guides for wetland restoration to protect beneficial uses of waters in San Francisco Bay, not only for species but also to purify and store State waters. Use of the Habitat Goals Reports will help ensure that developments in the Project area are implemented in a manner that benefits tidal species, migratory and resident shorebirds, waterfowl, and the federally listed salt marsh harvest mouse (SMHM).

Chapter 5 of the Habitat Goals contains goals for the South Bay Subregion of San Francisco Bay.

> The overall goal in the South Bay subregion is to restore large areas of tidal marsh connected by wide corridors of similar habitat along the perimeter of the Bay. Several large complexes of salt ponds, managed to optimize shorebird and waterfowl habitat functions, should be interspersed throughout the subregion, and naturalistic, unmanaged salt ponds (facsimiles of historical, hypersaline backshore pans) should be restored on the San Leandro shoreline. ***There should be natural transitions from mudflat through tidal marsh to adjacent uplands* [*emphasis added*]**, wherever possible. Adjacent moist grasslands, particularly those with vernal pools, should be protected and improved for

wildlife. Riparian vegetation and willow groves should be protected and restored wherever possible

Chapter 5 of the Habitat Goals also includes the following specific recommendations for Segment P of the Bay shoreline – Coyote Creek Area (Southern end of San Francisco Bay between Alviso Slough and Albrae Slough).

- Restore tidal marsh throughout most of the segment, providing a continuous corridor of tidal marsh along the bayshore. The type of tidal marsh created (salt or brackish) will be dependent on the amount and proximity to local freshwater outflows. Restoration should ***emphasize reestablishing a natural transition between tidal marsh and adjacent wetlands and upland habitats*** **[*emphasis added*]**, as well as transitions between salt and brackish tidal marsh.
- Modify and manage a large complex of salt ponds for shorebirds and waterfowl.
- Restore or enhance vernal pools in the adjacent undeveloped uplands.
- Reestablish native riparian vegetation and otherwise improve the riparian corridor along Coyote Creek.
- Manage discharges from the San Jose treatment plant to limit adverse environmental impacts, especially to tidal salt marsh habitat. Consider using recycled water to augment flows in Coyote Creek or for other habitat enhancements.

On the basis of the Habitat Goals Reports, it is likely appropriate for the Water Board to consider using the restoration of salt ponds to tidal marshes as part of the Project's mitigation for impacts to waters of the State. The highlighted text in the quotes from the Habitat Goals Reports is supportive of giving mitigation credit for the creation of ecotones between marshes. However, as is discussed below, the federal sponsor is not currently proposing funding for all of the tidal marsh restoration or any of the ecotone restoration. The uncertainty associated with this funding approach may complicate the Water Board's consideration of Project permits. 2

The Water Board's online *Fact Sheet for Reviewing Wetland and Riparian Projects, San Francisco Bay Water Board* (December 1, 2006), provides guidance for permitting projects with wetland and riparian projects.

> The Basin Plan (Section 4.23.4) states that the "Water Board will evaluate both the project and the proposed mitigation together to ensure that there will be no net loss of wetland acreage and no net loss of wetland functions. The Water Board may consider such sources as the *Baylands Ecosystem Habitat Goals* (1999) and the *Baylands Ecosystem Species and Community Profiles* (2000) (referred to collectively as the "Habitat Goals Reports"), the San Francisco Estuary Project's *Comprehensive Conservation and Management Plan (1993)*, or other approved watershed management plans when determining out-of-kind mitigation." Mitigation is most effective at maintaining beneficial uses of waters of the State and achieving conformance with No Net Loss polices, first, if the mitigation occurs at the impacted site, which is referred to as "on site" mitigation, and, second, if the mitigation wetland recreates the same type of wetland as the impacted wetland, which is referred to as "in-kind" mitigation. Water Board staff considers proposals for off-site or out-of-kind mitigation where:
>
> 1. on-site/in-kind would be impractical;

2. there is an agreed upon watershed plan that justifies the need for off-site or out-of-kind mitigation or Water Board staff believes that the proposed mitigation is environmentally preferable to on-site/in-kind mitigation;
3. there is general agreement with the ecosystem principles or habitat recommendations contained within the Habitat Goals Reports referred to above;
4. other agencies (e.g., U.S. Fish & Wildlife Service [FWS]) prohibit the re-creation of certain wetland or related habitats that threaten special status species13

The No Net Loss Policy is generally used to determine the amount of mitigation required. Existing wetlands are already successful ecosystems, but the success of mitigation projects is highly uncertain until after established monitoring periods have determined that wetland hydrology, vegetation, and soils have developed.... Each site is reviewed on a case-by-case basis, and no pre-determined set of ratios is used to determine mitigation, though a minimum of 1 acre lost to 1 acre gained is typically required. However, temporal losses must also be considered, which are defined as functions lost due to the passage of time between loss of the impacted wetland and creation/restoration of the full-functioning mitigation wetland..... Thereafter, additional mitigation can be required for:

- The loss of or potential for impacts to medium to high quality habitat;
- The loss of or potential for impacts to special status species or their associated habitats;
- The construction or restoration of wetlands that take relatively long to develop (e.g., riparian); 2
- ***Delays in the construction or restoration of mitigation wetlands, relative to when the impacted wetlands have been filled [emphasis added]***. Compensatory mitigation wetlands should generally be restored or constructed prior to or concurrent with filling the impacted wetland, and additional mitigation is typically required when the mitigation work occurs after the impacts;
- ***Uncertainty associated with the construction or restoration of mitigation wetlands [emphasis added]***;
- The placement of off-site mitigation wetlands or the creation of out-of-kind wetlands (created or restored wetlands that are different habitat types than the impacted wetland), though this can be allowed where it is demonstrated that an overall net gain will occur.

Based on the information provided in the F/EIS/EIR, there is considerable uncertainty associated with the successful establishment of fully functioning tidal marshes in the former salt ponds. As is noted in Chapter 3 of the F/EIS/EIR, the South Bay appears to be on the verge of becoming a sediment sink, rather than a sediment source.

In addition to the uncertainties around sea level change, the other part of the equation for adequate marsh accretion rates is the amount of suspended sediments in San Francisco Bay. Current levels are quite high in the interim study area, and recently restored marshes are benefiting from those levels as evidenced by high accretion rates. Recent research from the USGS, however, indicates that San Francisco Bay is becoming less turbid and that current levels of suspended sediments are not likely to remain the same in coming decades. With increasing sea levels and decreasing sediment supplies, restoration practitioners and

researchers in San Francisco Bay are encouraging proceeding with a sense of urgency to create sustainable marshes. Delays in initiating restoration would create a substantial risk of the ponds being restored to tidal action too late for their bottom surfaces to reach marsh elevation before the acceleration of sea level change renders the natural sedimentation process inadequate for marsh restoration to occur. Waiting until confirmation of the future rate of sea level change would create the risk of not being able to respond in a timely manner to a genuine change in the long-term trend. [From Section 3.11.1.1.2 of the F/EIS/EIR.]

Therefore, it is not completely certain that the South Bay will have sufficient sediment available for full tidal marsh restoration within almost 2,800 acres of current salt ponds at the time that the former salt ponds are breached to restore tidal flow to the ponds. Additional mitigation is usually required by the Water Board to compensate for this type of uncertainty. To compensate for the combination of out-of-kind mitigation, uncertain sediment supply for marsh restoration, and an unusually long time period between project impacts and the successful functioning of restored tidal marshes (See General Comment 3), the Water Board would usually would require that the area of restored tidal marshes be much greater than the area of impacted wetlands and open waters. 2

Since the uncertainties related to sediment supply will increase over time, we encourage the USACE to commence work on the Project as soon as possible. Additionally, we encourage the F/EIS/EIR to consider alternative sediment sources, such as beneficial reuse of dredged sediment associated with maintaining navigational channels in San Francisco Bay.

General Comment 3. There will be a significant time lag between Project impacts to waters of the State and the full functioning of mitigation elements.

Another complication with the Project's mitigation component is the significant time lag between the proposed fill of waters of the State along the proposed alignment of the new flood control levees and both the full restoration of tidal marshes in former salt ponds and the construction and full vegetation of the proposed ecotones. As was noted in General Comment 2, more mitigation is usually required by the Water Board when the duration of temporal losses of aquatic habitats is larger.

The mitigation component of the Project has a very long time lapse between the impacts to the wetlands and other waters in the footprint of the flood protection levee and the initiation of tidal marsh restoration in former salt ponds. According to Section 3.8.3 of the F/EIS/EIR, levee construction will occur between 2017 and 2020. Pond A12 will be breached in 2020 and Ponds A9 through A11 and A18 would be breached in 2025. Therefore, there is an 8 year time lapse between the first impacts to waters of the State and the breaching of levees at the majority of the ponds that are to be restored to tidal marshes. In addition, the end of the temporal loss period will not be attained until the restored marshes have become fully functional tidal marshes (assuming that the sediment supply is sufficient for the creation of the tidal marshes). Most of the projects authorized by Water Board permits commence mitigation construction in the same year that the project causes its first impact to waters of the State. The unusually long temporal loss period associated with the Project's mitigation likely will require a commensurately larger amount of mitigation to be consistent with other Water Board permits for projects with large impacts. In order to minimize the temporal losses associated with the Project, Water Board staff encourages the USACE to start preparation work for tidal breaching concurrently with levee 3

construction so that the first salt pond levees can be breached as soon as the flood control levee is completed.

General Comment 4, Water Board Staff are concerned that the use of the Combined Habitat Assessment Protocols (CHAPS) may not have been appropriate to selecting the Federally Preferred Alternative.

We are concerned that the process used to determine that the creation of an ecotone along the new flood control levee could not be considered part of the federally preferred alternative did not appropriately consider the Project benefits of the ecotones, including potential reductions in costs for the additional mitigation that may be required in the absence of the ecotones. The method used to evaluate environmental benefits of each alternative is summarized in Section S.11.7, *Screening of Ecosystem Restoration Options*:

> The study team evaluated the efficiency of ecosystem restoration options by comparing their costs to ecosystem restoration outputs. Costs include preconstruction engineering and design, real estate, construction, and ongoing operation, maintenance, and rehabilitation. Unlike the flood risk management options, however, benefits arising from an ecosystem restoration are not monetized. The ecosystem restoration outputs are calculated using the Combined Habitat Assessment Protocol (CHAP). The CHAP was agreed upon by the non-Federal sponsors and the vertical team when defining what type of assessment to use to screen ecosystem restoration options (discussed more in Section 3.6.4 *Criteria for Evaluation and Screening of Ecosystem Restoration Options* of the main report). The CHAP model, which is biased towards habitats benefitting more species, did not show increased habitat value for the transitional habitat because it does not benefit more species than does the tidal marsh. [However,] The transitional tidal marsh habitat is highly important, with technical and institutional significance, and will provide habitat functions that have been lost all around the San Francisco Bay.

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The application of this process to assessing the benefits of the proposed ecotone is summarized in Section S.11.7.2, *Transitional Habitat Screening*:

> The 30:1 ecotone met the completeness, effectiveness, and acceptability criteria but did not meet the efficiency criterion because the environmental benefits analysis (CHAP) did not show additional benefits when adding an ecotone to the project relative to the benefits provided by the less-extensive and less-expensive bench transitional habitat measure. This outcome is despite the widely accepted idea that greater areas of transitional habitats provide an opportunity to create more refugial habitat as well as specialized habitats which have been lost in San Francisco Bay. CHAP was unable to evaluate the efficacy of these considerations. As a result of the efficiency analysis, the level of Federal investment was set at the bench refugia measure, which only provides incidental benefits from building the levee. The additional cost of implementing an ecotone would be a non-Federal expense.

While Water Board staff appreciates the general value of focusing on more than one species in habitat evaluations, as the CHAPS analysis does, the unique characteristics of the restoration opportunities in the Alviso Complex Salt Ponds call for a focus on listed species that depend on tidal marshes. Both the Habitat Goals and the *USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan) (USFWS, August 27, 2013), which include recovery actions for the California Ridgeway rail (formerly California Clapper Rail) and salt marsh harvest mouse (SMHM), support both the restoration of as many acres of

tidal marsh as feasible and the creation of ecotones between marsh habitats and upland high water refuges.

The Recovery Plan features five endangered species: two endangered animals, California clapper rail (*Rallus longirostris obsoletus*) and salt marsh harvest mouse (*Reithrodontomys raviventris*), and three endangered plants, *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle), *Chloropyron molle* ssp. *molle* (soft bird's-beak), and *Suaeda californica* (California sea-blite). The biology of these species is at the core of the recovery plan, but the goal of this effort is the comprehensive restoration and management of tidal marsh ecosystems. According to the Recovery plan, "California clapper rails occur almost exclusively in tidal and brackish marshes with unrestricted daily tidal flows, adequate invertebrate prey food supply, well developed tidal channel networks, and suitable nesting and escape cover providing refugia during extreme high tides." In the restored marshes, the ecotones will provide critical refuge during extreme high tides.

The Recovery Plan also states that "*Viable* populations of salt marsh harvest mice also appear to be limited by the distribution of high tide cover and escape habitat. Recurrent but shallow flooding by saline water is probably needed to maintain habitat that favors the salt marsh harvest mouse over its potential competitors. Anticipated sea level rise presents a severe threat in the long-term, especially in the central and south San Francisco Bay where opportunities for landward migration of habitat are absent." The proposed ecotones will provide high tide cover and escape habitat, as well as providing some opportunities for landward migration of habitat.

Figure I-1, *Intertidal distribution of the focal species covered in this recovery plan,* in the Recovery Plan shows the distribution of listed species covered in the Recovery Plan along the tidal gradient. As is illustrated in this figure, the upland ecotone is used by both the California clapper rail and the SMHM, and also provides the majority of habitat for the three plant species covered in the Recovery Plan: *Cirsium hydrophilum* var. *hydrophilum, Cordylanthus mollis* ssp. *mollis,* and *Suaeda californica.* Table 8.5-1, *Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and California Clapper Rail,* in the F/EIS/EIR also emphasizes the importance of high marsh/upland transitional habitats. Since the CHAPs Environmental Benefits analysis was not able to identify the benefit to listed species associated with creating an upland ecotone, we are concerned that the CHAPs method may not have been an appropriate method for evaluating whether the federally preferred alternative should have included the ecotones. 4

Problems related to the use of the CHAPs methodology for the Project are also described in Section 3.11.6 of the F/EIS/EIR.

> The model used by the study to assess environmental benefits, CHAP, was unable to demonstrate that additional costs associated with accelerating restoration, or adding transitional habitat greater than the minimal refugia bench, would result in additional environmental outputs. Model results are presented in Appendix J. For the Pond A12, Ponds A13–A15, and Pond A18 increments considered as part of the CE/ICA process, the CHAP results show that additional cost and additional features result in the same or fewer average annual outputs. This model result is at odds with what the study team believes would be the ***real-world result*** [***emphasis added***]. For example, adding transitional marsh habitat (with 30:1 side slopes) to the restoration effort should result in greater outputs than what would be realized with the smaller bench refugia measure. Like all models, the

> CHAP model is an imperfect representation of the real world, and, whether due to model characteristics or to the way the model was used, it did not demonstrate and quantify this difference.

The analysis in Appendix J shows that the various habitat elements of tidal marshes were assessed as individual habitat units, rather than the complex mosaic of habitats that are essential to the recovery of the California clapper rail and the SMHM. Water Board staff encourages the Project team use an analysis that better reflects a "real-world result."

Section 4.7.2.2, Methodology for Impact Analysis, in the F/EIS/EIR states that, "according to the USACE Planning Guidance Notebook (ER 1105-2-100), the criteria for determining the significance of potential impacts associated with ecological resources "shall include, but not be limited to, ***the scarcity or uniqueness of the resource from a national, regional, state, and local perspective***" [***emphasis added***] (ER 1105-2-100, Appendix C, p. C-15)" and goes on to quote the Planning Guidance Notebook as follows:

> In summary, the case can be made that environmental resources are significant based on technical recognition when, within a specified geographic range, those resources are either scarce; are representative of their respective ecosystems; will improve connectivity or reduce fragmentation of habitat; represent limiting habitat for important species; will improve or increase biodiversity; or trends indicate that the health of the resource is imperiled and declining, but can be recovered through human intervention

This quote appears to support assigning value to the proposed 30:1 ecotone, since ecotone habitats in the South Bay are "scarce; are representative of their respective ecosystems; will improve connectivity or reduce fragmentation of habitat; represent limiting habitat for important species; will improve or increase biodiversity; or trends indicate that the health of the resource is imperiled and declining, but can be recovered through human intervention." 4

Finally, text in Section 9.3 of the F/EIS/EIR emphasizes the essential nature of the ecotone to the Project's mitigation.

> Ecosystem restoration under the TSP would also include an ecotone (30:1) transitional habitat feature in Ponds A12, A13, and A18, which would be constructed bayward to the proposed flood risk management levee along the eastern boarder of Pond A12 and the southern border of the ponds A13 and A18. The ecotone would contribute to the value of the marsh and future success of special status species using the marsh providing an important transitional zone and high-tide refugia. As noted earlier in this report, this sort of upland transitional habitat is not well represented in the South Bay due to severe loss of habitat. In the study area, ecotones are mostly absent along levees due to the abrupt transition between middle marsh habitat and steep-sided levees. In the long term, the transitional ecotone area would provide space for marshes to retreat inland in the face of sea level change. ***This habitat feature is critical to achieving the project's restoration objectives. By providing this refuge, the ecotone would greatly increase the resiliency and longevity of the outboard tidal wetlands and the incidental flood benefits they provide, such as wave attenuation and flood water storage [emphasis added].***

To Water Board staff, it does not appear appropriate for the federal sponsor to reject funding the construction of the ecotone on the basis of the CHAPs analysis, when the CHAPs analysis would also not support giving the Project mitigation credit for ecotone creation. If the Water Board is

being asked to consider the value of the new ecotones on habitat values when evaluating the sufficiency of the Project's mitigation, then the federal sponsor should also be using the same criteria when selecting the federally funded elements of the Project.

Individual Comment 1

According to text in Section S.11.2.3 *Wastewater Facility (WPCP) Segment Levee Alignment*:

> Four potential WPCP levee alignments are located east of Artesian Slough (Figure S-6). Two variations of WPCP South alignment follow the existing levee that runs west to east in a stair-step pattern along the north border of the existing Wastewater Facility infrastructure. One then cuts across existing Wastewater Facility drying beds, and the other turns north to follow the existing levee along the eastern side of Pond A18. Alternatively, the WPCP North alignment includes construction of a new levee that partially bisects Pond A18, expanding the area that would be available south of the proposed engineered levee, and then also either cuts across existing Wastewater Facility drying beds or turns north to follow the existing levee along the eastern side of Pond A18 (the same as the WPCP South options). Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. As the Wastewater Facility Master Planning effort proceeds into design, however, there may be further opportunity to revisit the alignment section. Additional environmental evaluation would be required if it is decided that this footprint is a better environmental option and meets the Wastewater Facility schedule for discontinuing the operation of drying biosolids in that area. 5

Water Board staff encourage the USACE to retain alignment options through the former Wastewater Facility drying ponds. Although these ponds may contain some contaminants at hazardous levels, the contaminants are relatively immobile inorganic contaminants. Capping such contaminants in place under an engineered levee may be an acceptable means of closing some of these historic wastes in place. It is also possible that a levee alignment along the former drying beds may make it possible to avoid the need for a flood gate across Artesian Slough, since the levee alignment could be brought south of Artesian Slough. While the Water Pollution Control Plant (WPCP) may lose some land area to a levee alignment through the historic drying ponds, removing the proposed flood gate from Artesian Slough may be beneficial for WPCP operating parameters. As is discussed in Individual Comments 2 and 13, placing a flood gate over Artesian Slough about 300 feet downstream from the discharge from the WPCP may complicate the discharge protocols for the WPCP. Under the current NPDES permit for the WPCP, discharge rates of treated, fresh water to Artesian Slough are restricted to prevent impacting tidal marshes with fresh water. Construction of the proposed tide gate over the slough may require a revision of the WPCP's NDPES permit.

Individual Comment 2

According to text in Section S.11.4.2, *Artesian Slough Crossing Options*: 6

> The flood wall closure with tide gate crossing measure met all screening criteria and was retained. The levee measure (construct new levees along Artesian Slough) met all of the screening criteria but was eliminated because it is less economically efficient than the tide gate measure and did not provide any additional advantages relative to the other criteria. A flood wall across the slough would provide an equal level of flood risk management at a lower cost than the new levees along Artesian Slough.

We encourage the USACE to consider retaining the levee measure along Artesian Slough. This would reduce the placement of fill into the Slough and could significantly reduce potential impacts to the WPCP and potential conversion of aquatic habitat in the Slough, thus reducing the Project's mitigation needs. Depending on the extent to which levees on the west and east banks of Artesian Slough would impact existing wetlands, this option may not have significant impacts to wetlands, but would avoid the direct fill of Artesian Slough that would be caused by flood gate construction. Also if the levee alignment were taken through the WPCP's historic drying ponds, the levee on the east bank of Artesian Slough could be eliminated. This option would also not directly impact the discharge of treated WPCP effluent to Artesian Slough, since the mixing zone for cyanide releases from the WPCP would not be impacted by a flood wall across the slough, about 300 feet downstream from the WPCP effluent discharge point. 6

Also, it is not clear that closing flood gates downstream of the WPCP effluent discharge is feasible. In 2012 and 2013, average daily discharge volumes to Artesian Slough were between 90 and 100 million gallons per day (MGD), with a maximum discharge of 132 MGD. Discharge rates from the WPCP are greatest during storm events, when infiltration into laterals adds to the volume of influent that is received by the WPCP, which is subsequently discharged into the Slough. Therefore, the times when the flood gates are most likely to be shut in response to potential flooding are likely to coincide with the highest discharge rates into Artesian Slough. The F/EIS/EIR should have evaluated how effluent would be managed during times when the flood gates are closed to provide flood protection.

Finally, placing a flood gate across Artesian Slough is likely to impact the nature of aquatic habitat upstream of the flood gate. This may be considered an impact to a water of the State that requires mitigation.

Individual Comment 3

Text in Section S.14.1, *National Economic Development* (pages S-43 to S-44), states that:

> There is a difference in cost of approximately $3 million between the two levees. However, the tentatively identified 13.5 foot alternative (NED Plan) has higher net benefits (compared to 12.5 foot levee), is more resilient, is more compatible with California policies on sea level change (CA has adopted a curve that aligns with USACE high SLC curve), and is more consistent with an adaptive management perspective in accordance with ETL 1100-2-1 (*Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*) with potential lower life-cycle project costs. Further, implementing a 13.5 foot NED Plan in all likelihood would have less long-term environmental impacts (i.e., build the levee once rather than having to mobilize equipment at a later date to raise the levee and incur adverse impacts to established tidal wetlands that support threatened and endangered species). The Tentative NED has therefore been identified as the 13.5 foot levee. It is acknowledged that the NED plan may revert to a different levee height (i.e., 7

12.5 foot) in consideration of policy stated in ER-1105-2100. Exhibit G-1 states that identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan, even though the level of outputs may be less. Further, USACE policy also generally recommends selection of smaller scale plans when plans have similar net benefits. Since the 12.5 foot levee has similar net benefits to the 13.5 foot levee across all three SLC scenarios, and because it could potentially be raised in the future if necessary for higher sea level change than that projected under the low or intermediate scenarios, it is possible that the 12.5 foot levee may be ultimately selected as the NED FRM option to establish the basis for Federal project cost share. This decision will be made prior to completion of the Final Report submittal.

Water Board staff are supportive of the preference for constructing the most resilient levee as part of the Project, rather than expanding the levee at a later date to maintain flood protection. Opportunities for shoreline mitigation have been declining in the Bay Area and costs for available mitigation options have been increasing. In the long run, it is likely to be cost effective to construct the most resilient levee feasible as part of the Project, since future mitigation for future impacts is likely to be more expensive. If the costs of mitigation associated with future raising of the levee are included in the cost analysis, constructing the higher levee now may be more economical. The absence of cost estimates for mitigation activities is a weakness in the analysis of the Project's alternatives. 7

Additionally, we encourage the federal sponsor to consider making the 15.2 foot levee the federal preferred option. As is noted in Section 4.4.1.2.2.3, land subsidence may be continuing in the Alviso area. Therefore, assessments of levee performance should account for ongoing land subsidence, as well as sea level rise. When land subsidence is factored into future levels of flood protection, it appears possible that the 15.2 foot levee could become the federally preferred alternative.

Individual Comment 4

Section, S.15, *Tentative NED/NER and Locally Preferred Plan*, contains the following text:

> The flood risk management and ecosystem restoration problems and opportunities are interrelated and should be constructed in parallel. Implementation of flood risk management features now, rather than after sea level change, allows earlier implementation of the tidal marsh restoration both on non-Federal lands under the proposed project and incidentally will afford the USFWS (or USACE pending WRRDA 2014, Section 1025 Implementation Guidance) the opportunity to implement tidal wetland restoration on USFWS lands (note- the purpose of flood risk management features is to provide protection to non-Federal infrastructure [i.e., Community of Alviso]). Delaying the restoration could require costly imported sediment to create marsh habitat in consideration of future sea level change. In addition, if the tidal marsh restoration was implemented prior to the flood risk management features, filling of wetlands and endangered species habitat (i.e., the newly established tidal marsh) would be required, resulting in a need to establish an off-site mitigation area. 8

> The Tentative NED/NER Plan includes the Alviso North levee alignment, WPCP South levee alignment with a Tentative 13.5 foot levee height and basic restoration of Ponds A9-15 (USFWS) and Pond A18 (City of San José) with a bench as part of the levee construction, but resulting in incidental transitional habitat (Figure S-9). Under current policy (pending WRRDA 2014, Section 1025 Implementation Guidance regarding restoration activities on USFWS lands), USACE is limited to implementing restoration on Pond A18.

We concur that the "flood risk management and ecosystem restoration problems and opportunities are interrelated and should be constructed in parallel." Because of this, the eventual application for the Project must include both the flood control elements, which have significant impacts to waters of the State, and the habitat restoration elements, which are essential to providing the necessary mitigation for the impacts to waters of the State. 8

However, as is noted in our prior comments, the Tentative NED/NER Plan should include both the 15.2 foot levee and the creation of the 30:1 ecotones on the outboard side of the new levees. We encourage the USACE to factor future mitigation costs associated with raising the levee from 13.5 to 15.2 feet at some time in the future into the economic analysis of alternatives. If sea level rise in the future requires raising the levee to15.2 feet to provide sufficient flood control, this levee raising work may occur after tidal marsh restoration is complete and tidal marsh restoration is no longer a source of mitigation credit.

Individual Comment 5

The summary of unavoidable adverse effects in Section CS-4 does not include the net loss of waters of the State in the footprint of the new levee. 9

Individual Comment 6

We are concerned by the following text in Section 2.7.4, *Additional Planning Considerations*:

> Current USACE levee guidance requires suppression of natural intertidal and transitional vegetation on levees and the artificial maintenance of perennial grass on the entire levee surface. This requirement may be impractical in intertidal brackish and saltwater areas.

As Water Board staff has pointed out in numerous comments on the USACE policy on vegetation on levees, we are concerned that the USACE guidance reduces habitat values on levees, without providing commensurate benefit to the structural integrity of levees. Along levees that will include an outboard ecotone, the lack of vegetation on the levee may be mitigated to a great extent by vegetation in the ecotone. However, along Pond A16, which is operated as a managed pond, the current Project plan does not include an ecotone. Therefore, species attempting to use the levee as a migration corridor will be vulnerable to predation. Water Board staff encourage the Project to include an ecotone along the levee at Pond A16. Vegetation on such an ecotone may provide a more secure migration corridor between Pond A18, to the east of Pond A16, and Ponds A12 and A13, to the west of Pond A16. The barriers to SMHM migration posed by levees with vegetation controls is specifically mentioned on page 4-298 of the F/EIS/EIR. We encourage the USACE to ensure that potential SMHM migration corridors are sufficiently vegetated to support SMHM migration. 10

Individual Comment 7

Section 3.5.5.4 of the F/EIS/EIR describes the reasons for selecting the tide gate option for the Artesian Slough crossing.

> The flood wall closure with tide gate crossing measure met all screening criteria and was retained. The levee measure (construct new levees along Artesian Slough) met all of the screening criteria but was eliminated because it is less economically efficient than the tide gate measure and did not provide any additional advantages relative to the other criteria. A flood wall across the slough would provide an equal level of flood risk management at a lower cost than the new levees along Artesian Slough. With or without a flood wall/tide gate closure, the Wastewater Facility would have to deal with sea level change in their discharge operations. In an effort to best meet the general operation requirements for the Wastewater Facility and allow for discharge during storms, the tide gate will be designed in coordination with Wastewater Facility engineers. It is assumed that the tide gate would have staged elevation relief points to minimize impacts to the treatment plant operation. Additionally, the proposed location of the tide gate for all alignment options would be at least 300 feet bayward of the existing Wastewater Facility outfall for treated water at Artesian Slough (see Figure 3.5-2 *Potential Artesian Slough* Crossing). 11

Water Board staff encourage the Project team to conduct further analysis of the Artesian Slough crossing. The Project's preferred flood wall closure with tide gates may provide additional permitting complexity, as well as operational complexity, for this element of the Project. The infrastructure associated with a tide gate will place fill in waters of the State, which will require mitigation. And the placement of a barrier across Artesian Slough, about 300 feet Bayward of the WPCP effluent pipe, may complicate the WPCP's compliance with its NPDES permit. The current NPDES permit limits the amount of treated water that may be discharged to Artesian Slough; this limitation is necessary to minimize the tendency of the effluent stream to convert tidal marshes to brackish or fresh water marshes. Obstructions in the slough may alter the salinity regimes in the slough and require modifications to the WPCP's NPDES permit.

In most of the F/EIS/EIR, the discussion of the tide gates states that they would only be closed in responses to imminent flood events, but in Section 4.6.2.3.2, a reference is made to seasonal closing of the tide gates. Extended periods of tide gate closure will impact salinity regimes in the slough and may affect the relative distribution of tidal and brackish habitats. Such changes in marsh type may require mitigation. The Project team should provide a more detailed description of tide gate operating protocols so that the full range of impacts associated with the tide gates, as well as any necessary mitigation for such impacts, can be evaluated by Water Board staff.

Individual Comment 8

A discussion of the level of Federal investment in the proposed ecotone is provided in Section 3.6.5.2.

> The bench refugia measure met all of the screening criteria and was retained. The 30:1 ecotone met the completeness, effectiveness, and acceptability criteria but did not meet the efficiency criterion because the environmental benefits analysis (CHAP) did not show additional benefits when adding an ecotone to the project relative to the benefits provided by the less-extensive and less-expensive bench transitional habitat measure. The model could not distinguish between two beneficial habitat types, which in this case, tidal habitat is the ideal transition, versus just pond. This outcome is despite the idea that greater areas 12

of transitional habitats provide an opportunity to create tidal marsh habitats that natural sedimentation would not create, because of low pond bottom elevations. As a result of the efficiency analysis, the level of Federal investment was set at the bench refugia measure, and the additional cost of implementing an ecotone would be a non-Federal expense.

As is discussed in General Comment 4, Water Board staff is not convinced that the CHAP analysis appropriately assessed the efficiency criterion. The Recovery Plan, which is a federal document, clearly states that ecotones are an essential habitat element to the recovery of California clapper rails and SMHM, as well as the three plants covered by the Recovery Plan. The Project team is encouraged to revisit the screening protocol and use a protocol that reflects the clear guidance provided in the Recovery Plan. 12

Individual Comment 9

Section 3.9.1.1 of the F/EIS/EIR contains the following text:

> Mitigation for the loss of wetlands and related impacts to wetland species from construction of the levees would be required if this were a USACE single-purpose flood risk management project. Because the project also includes restoration of managed ponds to tidal marsh, however, and this restoration will provide much more habitat than would be lost to the levee construction, no mitigation is proposed.

We are concerned that the approach proposed in this text may pose a significant permitting challenge. For Alternative 3, the Project would place fill into a total of about 137.6 waters of State, consisting of 16.8 acres of wetlands and 120.8 acres of other waters. As noted in General Comments 2 and 3, the mitigation elements of the Project are associated with potentially significant temporal losses in habitat and significant uncertainty related to the availability of sediment for the full restoration of about 2,800 acres of tidal marshes (See Section 3.11.1.1.2 of the F/EIS/EIR). In addition, much of the mitigation is associated with the conversion of one type of water of the State, open waters, into another type of water of the State, tidal marshes. To compensate for the net loss of waters of the State, the Project should demonstrate consistency with the Basin Plan by including closer conformance with the Habitat Goals and the Recovery Plan in the mitigation covered under the federally funded project elements. Also, since some of the mitigation elements are not covered under the federally preferred project, and, therefore, not federally funded, there is additional uncertainty associated with full implementation of all of the Project's mitigation measures. 13

Individual Comment 10

Section 4.4.3 of the F/EIS/EIR discusses potential mitigation measures for the potential impacts of Project-related scour on the Union Pacific Railroad bridge crossing of Coyote Creek. Proposed measures include the following:

- Modify the bridge structure, such as by constructing new pilings and underpinnings, to accommodate the scour.
- Place rock armoring across the channel for some distance upstream and/or downstream of the bridge to limit scour at the bridge supports and approaches.
- Place rock armor along the bed and banks of the channel at the bridge and along the bed and railway embankment on both sides of the bridge to limit scour. 14

Water Board staff would like to point out that all of these proposed measures involve the placement of fill in waters of the State and would require permits from the Water Board and

appropriate mitigation. Also, the Water Board does not usually allow armoring that extends from bank to bank across a channel.

Individual Comment 11

The Basin Plan, which was developed under the authority of the State's Porter-Cologne Water Quality Control Act, should be added to Table 4.6-1, *Regulations and Programs That Apply to Aquatic Biological Resources.* In the Basin Plan, waters and wetlands in the South San Francisco Bay have been assigned beneficial uses that include estuarine habitat, fish migration, fish spawning, wildlife habitat, and the preservation of rare and endangered species. 15

Individual Comment 12

Section 4.6.2.2 includes the following text:

> **Impact ABR-1**: Have a substantial adverse effect, either directly or through habitat modifications on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, or the USFWS; a substantial adverse effect includes an impact that would jeopardize the continued existence of a species listed under the FESA and/or cause substantial adverse effects to EFH; or substantially interfere with the movement of any native resident or migratory fish 16

Please add the National Marine Fisheries Service (NMFS) to the species agencies in this impact discussion. NMFS addresses impacts to EFH and to anadromous fish species (e.g., steelhead and salmon).

Individual Comment 13

Section 4.6.2.3.2, *Action Alternatives*, includes a discussion of operation of the proposed Artesian Slough tide gate (See Page 4-227).

> Seasonal or event-based operation of the Artesian Slough tide gate could interfere with the movement of aquatic species into and out of Artesian Slough for feeding and rearing. Negative effects for fish could be attributed primarily to potential entrainment and stranding on the landward side of a closed gate and exclusion from the slough for fish on the bayward side of the gate. These effects could temporarily affect survivability and could alter migratory patterns, foraging behavior, and the availability of prey. Restoring tidal habitats would provide conditions for improving the health of the estuarine ecosystem and would substantially outweigh potential effects of temporary exclusion from or entrainment in Artesian Slough. 17

This is the first time in the F/EIS/EIR that the possibility of "seasonal" rather than "event-based" operation of the tide gate is proposed. As is noted in Section 4.6.2.3.2, seasonal operation would be likely to have impacts to habitat values in Artesian Slough and habitat types in Artesian Slough. The Water Board is likely to require mitigation for those impacts. Event-based operation is also likely to have impacts habitats in the slough, but those impacts are anticipated to be of shorter duration. The text also suggests that tidal marsh habitat enhancement would mitigate the tide gate's impacts to brackish marsh and open water habitat. As is noted in prior comments, the tidal marsh restoration would be off-site and out-of-kind mitigation for impacts to Artesian Slough.

Seasonal operation of the tide gate is also more likely to impact the WPCP's discharges to Artesian Slough and require modification to the WPCP's NPDES permit.

Individual Comment 14

The discussion of Ongoing Effects Due to the Presence of Recreation Features on Page 4-229 of Section 4.6.2.3.2 should be expanded to include a discussion of the use of pedestrian bridge railings as perches by avian predators of fish, California clapper rails, and SMHM. 18

Individual Comment 15

Page 4-295 of the discussion in Section 4.7.2.4.2.1, *Levee Construction Effects*, includes the following text.

> As noted in Table 4.6-8 *Post-Construction Tidal Marsh Totals in the Study Area*, ecosystem restoration associated with Alternative 3 is expected to result in the creation of 2,783 acres of tidal marsh (assuming the project is implemented as proposed and all ponds are converted). The minor losses of seasonal wetland (saline flat) and muted tidal/diked marsh habitat associated with levee construction effects would be completely offset in the long term by tidal marsh habitat gains associated with the Shoreline Phase I Project.
>
> However, it is understood that the immediate direct effect on the habitat would not be mitigated until a later date. Breach of Pond A18 to restore tidal action is scheduled for 2025–2026; creation of fully functioning tidal marsh would depend on natural action and adaptive management, if needed. This process could take many years. Overall, however, this impact would not be significant since the project would not result in a net loss of tidal marsh habitat over time.
>
> *Impacts on sensitive natural communities, including seasonal wetland and muted tidal/diked marsh habitat as a result of the Alviso North levee segment option would be less than significant.* 19

First, we note that the fill of almost 140 acres of waters of the State is not considered a minor loss by the Water Board. The considerable uncertainties associated with the Project's mitigation measures do not support the statement that "losses of seasonal wetland (saline flat) and muted tidal/diked marsh habitat associated with levee construction effects would be completely offset in the long term by tidal marsh habitat gains associated with the Shoreline Phase I Project."

As noted in prior comments, there are significant uncertainties associated with the proposed mitigation. The timing of the marsh restoration results in significant temporal losses and the availability of sufficient sediment for tidal marsh restoration at the time of the future salt pond levee breaches cannot be guaranteed. Also, as is noted in the Adaptive Management Plan (Appendix I), it is possible the adaptive management responses may reduce the amount of tidal marsh that is restored by the Project. Therefore, there is considerable uncertainty about the Project's ability to restore 2,783 acres of tidal marsh habitat and about the timing of that restoration.

Finally, the lack of federal funding for some of the tidal marsh restoration and all of the ecotone creation adds uncertainty to the full implementation of these Project elements.

Individual Comment 16

Page 4-295 of the discussion in Section 4.7.2.4.2.1, *Levee Construction Effects*, includes the following text under Impact TBR-2: 20

> Loss of SMHM and salt marsh wandering shrew habitat due to construction of the FRM levees would be significant absent the provision for the expansion of restored tidal marsh the FRM levees promotes in adjacent ponds. The project would provide high-quality habitat, which would benefit not only these species but other wetland species.
>
> Tidal marsh habitat created through Pond A18 ecosystem restoration would provide more habitat for these species than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of habitat. Although the tidal marsh habitat would not be established immediately, this impact is not considered significant since the project would not result in a net loss of habitat over time. 20

The argument that Project impacts on SMHM would not be significant over time appears to be flawed. The length of time between impacts to SHMH and the full functioning of restored tidal marshes should be compared to the life cycle of the SHMH. It appears likely that the time lapse between impacts and the full functioning of mitigation may exceed the lifespan of a SMHM. Therefore the impact may be significant and not fully mitigated. Mitigation provided for impacts to SMHM could be enhanced by including the construction of ecotones in the federally funded project.

Individual Comment 17

The discussion of Impact TBR-4 on page 4-328 includes the following text:

> To minimize these types of construction-related impacts, the Shoreline Phase I Study includes several avoidance and minimization measures. Work in and adjacent to potential bird nesting habitat would be conducted outside of the avian nesting season to the ***extent practicable [emphasis added].*** Work in these areas that could cause disturbance or direct take (e.g., accidental crushing of individuals or nests) would be limited to the nonbreeding period to the ***extent practicable [emphasis added]*** (AMM-TRB-2). This condition would minimize potential impacts on nesting birds. If seasonal avoidance is not possible, preconstruction surveys would be conducted for nesting birds (AMM-TRB-3). If any nesting pond–associated waterbirds are detected in areas that could be disturbed by project-related construction activities, project implementation would be delayed or redesigned to minimize potential impacts on actively nesting birds, or other measures may be taken to avoid impacts in consultation with the USFWS and the CDFW. 21
>
> *Impacts on population and habitat trends resulting from ecosystem restoration construction activities associated with all alternatives would be less than significant.*

To better establish the extent to which the proposed mitigation measure would reduce impacts to bird nesting to less than significant levels, please provide the protocol that shall be used to establish the ***extent practicable*** for avoidance measures.

Individual Comment 18

The discussion of Transition Habitat on page 4-329, includes the following text:

> Alternative 3 includes a 30:1 ecotone type of broad, gently sloping transitional habitat along the FRM levee where it abuts Pond A12 and the corner of Pond A13 and Pond A18. The 30:1 ecotone would be constructed on the bay side of the FRM levee, and the slope would encroach about 345 feet into the ponds. Vegetation in the 30:1 transitional habitat 22

> area would be limited to nonwoody and semi-woody plants, but would otherwise be lightly managed (such as noxious weed removal) and would not be subject to the USACE policy on levee vegetation. The exception is a 15-foot band adjacent to the exposed levee slope, which would be maintained to USACE levee standards.

Since the ecotone is to be constructed independently of the flood control levee, Water Board staff does not understand why it is necessary to lightly manage vegetation on the ecotone and prevent woody vegetation from establishing on the ecotone. If these vegetation restrictions on the ecotone are not lifted, it will be more difficult for Water Board staff to conclude that the overall Project is self-mitigating. 22

Individual Comment 19

AMM-HAZ-1 in Section 4.8.2.1 of the F/EIS/EIR states:

> All sites listed in Table 4.8-1 that are designated as "having HTRW concerns that are not likely to or with the potential to affect future construction" should be avoided for inclusion in this Proposed Project. Moreover, construction will be avoided in all areas where the presence or potential presence of HTRW has been documented previously. Further coordination with the San José–Santa Clara Regional Wastewater Facility will be conducted in order to accurately locate and avoid all areas with HTRW concerns prior to construction 23

If contaminants in any of these sites consist mostly of fairly inert and immobile chemicals (e.g., metals in soils) it may be acceptable to route levees through these sites. The placement of significant quantities of engineered fill in a permanent flood control structure may be an acceptable method of capping the remaining wastes in place.

Individual Comment 20

Section 5.5.5, *Irreversible and Irretrievable Commitments of Resources (NEPA and CEQA)*, includes the following text in the third bullet point:

> Some of the materials used for transitional habitat construction (Pond A12 materials) would come from on-site sources. The majority of the material (transitional habitat fill for A18) would need to be imported, but an agreement between the local project sponsor and the USACE notes that such material would be imported at no cost to the sponsors. For the Proposed Project, if insufficient free fill material to construct the 30:1 ecotone is acquired by proposed construction dates, the transitional habitat would be reduced in size to the 50-foot bench (as included in all other alternatives); in either case there would be no associated investment by the sponsors for transitional habitat material. 24

The possibility that a lack of material could result in Pond A18 being constructed with a 50-foot bench, rather than a 30:1 ecotone, adds an additional level of uncertainty to the Project's ability to meet its mitigation requirements. This adds further doubt to the Project's ability to be self-mitigating.

Individual Comment 21

In Chapter 9.0, *Findings and Tentatively Selected Plan*, Section 9.1 includes the following text: 25

> The Tentative NED/NER plan is Alternative 2. It includes levees at the same location as Alternative 3, but with a height tentatively identified at 13.5 feet. The Tentative NED/NER

> would restore the same set of ponds as the TSP and would result in approximately 2,900 acres of tidal marsh, however, it does not include the 30:1 ecotone that is part of the TSP. Like the TSP, the Tentative NED/NER plan includes a pedestrian bridge over Alviso Slough.

It is not clear to Water Board staff why an alternative that does not provide 100-year flood protection over the lifetime of the Project was selected as the Tentative NED/NER. Text in Section 4.4.1.2.2.3, *Fluvial Flood Hazards*, indicates that, although subsidence in the Alviso area has been slowed since groundwater recharge efforts were initiated in the 1970s, the current rate of subsidence is still being monitored. It may be useful to factor the potential for ongoing subsidence in the Alviso area to impact the level of flood control provided by the current Tentative NED/NER plan. Text on page 4-107 also suggests that construction dewatering and heavy construction activities could produce further subsidence along the Project alignment. Therefore, higher levees may deserve to be selected as the NED/NER plan. 25

Individual Comment 22

Section 9.5.1, *Cost Allocation of the Tentative NED/NER Plan and TSP*, contains the following text:

> For a single purpose FRM project, there would be some environmental impacts. However, the costs for mitigating for such impacts would be insignificant relative to the overall costs. Further, since the ER component of the multipurpose project provides a significant net gain in ecological outputs, a combined plan would not require mitigation and a determination was made that it is not necessary to allocate any ER related costs to the FRM component of the project

The FRM only project would impact about 57 acres of waters of the State. This is a very large impact for a single project. The costs associated with providing sufficient mitigation for such a large impact would be considerable. Recent projects with an order of magnitude lower impacts have had great difficulty in finding sufficient mitigation along the South Bay shoreline. The F/EIS/EIR provides no support for the statement that "the costs for mitigating for such impacts would be insignificant relative to the overall costs." The F/EIS/EIR should either be revised to provide current mitigation costs for impacts on the order of 57 acres of jurisdictional waters, or the sentence should be deleted from the document. In general, the F/EIS/EIR could be improved if estimated mitigation costs for future levee raising to 13.5 or 15.2 feet had been included in the comparison of alternatives. 26

Individual Comment 23

Section 9.6.5.1, *Federal Responsibilities*, includes the following text:

> However, with the passage of the WRRDA 2014 and language in Section 1025 relevant to the Shoreline Study, there may be an opportunity to include the ecosystem restoration of the USFWS lands as part of the NED/NER Plan and TSP, to be cost shared between the USACE and the non-Federal sponsor

Water Board staff encourage the USACE to pursue federal funding of the ecosystem restoration elements of the Project, since full implementation of 2,800 acres of tidal marsh restoration and ecotone restoration are likely to be necessary to provide appropriate mitigation for impacts to waters of the State. Federal funding of all tidal marsh restoration and ecotone construction 27

would also reduce the uncertainties associated with implementation of the Project's mitigation elements.

Individual Comment 24

Section 9.6.5.3, *Views of Non-Federal Sponsors*, includes the following text:

> The LPP is supported by the non-Federal sponsors because it meets local planning objectives, addresses regulatory agency concerns regarding environmental impacts, and allows the project to utilize a free source of fill material to establish transitional habitat. The LPP also eliminates the need to pay flood insurance for the community of Alviso and the surrounding area.
>
> Although non-Federal sponsors understand that the feasibility report must indicate that ecosystem restoration or recreation on USFWS lands would be implemented by the USFWS, they support legislation that would include the USFWS actions in the authorized USACE project, thereby allowing the USACE to be funded to implement these actions. The non-Federal sponsors believe that the overall ecosystem restoration effort (on USFWS and non-Federal lands) would be more efficiently and effectively implemented by one Federal agency. Although the USACE could construct the flood risk management levee and restore Pond A18 without the implementation of the USFWS project, the USFWS project could not proceed until the flood risk management levee is built. In addition, although the Pond A18 restoration could occur without first restoring Pond A12, it would be contrary to the landscape evolution modeling effort undertaken to evaluate the order in which the ponds should be restored. This analysis determined that Pond A12 should be opened to tidal flows first because it is the deepest pond in the study area. It would require more sediment than the other ponds to bring the pond bottom up to marsh plain elevations. If the project is to rely on natural processes to deposit sediments in Pond A12, it is critical to open this pond as soon as possible before sea levels change and bay sediments decline as is currently predicted. In addition, there is concern from the non-Federal sponsors that due to the large size of Pond A18 (856 acres) there is a larger risk of adverse impacts to the regional landscape. From the perspective of Adaptive Management, it would be better to open A18 after other ponds in the area have been opened and there has been monitoring data collected. This would provide project managers an opportunity to delay or modify the breaching of Pond A18 if there were any adverse impacts to local sediment supplies, wildlife, or infrastructure detected. Finally, the non-Federal sponsors are concerned that without a single funding stream, and the certainty associated with sufficient funding, both the USACE and USFWS projects are at greater risk. If one agency is funded but not the other, it is more likely that there will be costly project modifications or that some projects will not be able to be constructed at all.

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Water Board staff shares the concerns of the non-Federal sponsors.

Individual Comment 25

Appendix X to the F/EIS/EIR contains the Shoreline Phase I 404(b)(1) Analysis. Appendix X is only 16 pages long. For a project with potential direct impacts on the order of 140 acres of waters of the U.S. and many potential indirect impacts, this is a fairly brief analysis. Appendix X reads more like a summary of the alternatives discussion on the body of the F/EIS/EIR than a full alternatives analysis.

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In addition, the analysis inappropriately attempts to minimize the Project's considerable impacts to jurisdictional waters by expressing them as a percentage of the total acres of waters present within the Alviso Complex ponds in the project vicinity. This is not an acceptable means of assessing the Project's impacts. Impacts that range between 57 and 138 acres of jurisdictional waters cannot be described as "small".
Also, as is discussed above, the description of many of the Project's impacts as "short term" is not appropriate, since there will be a considerable lag time between impacts and full functioning of restored tidal marshes, and that lag time may be greater than the life cycles of the California clapper rail and the SMHM. 29

Please contact me at (510) 622-5680 or brian.wines@waterboards.ca.gov if you have any questions. All future correspondence regarding this Project should reference the CIWQS Place ID Number indicated at the top of this letter.

Sincerely,

Brian Wines
Water Resource Control Engineer
Watershed Management Division

cc: State Clearinghouse (state.clearinghouse@opr.ca.gov)

ID	Issue Text	Response Text
027_RWQCB_2-1	General Comment 1. Water Board staff supports the development of a combined flood control and habitat enhancement project. We are encouraged by the evaluation of the flood control project as a component of the complete Project to both provide flood protection to communities in the south end of San Francisco Bay and to restore about 2,800 acres of tidal salt marsh in the former Alviso Salt Pond Complex Ponds A9 through A15 and A18. Water Board staff concur with the following text in Section 2.1, Need for the Project. Both flood risk management and ecosystem restoration are important to both the local community and the larger South Bay area. By formulating a multipurpose flood risk management and ecosystem restoration project, the project partners can both reduce flood risk in the area and facilitate tidal marsh restoration. Reviewed in isolation, the flood control project would place fill into between 57 and 137 acres of waters of the State, consisting of wetlands and open water. This impact is unusually large for a single project and would require significant mitigation to be consistent with the San Francisco Bay Basin Water Quality Control Plan (Basin Plan), which incorporates the State of California's no net loss policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28). Therefore, the inclusion of tidal marsh restoration, along with the habitat enhancement provided by the proposed ecotone in the LPP, is valuable to expediting the Water Board's permitting of the Project with a Clean Water Act (CWA) Section 401 water quality certification (Certification) and Waste Discharge Requirements (WDRs) issued pursuant to the California Water Code.	Your comment is acknowledged; we understand that no revision to the text is requested in this general comment.
027_RWQCB_2-2	General Comment 2. Proposed mitigation for the impacts associated with the flood control elements of the project may result in a net loss of waters of the State and there is considerable uncertainty associated with full attainment of the Project's restoration goals. The mitigation proposed for the Project's significant impacts to waters of the State consists of restoring open waters (former salt production ponds) to tidal marshes. This type of mitigation consists of transforming one type of jurisdictional water into a different type of jurisdictional water. The Water Board has not traditionally accepted this type of mitigation for significant impacts to waters of the State, since no new waters of the State are created as mitigation for the acres of waters of the State that will be lost to fill in the course of project implementation. However, the Basin Plan directs the Water Board to consider specific guidelines and requirements, including the following, as a part of its mandated duty to protect waters of the State: ? The California Wetlands Conservation Policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28), requiring no net loss and a long-term net gain in the quantity, quality, and permanence of wetlands in California, including the San Francisco Bay region. ? The Baylands Ecosystem Habitat Goals (1999) (Habitat Goals), and the Baylands Ecosystem Species and Community Profiles (2000) (referred to collectively as the "Habitat Goals Reports"), which are to be used as guides for wetlands restoration in the vicinity of San Francisco Bay. The Habitat Goals Reports envision the restoration of tidal marsh and similar habitat throughout the South Bay region, including the Project area, and contain recommendations for enlarging tidal marshes and protecting and enhancing marsh transition areas. The Basin Plan recommends that the Habitat Goals Reports, which were written by over 100 local scientists and resource managers, be used as guides for wetland restoration to protect beneficial uses of waters in San Francisco Bay, not only for species but also to purify and store State waters. Use of the Habitat Goals Reports will help ensure that developments in the Project area are implemented in a manner that benefits tidal species, migratory and resident shorebirds, waterfowl, and the federally listed salt marsh harvest mouse (SMHM). Chapter 5 of the Habitat Goals contains goals for the South Bay Subregion of San Francisco Bay. The overall goal in the South Bay subregion is to restore large areas of tidal marsh connected by wide corridors of similar habitat along the perimeter of the Bay. Several large complexes of salt ponds, managed to optimize shorebird and waterfowl habitat functions, should be interspersed throughout the subregion, and naturalistic, unmanaged salt ponds (facsimiles of historical, hypersaline backshore pans) should be restored on the San Leandro shoreline. There should be natural transitions from mudflat through tidal marsh to adjacent uplands [emphasis added], wherever possible. Adjacent moist grasslands, particularly those with vernal pools, should be protected and improved for wildlife. Riparian vegetation and willow groves should be protected and restored wherever possible. Chapter 5 of the Habitat Goals also includes the following specific recommendations for Segment P of the Bay shoreline – Coyote Creek Area (Southern end of San Francisco Bay between Alviso Slough and Albrae Slough). ? Restore tidal marsh throughout most of the segment, providing a continuous corridor of tidal marsh along the bayshore. The type of tidal marsh created (salt or brackish) will be dependent on the amount and proximity to local freshwater outflows. Restoration should emphasize reestablishing a natural transition between tidal marsh and adjacent wetlands and upland habitats [emphasis added], as well as transitions between salt and	We appreciate this comment and concur with the Water Board's interpretation of the Basin Plan to protect waters of the State. It is a primary goal of this project to ensure thriving wetland habitat where none currently exists, and to create large transition zones to facilitate the persistence of that habitat in the coming decades in the face of increasing sea levels. It is understood by the project that what we are proposing may result in an immediate decrease in the net amount of waters of the State due to the construction of the levee and ecotone. However, the restoration of these former salt ponds back to tidal wetlands is not possible without the construction of the new levee. In addition, you thoroughly and accurately outline the rationale as to why these features are desirable and potentially appropriate for the water board to accept as mitigation for the loss of water of the State. Since the first draft of the report, the USACE has since received implementation guidance on the language in the latest WRRDA bill that will allow for the federal government to cost share on the ecosystem restoration components of the project. We hope that this helps to alleviate some of the sense of uncertainty around the implementation of the ecosystem restoration components. However, the ecotone portion of the project remains part of the LPP (which is the Recommended Plan) and is the responsibility of the non-federal sponsor. The project proponents agree that time is of the essence and assure you that we are working hard to expedite tidal wetland restoration in the south bay to capitalize on the currently favorable sediment supply situation. Our non-federal sponsors are also simultaneously pursuing upland sources of clean fill, as well as long-term options to bring dredged material to the far south bay.

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brackish tidal marsh. ? Modify and manage a large complex of salt ponds for shorebirds and waterfowl. ? Restore or enhance vernal pools in the adjacent undeveloped uplands. ? Reestablish native riparian vegetation and otherwise improve the riparian corridor along Coyote Creek. ? Manage discharges from the San Jose treatment plant to limit adverse environmental impacts, especially to tidal salt marsh habitat. Consider using recycled water to augment flows in Coyote Creek or for other habitat enhancements. On the basis of the Habitat Goals Reports, it is likely appropriate for the Water Board to consider using the restoration of salt ponds to tidal marshes as part of the Project's mitigation for impacts to waters of the State. The highlighted text in the quotes from the Habitat Goals Reports is supportive of giving mitigation credit for the creation of ecotones between marshes. However, as is discussed below, the federal sponsor is not currently proposing funding for all of the tidal marsh restoration or any of the ecotone restoration. The uncertainty associated with this funding approach may complicate the Water Board's consideration of Project permits. The Water Board's online Fact Sheet for Reviewing Wetland and Riparian Projects, San Francisco Bay Water Board (December 1, 2006), provides guidance for permitting projects with wetland and riparian projects. The Basin Plan (Section 4.23.4) states that the "Water Board will evaluate both the project and the proposed mitigation together to ensure that there will be no net loss of wetland acreage and no net loss of wetland functions. The Water Board may consider such sources as the Baylands Ecosystem Habitat Goals (1999) and the Baylands Ecosystem Species and Community Profiles (2000) (referred to collectively as the "Habitat Goals Reports"), the San Francisco Estuary Project's Comprehensive Conservation and Management Plan (1993), or other approved watershed management plans when determining out-of-kind mitigation." Mitigation is most effective at maintaining beneficial uses of waters of the State and achieving conformance with No Net Loss polices, first, if the mitigation occurs at the impacted site, which is referred to as "on site" mitigation, and, second, if the mitigation wetland recreates the same type of wetland as the impacted wetland, which is referred to as "in-kind" mitigation. Water Board staff considers proposals for off-site or out-of-kind mitigation where: 1. on-site/in-kind would be impractical; 2. there is an agreed upon watershed plan that justifies the need for off-site or out-of kind mitigation or Water Board staff believes that the proposed mitigation is environmentally preferable to on-site/in-kind mitigation; 3. there is general agreement with the ecosystem principles or habitat recommendations contained within the Habitat Goals Reports referred to above; 4. other agencies (e.g., U.S. Fish & Wildlife Service [FWS]) prohibit the re-creation of certain wetland or related habitats that threaten special status species13 The No Net Loss Policy is generally used to determine the amount of mitigation required. Existing wetlands are already successful ecosystems, but the success of mitigation projects is highly uncertain until after established monitoring periods have determined that wetland hydrology, vegetation, and soils have developed.... Each site is reviewed on a case-by-case basis, and no pre-determined set of ratios is used to determine mitigation, though a minimum of 1 acre lost to 1 acre gained is typically required. However, temporal losses must also be considered, which are defined as functions lost due to the passage of time between loss of the impacted wetland and creation/restoration of the full-functioning mitigation wetland..... Thereafter, additional mitigation can be required for: ? The loss of or potential for impacts to medium to high quality habitat; ? The loss of or potential for impacts to special status species or their associated habitats; ? The construction or restoration of wetlands that take relatively long to develop (e.g., riparian); ? Delays in the construction or restoration of mitigation wetlands, relative to when the impacted wetlands have been filled [emphasis added]. Compensatory mitigation wetlands should generally be restored or constructed prior to or concurrent with filling the impacted wetland, and additional mitigation is typically required when the mitigation work occurs after the impacts; ? Uncertainty associated with the construction or restoration of mitigation wetlands [emphasis added]; ? The placement of off-site mitigation wetlands or the creation of out-of-kind wetlands (created or restored wetlands that are different habitat types than the impacted wetland), though this can be allowed where it is demonstrated that an overall net gain will occur. Based on the information provided in the F/EIS/EIR, there is considerable uncertainty associated with the successful establishment of fully functioning tidal marshes in the former salt ponds. As is noted in Chapter 3 of the F/EIS/EIR, the South Bay appears to be on the verge of becoming a sediment sink, rather than a sediment source. In addition to the uncertainties around sea level change, the other part of the equation for adequate marsh accretion rates is the amount of suspended sediments in San Francisco Bay. Current levels are quite high in the interim study area, and recently restored marshes are benefiting from those levels as evidenced by high accretion rates. Recent research from the USGS, however, indicates that San Francisco Bay is becoming less turbid and that current levels of suspended sediments are not likely to remain the same in coming decades. With increasing sea levels and decreasing sediment supplies, restoration practitioners and researchers in San Francisco Bay are encouraging proceeding with a sense of urgency to create sustainable marshes. Delays in initiating restoration would create a substantial risk of the ponds being restored to tidal action too late for their bottom surfaces to reach marsh elevation before the acceleration of sea level change

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	renders the natural sedimentation process inadequate for marsh restoration to occur. Waiting until confirmation of the future rate of sea level change would create the risk of not being able to respond in a timely manner to a genuine change in the long-term trend. [From Section 3.11.1.1.2 of the F/EIS/EIR.] Therefore, it is not completely certain that the South Bay will have sufficient sediment available for full tidal marsh restoration within almost 2,800 acres of current salt ponds at the time that the former salt ponds are breached to restore tidal flow to the ponds. Additional mitigation is usually required by the Water Board to compensate for this type of uncertainty. To compensate for the combination of out-of-kind mitigation, uncertain sediment supply for marsh restoration, and an unusually long time period between project impacts and the successful functioning of restored tidal marshes (See General Comment 3), the Water Board would usually would require that the area of restored tidal marshes be much greater than the area of impacted wetlands and open waters. Since the uncertainties related to sediment supply will increase over time, we encourage the USACE to commence work on the Project as soon as possible. Additionally, we encourage the F/EIS/EIR to consider alternative sediment sources, such as beneficial reuse of dredged sediment associated with maintaining navigational channels in San Francisco Bay.	
027_RWQCB_2-3	General Comment 3. There will be a significant time lag between Project impacts to waters of the State and the full functioning of mitigation elements. Another complication with the Project's mitigation component is the significant time lag between the proposed fill of waters of the State along the proposed alignment of the new flood control levees and both the full restoration of tidal marshes in former salt ponds and the construction and full vegetation of the proposed ecotones. As was noted in General Comment 2, more mitigation is usually required by the Water Board when the duration of temporal losses of aquatic habitats is larger. The mitigation component of the Project has a very long time lapse between the impacts to the wetlands and other waters in the footprint of the flood protection levee and the initiation of tidal marsh restoration in former salt ponds. According to Section 3.8.3 of the F/EIS/EIR, levee construction will occur between 2017 and 2020. Pond A12 will be breached in 2020 and Ponds A9 through A11 and A18 would be breached in 2025. Therefore, there is an 8 year time lapse between the first impacts to waters of the State and the breaching of levees at the majority of the ponds that are to be restored to tidal marshes. In addition, the end of the temporal loss period will not be attained until the restored marshes have become fully functional tidal marshes (assuming that the sediment supply is sufficient for the creation of the tidal marshes). Most of the projects authorized by Water Board permits commence mitigation construction in the same year that the project causes its first impact to waters of the State. The unusually long temporal loss period associated with the Project's mitigation likely will require a commensurately larger amount of mitigation to be consistent with other Water Board permits for projects with large impacts. In order to minimize the temporal losses associated with the Project, Water Board staff encourages the USACE to start preparation work for tidal breaching concurrently with levee construction so that the first salt pond levees can be breached as soon as the flood control levee is completed.	The project described in the draft Integrated Report would breach Pond A18 as soon as practical after completion of the FRM levee and ecotone. Restoration phasing has been adjusted to also breach Pond A12 as soon as practical. Remaining ponds would be breached in two additional phases as previously described (See Section 3.8.3)..
027_RWQCB_2-4	General Comment 4. Water Board Staff are concerned that the use of the Combined Habitat Assessment Protocols (CHAPS) may not have been appropriate to selecting the Federally Preferred Alternative. We are concerned that the process used to determine that the creation of an ecotone along the new flood control levee could not be considered part of the federally preferred alternative did not appropriately consider the Project benefits of the ecotones, including potential reductions in costs for the additional mitigation that may be required in the absence of the ecotones. The method used to evaluate environmental benefits of each alternative is summarized in Section S.11.7, Screening of Ecosystem Restoration Options: The study team evaluated the efficiency of ecosystem restoration options by comparing their costs to ecosystem restoration outputs. Costs include preconstruction engineering and design, real estate, construction, and ongoing operation, maintenance, and rehabilitation. Unlike the flood risk management options, however, benefits arising from an ecosystem restoration are not monetized. The ecosystem restoration outputs are calculated using the Combined Habitat Assessment Protocol (CHAP). The CHAP was agreed upon by the non-Federal sponsors and the vertical team when defining what type of assessment to use to screen ecosystem restoration options (discussed more in Section 3.6.4 Criteria for Evaluation and Screening of Ecosystem Restoration Options of the main report). The CHAP model, which is biased towards habitats benefitting more species, did not show increased habitat value for the transitional habitat because it does not benefit more species than does the tidal marsh. [However,] The transitional tidal marsh habitat is highly important, with technical and institutional significance, and will provide habitat functions that have been lost all around the San Francisco Bay. The application of this process to assessing the benefits of the proposed ecotone is summarized in Section S.11.7.2, Transitional Habitat Screening: The 30:1 ecotone met the completeness, effectiveness, and acceptability criteria but did not meet the efficiency criterion because the environmental benefits analysis (CHAP) did not show additional benefits when adding an ecotone to the project relative to the benefits provided by the less-extensive and less-expensive bench transitional habitat measure. This outcome is despite	CHAP MODEL SELECTION AND RESULTS The study team examined a number of models for determining ecosystem restoration benefits. To be used in a USACE study, such a model must be able to provide annualized benefits and much have been certified (or otherwise approved for single use) by the USACE Ecosystem Restoration Center of Expertise. Few models fit both criteria, and fewer still were applicable to estuarine habitats in San Francisco Bay. The study team did not consider it practical to develop a new habitat model and obtain certification or approval given the budget and schedule available at the time. The Combined Habitat Assessment Protocols (CHAP) is a habitat evaluation method which builds upon the earlier successes of the US Fish and Wildlife Service Habitat Evaluation Procedures (HEP) and the Northwest Habitat Institute (NHI) Habitat Assessment and Bartering (HAB) method, and which provides annualized habitat units. This method was already being processed for approval or certification on other USACE studies so was considered to be practical for use in this study. It is more sophisticated than the HEP models traditionally used in evaluating the fish and wildlife habitat impacts of federal water resources projects. In general, habitat assessment methods that produce quantified habitat values are essentially accounting systems for summing up fish and wildlife habitat value over time. This sort of approach is required by USACE planning guidance. These models do not directly measure the geomorphic and biochemical functions of wetlands or other habitats. Nor are they able to take a strategic view of fish and wildlife habitat in a landscape context or make subjective judgments of fish and wildlife restoration priorities. This was the case in the analysis of study area habitats by CHAP. The existing ponds, the post-breaching mudflats, and the later tidal marshes all showed high levels of fish and wildlife habitat value under CHAP. The pre-breaching ponds and the later tidal marshes showed the highest values but the differences were not large. Outside of this modeling effort, selection of any of these habitats as a preferred outcome is essentially a subjective decision, albeit one that can be informed by scientific findings. The study started with a goal of restoring tidal habitats so those habitats were preferred. In addition, tidal marsh was favored over tidal mudflats due to greater historic losses and greater current scarcity, so restoration phasing was adjusted during the landscape modeling process to create a better

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the widely accepted idea that greater areas of transitional habitats provide an opportunity to create more refugial habitat as well as specialized habitats which have been lost in San Francisco Bay. CHAP was unable to evaluate the efficacy of these considerations. As a result of the efficiency analysis, the level of Federal investment was set at the bench refugia measure, which only provides incidental benefits from building the levee. The additional cost of implementing an ecotone would be a non-Federal expense. While Water Board staff appreciates the general value of focusing on more than one species in habitat evaluations, as the CHAPS analysis does, the unique characteristics of the restoration opportunities in the Alviso Complex Salt Ponds call for a focus on listed species that depend on tidal marshes. Both the Habitat Goals and the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (Recovery Plan) (USFWS, August 27, 2013), which include recovery actions for the California Ridgeway rail (formerly California Clapper Rail) and salt marsh harvest mouse (SMHM), support both the restoration of as many acres of tidal marsh as feasible and the creation of ecotones between marsh habitats and upland high water refuges. The Recovery Plan features five endangered species: two endangered animals, California clapper rail (Rallus longirostris obsoletus) and salt marsh harvest mouse (Reithrodontomys raviventris), and three endangered plants, Cirsium hydrophilum var. hydrophilum (Suisun thistle), Chloropyron molle ssp. molle (soft bird's-beak), and Suaeda californica (California seablite). The biology of these species is at the core of the recovery plan, but the goal of this effort is the comprehensive restoration and management of tidal marsh ecosystems. According to the Recovery plan, "California clapper rails occur almost exclusively in tidal and brackish marshes with unrestricted daily tidal flows, adequate invertebrate prey food supply, well developed tidal channel networks, and suitable nesting and escape cover providing refugia during extreme high tides." In the restored marshes, the ecotones will provide critical refuge during extreme high tides. The Recovery Plan also states that "Viable populations of salt marsh harvest mice also appear to be limited by the distribution of high tide cover and escape habitat. Recurrent but shallow flooding by saline water is probably needed to maintain habitat that favors the salt marsh harvest mouse over its potential competitors. Anticipated sea level rise presents a severe threat in the long-term, especially in the central and south San Francisco Bay where opportunities for landward migration of habitat are absent." The proposed ecotones will provide high tide cover and escape habitat, as well as providing some opportunities for landward migration of habitat. Figure I-1, Intertidal distribution of the focal species covered in this recovery plan, in the Recovery Plan shows the distribution of listed species covered in the Recovery Plan along the tidal gradient. As is illustrated in this figure, the upland ecotone is used by both the California clapper rail and the SMHM, and also provides the majority of habitat for the three plant species covered in the Recovery Plan: Cirsium hydrophilum var. hydrophilum, Cordylanthus mollis ssp. mollis, and Suaeda californica. Table 8.5-1, Recovery Plan Criteria for Downlisting and Delisting for California Sea-Blite, Salt Marsh Harvest Mouse, and California Clapper Rail, in the F/EIS/EIR also emphasizes the importance of high marsh/upland transitional habitats. Since the CHAPs Environmental Benefits analysis was not able to identify the benefit to listed species associated with creating an upland ecotone, we are concerned that the CHAPs method may not have been an appropriate method for evaluating whether the federally preferred alternative should have included the ecotones. Problems related to the use of the CHAPs methodology for the Project are also described in Section 3.11.6 of the F/EIS/EIR. The model used by the study to assess environmental benefits, CHAP, was unable to demonstrate that additional costs associated with accelerating restoration, or adding transitional habitat greater than the minimal refugia bench, would result in additional environmental outputs. Model results are presented in Appendix J. For the Pond A12, Ponds A13–A15, and Pond A18 increments considered as part of the CE/ICA process, the CHAP results show that additional cost and additional features result in the same or fewer average annual outputs. This model result is at odds with what the study team believes would be the real-world result [emphasis added]. For example, adding transitional marsh habitat (with 30:1 side slopes) to the restoration effort should result in greater outputs than what would be realized with the smaller bench refugia measure. Like all models, the CHAP model is an imperfect representation of the real world, and, whether due to model characteristics or to the way the model was used, it did not demonstrate and quantify this difference. The analysis in Appendix J shows that the various habitat elements of tidal marshes were assessed as individual habitat units, rather than the complex mosaic of habitats that are essential to the recovery of the California clapper rail and the SMHM. Water Board staff encourages the Project team use an analysis that better reflects a "real-world result." Section 4.7.2.2, Methodology for Impact Analysis, in the F/EIS/EIR states that, "according to the USACE Planning Guidance Notebook (ER 1105-2-100), the criteria for determining the significance of potential impacts associated with ecological resources "shall include, but not be limited to, the scarcity or uniqueness of the resource from a national, regional, state, and local perspective" [emphasis added] (ER 1105-2-100, Appendix C, p. C-15)" and goes on to quote the Planning Guidance Notebook as follows: In summary, the case can be made that environmental resources are significant based on technical chance of tidal marsh forming prior to the expected period of rapid sea level rise later in the evaluation period. In addition, USACE ecosystem restoration policy favors restoration approaches that are largely self-evolving and self-sustaining after the initial investment.

CHAP found slightly lower habitat outputs with an ecotone included in the design. This was due to loss of habitat value for a number of fish species exceeding the gains to marsh wildlife from having better upland refugia available. Again, models of this sort cannot make strategic trade-offs between suites of species. However, USACE policy requires quantified ecosystem benefits from major ecosystem restoration features. Thus, the ecotone was determined to not qualify for federal funding, but was retained as a locally funded feature.

The study team also selected the California Rapid Assessment Method (CRAM) for evaluation of the restored areas, in the hope that the focus of this method on wetland functions beyond fish and wildlife habitat would allow it to show the expected value of the ecotone. However, this method was unable to produce annualized benefits. In addition, due to the particular history and pattern of both tidal marsh loss and gain in the San Francisco Estuary, available reference sites tended to be poor analogues for the restoration areas to be created by the study alternatives, thus limiting the predictive value of this method.

SINGLE-SPECIES MODELS

The RWQCB comments state: "... the unique characteristics of the restoration opportunities in the Alviso Complex Salt Ponds call for a focus on listed species that depend on tidal marshes." The only unique attribute of the Alviso Ponds area with regard to restoration is the degree of subsidence. Nearly all of the shoreline of the South Bay is lacking the historic ecotone, and all the tidal range of the salt marsh harvest mouse in the South Bay has this problem, so the issue raised here is more generally applicable than to just the Alviso Ponds.

The study sponsors agree that the recovery of listed tidal marsh species is important and that the proposed project would assist with this goal. However, USACE ecosystem restoration studies are focused on evaluating overall benefits to fish and wildlife habitat rather than benefits to one or a few listed species, except in the case of studies specifically targeted to ameliorating the effect of past USACE projects on specific species such as anadromous fish.

One concern raised by the RWQCB is the exclusion of federal funding for the ecotone at the same time that the ecotone is cited as having mitigation value. However, these are different issues. The ecotone did not meet federal criteria for federal funding. However, its inclusion in the proposed plan means that its effects must be considered.

The ecotone would not create additional habitat acreage or more wetland habitat in the long term. In fact, in the long term it would slightly reduce jurisdictional wetland habitat (defined by ordinary high water) relative to the bench it would replace. However, it would have the benefit of restoring new marsh habitat quickly upon breaching of the ponds, relative to the decades required for breached subsided ponds to form new marsh or the minimal wetland habitat that would be created on edge of the bench.

Thus, the ecotone would assist in temporal impact mitigation by replacing relatively rapidly with tidal marshes much of the non-tidal wetland lost due to initial levee construction. The ecotone is probably not the most cost-effective way of providing this temporal mitigation, so this is not a primary argument for building the ecotone. The ecological values of the ecotone are stated in the draft report but the habitat evaluation method did not find these larger than the total fish and wildlife value produced in its absence.

Given the results of the CHAP study, the RWQCB has requested that the study sponsors re-examine the value of the ecotone and "use a protocol that reflects the clear guidance provided in the Recovery Plan". While restoring habitat for listed species is one of the study goals, the primary intent of the study sponsors in studying ecosystem restoration for the study area was always to provide broad-based benefits to fish and wildlife. Should the proposed project be forwarded to Congress for possible authorization, Congress will have the opportunity to decide whether to provide federal funding for the ecotone based on its own criteria.

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	recognition when, within a specified geographic range, those resources are either scarce; are representative of their respective ecosystems; will improve connectivity or reduce fragmentation of habitat; represent limiting habitat for important species; will improve or increase biodiversity; or trends indicate that the health of the resource is imperiled and declining, but can be recovered through human intervention This quote appears to support assigning value to the proposed 30:1 ecotone, since ecotone habitats in the South Bay are "scarce; are representative of their respective ecosystems; will improve connectivity or reduce fragmentation of habitat; represent limiting habitat for important species; will improve or increase biodiversity; or trends indicate that the health of the resource is imperiled and declining, but can be recovered through human intervention." Finally, text in Section 9.3 of the F/EIS/EIR emphasizes the essential nature of the ecotone to the Project's mitigation. Ecosystem restoration under the TSP would also include an ecotone (30:1) transitional habitat feature in Ponds A12, A13, and A18, which would be constructed bayward to the proposed flood risk management levee along the eastern boarder of Pond A12 and the southern border of the ponds A13 and A18. The ecotone would contribute to the value of the marsh and future success of special status species using the marsh providing an important transitional zone and high-tide refugia. As noted earlier in this report, this sort of upland transitional habitat is not well represented in the South Bay due to severe loss of habitat. In the study area, ecotones are mostly absent along levees due to the abrupt transition between middle marsh habitat and steep-sided levees. In the long term, the transitional ecotone area would provide space for marshes to retreat inland in the face of sea level change. This habitat feature is critical to achieving the project's restoration objectives. By providing this refuge, the ecotone would greatly increase the resiliency and longevity of the outboard tidal wetlands and the incidental flood benefits they provide, such as wave attenuation and flood water storage [emphasis added]. To Water Board staff, it does not appear appropriate for the federal sponsor to reject funding the construction of the ecotone on the basis of the CHAPs analysis, when the CHAPs analysis would also not support giving the Project mitigation credit for ecotone creation. If the Water Board is being asked to consider the value of the new ecotones on habitat values when evaluating the sufficiency of the Project's mitigation, then the federal sponsor should also be using the same criteria when selecting the federally funded elements of the Project.	
027_RWQCB_2-5	Individual Comment 1 According to text in Section S.11.2.3 Wastewater Facility (WPCP) Segment Levee Alignment: Four potential WPCP levee alignments are located east of Artesian Slough (Figure S-6). Two variations of WPCP South alignment follow the existing levee that runs west to east in a stair-step pattern along the north border of the existing Wastewater Facility infrastructure. One then cuts across existing Wastewater Facility drying beds, and the other turns north to follow the existing levee along the eastern side of Pond A18. Alternatively, the WPCP North alignment includes construction of a new levee that partially bisects Pond A18, expanding the area that would be available south of the proposed engineered levee, and then also either cuts across existing Wastewater Facility drying beds or turns north to follow the existing levee along the eastern side of Pond A18 (the same as the WPCP South options). Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. As the Wastewater Facility Master Planning effort proceeds into design, however, there may be further opportunity to revisit the alignment section. Additional environmental evaluation would be required if it is decided that this footprint is a better environmental option and meets the Wastewater Facility schedule for discontinuing the operation of drying biosolids in that area. Water Board staff encourage the USACE to retain alignment options through the former Wastewater Facility drying ponds. Although these ponds may contain some contaminants at hazardous levels, the contaminants are relatively immobile inorganic contaminants. Capping such contaminants in place under an engineered levee may be an acceptable means of closing some of these historic wastes in place. It is also possible that a levee alignment along the former drying beds may make it possible to avoid the need for a flood gate across Artesian Slough, since the levee alignment could be brought south of Artesian Slough. While the Water Pollution Control Plant (WPCP) may lose some land area to a levee alignment through the historic drying ponds, removing the proposed flood gate from Artesian Slough may be beneficial for WPCP operating parameters. As is discussed in Individual Comments 2 and 13, placing a flood gate over Artesian Slough about 300 feet downstream from the discharge from the WPCP may complicate the discharge protocols for the WPCP. Under the current NPDES permit for the WPCP, discharge rates of treated, fresh water to Artesian Slough are restricted to prevent impacting tidal marshes with fresh water. Construction of the proposed tide gate over the slough may require a revision of the WPCP's NDPES permit.	See Master Response regarding Coyote Creek Levee Alignment

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027_RWQCB_2-6	Individual Comment 2 According to text in Section S.11.4.2, Artesian Slough Crossing Options: The flood wall closure with tide gate crossing measure met all screening criteria and was retained. The levee measure (construct new levees along Artesian Slough) met all of the screening criteria but was eliminated because it is less economically efficient than the tide gate measure and did not provide any additional advantages relative to the other criteria. A flood wall across the slough would provide an equal level of flood risk management at a lower cost than the new levees along Artesian Slough. We encourage the USACE to consider retaining the levee measure along Artesian Slough. This would reduce the placement of fill into the Slough and could significantly reduce potential impacts to the WPCP and potential conversion of aquatic habitat in the Slough, thus reducing the Project's mitigation needs. Depending on the extent to which levees on the west and east banks of Artesian Slough would impact existing wetlands, this option may not have significant impacts to wetlands, but would avoid the direct fill of Artesian Slough that would be caused by flood gate construction. Also if the levee alignment were taken through the WPCP's historic drying ponds, the levee on the east bank of Artesian Slough could be eliminated. This option would also not directly impact the discharge of treated WPCP effluent to Artesian Slough, since the mixing zone for cyanide releases from the WPCP would not be impacted by a flood wall across the slough, about 300 feet downstream from the WPCP effluent discharge point. Also, it is not clear that closing flood gates downstream of the WPCP effluent discharge is feasible. In 2012 and 2013, average daily discharge volumes to Artesian Slough were between 90 and 100 million gallons per day (MGD), with a maximum discharge of 132 MGD. Discharge rates from the WPCP are greatest during storm events, when infiltration into laterals adds to the volume of influent that is received by the WPCP, which is subsequently discharged into the Slough. Therefore, the times when the flood gates are most likely to be shut in response to potential flooding are likely to coincide with the highest discharge rates into Artesian Slough. The F/EIS/EIR should have evaluated how effluent would be managed during times when the flood gates are closed to provide flood protection. Finally, placing a flood gate across Artesian Slough is likely to impact the nature of aquatic habitat upstream of the flood gate. This may be considered an impact to a water of the State that requires mitigation.	See Master Response regarding Artesian Slough.

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027_RWQCB_2-7	Individual Comment 3 Text in Section S.14.1, National Economic Development (pages S-43 to S-44), states that: There is a difference in cost of approximately $3 million between the two levees. However, the tentatively identified 13.5 foot alternative (NED Plan) has higher net benefits (compared to 12.5 foot levee), is more resilient, is more compatible with California policies on sea level change (CA has adopted a curve that aligns with USACE high SLC curve), and is more consistent with an adaptive management perspective in accordance with ETL 1100-2-1 (Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation) with potential lower life-cycle project costs. Further, implementing a 13.5 foot NED Plan in all likelihood would have less long-term environmental impacts (i.e., build the levee once rather than having to mobilize equipment at a later date to raise the levee and incur adverse impacts to established tidal wetlands that support threatened and endangered species). The Tentative NED has therefore been identified as the 13.5 foot levee. It is acknowledged that the NED plan may revert to a different levee height (i.e., 12.5 foot) in consideration of policy stated in ER-1105-2100. Exhibit G-1 states that identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost-effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan, even though the level of outputs may be less. Further, USACE policy also generally recommends selection of smaller scale plans when plans have similar net benefits. Since the 12.5 foot levee has similar net benefits to the 13.5 foot levee across all three SLC scenarios, and because it could potentially be raised in the future if necessary for higher sea level change than that projected under the low or intermediate scenarios, it is possible that the 12.5 foot levee may be ultimately selected as the NED FRM option to establish the basis for Federal project cost share. This decision will be made prior to completion of the Final Report submittal. Water Board staff are supportive of the preference for constructing the most resilient levee as part of the Project, rather than expanding the levee at a later date to maintain flood protection. Opportunities for shoreline mitigation have been declining in the Bay Area and costs for available mitigation options have been increasing. In the long run, it is likely to be cost effective to construct the most resilient levee feasible as part of the Project, since future mitigation for future impacts is likely to be more expensive. If the costs of mitigation associated with future raising of the levee are included in the cost analysis, constructing the higher levee now may be more economical. The absence of cost estimates for mitigation activities is a weakness in the analysis of the Project's alternatives. Additionally, we encourage the federal sponsor to consider making the 15.2 foot levee the federal preferred option. As is noted in Section 4.4.1.2.2.3, land subsidence may be continuing in the Alviso area. Therefore, assessments of levee performance should account for ongoing land subsidence, as well as sea level rise. When land subsidence is factored into future levels of flood protection, it appears possible that the 15.2 foot levee could become the federally preferred alternative.	The Shoreline Study includes consideration of *flood risk management*. The study examines the feasibility of moderating flood risk and the economic benefits and costs of providing these modified levels of flood risk over the planning horizon. The economic planning horizon for USACE studies is 50 years. This study considers three sea level rise scenarios for this 50-year period and evaluates the residual risk associated with each scenario. Selection of the levee height as the NED plan is based on several factors according to Engineer Technical Letter (ETL) 1100-2-1 (*Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*), which includes evaluating residual risk, net economic benefits, and future adaptability. The NED levee height has been closely coordinated with USACE headquarters to ensure the intent of the Engineering Record and ETL are being met. USACE projects are analyzed and described in terms of their expected performance, not in terms of levels of protection. There is no minimum level of performance or protection or size required for USACE projects. The smaller in size or the lower the level of performance however, the higher the residual risk. Residual risk must therefore be carefully analyzed and communicated. The cost of retrofitting the levee in response to a higher-than-expected rate of sea level rise, or to sea level rise after the 50-year period of analysis, is not considered in the economic evaluation. All the alternatives have ability to be adapted to higher sea level through raising the levee height or installing a floodwall on top of the levee in the future. Land subsidence is not continuing in the Alviso area and report text will be revised to clarify this. If a study is authorized in the future to consider additional federal investment in flood risk reduction, the same cost-risk analysis would be completed. The cost analysis would include any new mitigation costs from further flood risk management activities. Such activities could include managed retreat, structural measures, non-structural measures, or a combination of these.
027_RWQCB_2-8	Individual Comment 4 Section, S.15, Tentative NED/NER and Locally Preferred Plan, contains the following text: The flood risk management and ecosystem restoration problems and opportunities are interrelated and should be constructed in parallel. Implementation of flood risk management features now, rather than after sea level change, allows earlier implementation of the tidal marsh restoration both on non-Federal lands under the proposed project and incidentally will afford the USFWS (or USACE pending WRRDA 2014, Section 1025 Implementation Guidance) the opportunity to implement tidal wetland restoration on USFWS lands (note- the purpose of flood risk management features is to provide protection to non-Federal infrastructure [i.e., Community of Alviso]). Delaying the restoration could require costly imported sediment to create marsh habitat in consideration of future sea level change. In addition, if the tidal marsh restoration was implemented prior to the flood risk management features, filling of wetlands and endangered species habitat (i.e., the newly established tidal marsh) would be required, resulting in a need to establish an off-site mitigation area, levee alignment with a Tentative 13.5 foot levee height and basic restoration of Ponds A9-15 (USFWS) and Pond A18 (City of San José) with a bench as part of the levee construction, but resulting in incidental transitional habitat (Figure S-9). Under current policy (pending WRRDA 2014, Section 1025 Implementation Guidance regarding restoration activities on USFWS lands), USACE is limited to implementing restoration on Pond A18. We concur that the "flood risk management and ecosystem restoration problems and opportunities are interrelated and should be constructed in parallel." Because of this, the eventual application for the Project must include both the flood control elements, which have significant impacts to waters of the State, and the habitat restoration elements, which are essential to providing the necessary mitigation for the impacts to waters of the State. However, as is noted in our prior comments, the Tentative NED/NER Plan should include both the 15.2 foot levee and the creation of the 30:1 ecotones on the outboard side of the new levees. We encourage the USACE to factor future mitigation costs associated with raising the levee from 13.5 to 15.2 feet at some time in the future into the economic analysis of alternatives. If sea level rise in the future requires raising the levee to15.2 feet to provide sufficient flood control, this levee raising work may occur after tidal marsh restoration is complete and tidal marsh restoration is no longer a source	The Shoreline Study includes consideration of *flood risk management*. The study examines the feasibility of moderating flood risk and the economic benefits and costs of providing these modified levels of flood risk over the planning horizon. The economic planning horizon for USACE studies is 50 years. This study considers three sea level rise scenarios for this 50-year period and evaluates the residual risk associated with each scenario. Selection of the levee height as the NED plan is based on several factors according to Engineer Technical Letter (ETL) 1100-2-1 (*Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*), which includes evaluating residual risk, net economic benefits, and future adaptability. The NED levee height has been closely coordinated with USACE headquarters to ensure the intent of the Engineering Record and ETL are being met. USACE projects are analyzed and described in terms of their expected performance, not in terms of levels of protection. There is no minimum level of performance or protection or size required for USACE projects. The smaller in size or the lower the level of performance however, the higher the residual risk. Residual risk must therefore be carefully analyzed and communicated. The cost of retrofitting the levee in response to a higher-than-expected rate of sea level rise, or to sea level rise after the 50-year period of analysis, is not considered in the economic evaluation. All the alternatives have ability to be adapted to higher sea level through raising the levee height or installing a floodwall on top of the levee in the future. Land subsidence is not continuing in the Alviso area and report text will be revised to clarify this. If a study is authorized in the future to consider additional federal investment in flood risk reduction, the same cost-risk analysis would be completed. The cost analysis would include any new mitigation costs from further flood risk management activities. Such activities could include managed retreat, structural measures, non-structural measures, or a combination of these.

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	of mitigation credit.	
027_RWQCB_2-9	Individual Comment 5 The summary of unavoidable adverse effects in Section CS-4 does not include the net loss of waters of the State in the footprint of the new levee.	The net loss of waters of the State was not included in Section CS-4 because, for purposes of the CEQA analysis, the Shoreline project was determined to have an overall less-than-significant impact on the quantity and quality of waters of the State. When assessing the impacts of the project, the Feasibility Study weighed the impacts of fill with the overall enhancement to the habitat and water quality of San Francisco Bay brought about restoring 2,900 acres of former salt ponds to their historic condition. In addition, to the marsh acreage created in the former salt ponds, approximately 54.7 acres of new vegetated marsh will be created in the first phase of pond restoration by using existing A12 and A18 levees as borrow sites and the lower slope of the ecotone area will become vegetated immediately as described in the response to comment number 24. While the filling of the waters of the state is unavoidable, the Feasibility Study determined that it was not a significant adverse effect for CEQA when the project is considered in its entirety.
027_RWQCB_2-10	Individual Comment 6 We are concerned by the following text in Section 2.7.4, Additional Planning Considerations: Current USACE levee guidance requires suppression of natural intertidal and transitional vegetation on levees and the artificial maintenance of perennial grass on the entire levee surface. This requirement may be impractical in intertidal brackish and saltwater areas. As Water Board staff has pointed out in numerous comments on the USACE policy on vegetation on levees, we are concerned that the USACE guidance reduces habitat values on levees, without providing commensurate benefit to the structural integrity of levees. Along levees that will include an outboard ecotone, the lack of vegetation on the levee may be mitigated to a great extent by vegetation in the ecotone. However, along Pond A16, which is operated as a managed pond, the current Project plan does not include an ecotone. Therefore, species attempting to use the levee as a migration corridor will be vulnerable to predation. Water Board staff encourage the Project to include an ecotone along the levee at Pond A16. Vegetation on such an ecotone may provide a more secure migration corridor between Pond A18, to the east of Pond A16, and Ponds A12 and A13, to the west of Pond A16. The barriers to SMHM migration posed by levees with vegetation controls is specifically mentioned on page 4-298 of the F/EIS/EIR. We encourage the USACE to ensure that potential SMHM migration corridors are sufficiently vegetated to support SMHM migration.	Levee vegetation along Pond A16 is expected to include scattered pickleweed and fairly continuous low vegetation on both sides of the levee, and will likely provide better vegetative cover than is on the existing levee. Provision of an ecotone along this section of levee, as suggested by the RWQCB, would not provide the marsh transition benefits that it would provide in a tidal zone and would encroach upon the managed pond habitat of Pond A16.
027_RWQCB_2-11	Individual Comment 7 Section 3.5.5.4 of the F/EIS/EIR describes the reasons for selecting the tide gate option for the Artesian Slough crossing. The flood wall closure with tide gate crossing measure met all screening criteria and was retained. The levee measure (construct new levees along Artesian Slough) met all of the screening criteria but was eliminated because it is less economically efficient than the tide gate measure and did not provide any additional advantages relative to the other criteria. A flood wall across the slough would provide an equal level of flood risk management at a lower cost than the new levees along Artesian Slough. With or without a flood wall/tide gate closure, the Wastewater Facility would have to deal with sea level change in their discharge operations. In an effort to best meet the general operation requirements for the Wastewater Facility and allow for discharge during storms, the tide gate will be designed in coordination with Wastewater Facility engineers. It is assumed that the tide gate would have staged elevation relief points to minimize impacts to the treatment plant operation. Additionally, the proposed location of the tide gate for all alignment options would be at least 300 feet bayward of the existing Wastewater Facility outfall for treated water at Artesian Slough (see Figure 3.5-2 Potential Artesian Slough Crossing). Water Board staff encourage the Project team to conduct further analysis of the Artesian Slough crossing. The Project's preferred flood wall closure with tide gates may provide additional permitting complexity, as well as operational complexity, for this element of the Project. The infrastructure associated with a tide gate will place fill in waters of the State, which will require mitigation. And the placement of a barrier across Artesian Slough, about 300 feet Bayward of the WPCP effluent pipe, may complicate the WPCP's compliance with its NPDES permit. The current NPDES permit limits the amount of treated water that may be discharged to Artesian Slough; this limitation is necessary to minimize the tendency of the effluent stream to convert tidal marshes to brackish or fresh water marshes. Obstructions in the slough may alter the salinity regimes in the slough and require modifications to the WPCP's NPDES permit. In most of the F/EIS/EIR, the discussion of the tide gates states that they would only be closed in responses to imminent flood events, but in Section 4.6.2.3.2, a reference is made to seasonal closing of the tide gates. Extended periods of tide gate closure will impact salinity regimes in the slough and may affect the relative distribution of tidal and brackish habitats. Such changes in marsh type may require mitigation. The Project team should provide a	The gate is intended to have "event" and not "seasonal" type closures. In general, the closure would remain in the "open" position until a high water event requiring flood control actions is forecast and/or experienced. The project team is continuing to analyze and refine the design configuration and operations of the proposed closure on Artesian Slough to minimize impacts to the existing tidal flow regime while providing reliable flood risk management. Statements in Section 4.6.2.3.2 have been modified to correctly state when the gate would be closed (i.e. high water events). See Master Response regarding Artesian Slough for a discussion as how that measure was selected.

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	more detailed description of tide gate operating protocols so that the full range of impacts associated with the tide gates, as well as any necessary mitigation for such impacts, can be evaluated by Water Board staff.	
027_RWQCB_2-12	Individual Comment 8 A discussion of the level of Federal investment in the proposed ecotone is provided in Section 3.6.5.2. The bench refugia measure met all of the screening criteria and was retained. The 30:1 ecotone met the completeness, effectiveness, and acceptability criteria but did not meet the efficiency criterion because the environmental benefits analysis (CHAP) did not show additional benefits when adding an ecotone to the project relative to the benefits provided by the less-extensive and less-expensive bench transitional habitat measure. The model could not distinguish between two beneficial habitat types, which in this case, tidal habitat is the ideal transition, versus just pond. This outcome is despite the idea that greater areas of transitional habitats provide an opportunity to create tidal marsh habitats that natural sedimentation would not create, because of low pond bottom elevations. As a result of the efficiency analysis, the level of Federal investment was set at the bench refugia measure, and the additional cost of implementing an ecotone would be a non-Federal expense. As is discussed in General Comment 4, Water Board staff is not convinced that the CHAP analysis appropriately assessed the efficiency criterion. The Recovery Plan, which is a federal document, clearly states that ecotones are an essential habitat element to the recovery of California clapper rails and SMHM, as well as the three plants covered by the Recovery Plan. The Project team is encouraged to revisit the screening protocol and use a protocol that reflects the clear guidance provided in the Recovery Plan.	CHAP MODEL SELECTION AND RESULTS The study team examined a number of models for determining ecosystem restoration benefits. To be used in a USACE study, such a model must be able to provide annualized benefits and much have been certified (or otherwise approved for single use) by the USACE Ecosystem Restoration Center of Expertise. Few models fit both criteria, and fewer still were applicable to estuarine habitats in San Francisco Bay. The study team did not consider it practical to develop a new habitat model and obtain certification or approval given the budget and schedule available at the time. The Combined Habitat Assessment Protocols (CHAP) is a habitat evaluation method which builds upon the earlier successes of the US Fish and Wildlife Service Habitat Evaluation Procedures (HEP) and the Northwest Habitat Institute (NHI) Habitat Assessment and Bartering (HAB) method, and which provides annualized habitat units. This method was already being processed for approval or certification on other USACE studies so was considered to be practical for use in this study. It is more sophisticated than the HEP models traditionally used in evaluating the fish and wildlife habitat impacts of federal water resources projects. In general, habitat assessment methods that produce quantified habitat values are essentially accounting systems for summing up fish and wildlife habitat value over time. This sort of approach is required by USACE planning guidance. These models do not directly measure the geomorphic and biochemical functions of wetlands or other habitats. Nor are they able to take a strategic view of fish and wildlife habitat in a landscape context or make subjective judgments of fish and wildlife restoration priorities. This was the case in the analysis of study area habitats by CHAP. The existing ponds, the post-breaching mudflats, and the later tidal marshes all showed high levels of fish and wildlife habitat value under CHAP. The pre-breaching ponds and the later tidal marshes showed the highest values but the differences were not large. Outside of this modeling effort, selection of any of these habitats as a preferred outcome is essentially a subjective decision, albeit one that can be informed by scientific findings. The study started with a goal of restoring tidal habitats so those habitats were preferred. In addition, tidal marsh was favored over tidal mudflats due to greater historic losses and greater current scarcity, so restoration phasing was adjusted during the landscape modeling process to create a better chance of tidal marsh forming prior to the expected period of rapid sea level rise later in the evaluation period. In addition, USACE ecosystem restoration policy favors restoration approaches that are largely self-evolving and self-sustaining after the initial investment. CHAP found slightly lower habitat outputs with an ecotone included in the design. This was due to loss of habitat value for a number of fish species exceeding the gains to marsh wildlife from having better upland refugia available. Again, models of this sort cannot make strategic trade-offs between suites of species. However, USACE policy requires quantified ecosystem benefits from major ecosystem restoration features. Thus, the ecotone was determined to not qualify for federal funding, but was retained as a locally funded feature. The study team also selected the California Rapid Assessment Method (CRAM) for evaluation of the restored areas, in the hope that the focus of this method on wetland functions beyond fish and wildlife habitat would allow it to show the expected value of the ecotone. However, this method was unable to produce annualized benefits. In addition, due to the particular history and pattern of both tidal marsh loss and gain in the San Francisco Estuary, available reference sites tended to be poor analogues for the restoration areas to be created by the study alternatives, thus limiting the predictive value of this method. SINGLE-SPECIES MODELS The RWQCB comments state: "... the unique characteristics of the restoration opportunities in the Alviso Complex Salt Ponds call for a focus on listed species that depend on tidal marshes." The only unique attribute of the Alviso Ponds area with regard to restoration is the degree of subsidence. Nearly all of the shoreline of the South Bay is lacking the historic ecotone, and all the tidal range of the salt marsh harvest mouse in the South Bay has this problem, so the issue raised here is more generally applicable than to just the Alviso Ponds. The study sponsors agree that the recovery of listed tidal marsh species is important and that the proposed project would assist with this goal. However, USACE ecosystem restoration studies are focused on evaluating overall benefits to fish and wildlife habitat rather than benefits to one or a few listed species, except in the case of studies specifically targeted to ameliorating the effect of past USACE projects on specific species such as anadromous fish. One concern raised by the RWQCB is the exclusion of federal funding for the ecotone at the same time that the ecotone is cited as having mitigation value. However, these are different issues. The ecotone did not meet federal criteria for federal funding. However, its inclusion in the proposed plan means that its effects must be considered. The ecotone would not create additional habitat acreage or more wetland habitat in the long term. In fact, in the long term it would slightly reduce jurisdictional wetland habitat (defined by ordinary high water) relative to the bench it would

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		replace. However, it would have the benefit of restoring new marsh habitat quickly upon breaching of the ponds, relative to the decades required for breached subsided ponds to form new marsh or the minimal wetland habitat that would be created on edge of the bench. Thus, the ecotone would assist in temporal impact mitigation by replacing relatively rapidly with tidal marshes much of the non-tidal wetland lost due to initial levee construction. The ecotone is probably not the most cost-effective way of providing this temporal mitigation, so this is not a primary argument for building the ecotone. The ecological values of the ecotone are stated in the draft report but the habitat evaluation method did not find these larger than the total fish and wildlife value produced in its absence. Given the results of the CHAP study, the RWQCB has requested that the study sponsors re-examine the value of the ecotone and "use a protocol that reflects the clear guidance provided in the Recovery Plan". While restoring habitat for listed species is one of the study goals, the primary intent of the study sponsors in studying ecosystem restoration for the study area was always to provide broad-based benefits to fish and wildlife. Should the proposed project be forwarded to Congress for possible authorization, Congress will have the opportunity to decide whether to provide federal funding for the ecotone based on its own criteria.
027_RWQCB_ 2-13	Individual Comment 9 Section 3.9.1.1 of the F/EIS/EIR contains the following text: Mitigation for the loss of wetlands and related impacts to wetland species from construction of the levees would be required if this were a USACE single-purpose flood risk management project. Because the project also includes restoration of managed ponds to tidal marsh, however, and this restoration will provide much more habitat than would be lost to the levee construction, no mitigation is proposed. We are concerned that the approach proposed in this text may pose a significant permitting challenge. For Alternative 3, the Project would place fill into a total of about 137.6 waters of State, consisting of 16.8 acres of wetlands and 120.8 acres of other waters. As noted in General Comments 2 and 3, the mitigation elements of the Project are associated with potentially significant temporal losses in habitat and significant uncertainty related to the availability of sediment for the full restoration of about 2,800 acres of tidal marshes (See Section 3.11.1.1.2 of the F/EIS/EIR). In addition, much of the mitigation is associated with the conversion of one type of water of the State, open waters, into another type of water of the State, tidal marshes. To compensate for the net loss of waters of the State, the Project should demonstrate consistency with the Basin Plan by including closer conformance with the Habitat Goals and the Recovery Plan in the mitigation covered under the federally funded project elements. Also, since some of the mitigation elements are not covered under the federally preferred project, and, therefore, not federally funded, there is additional uncertainty associated with full implementation of all of the Project's mitigation measures.	HABITAT GOALS The Baylands Habitat Goals are in the process of being revised by the San Francisco Estuary Institute, but the 1999 report states the following under habitat design and management for tidal marsh (pp. 150-151). Quotes from the report are in italics, and notations and responses in roman: The design and management of tidal marsh restoration projects should: • *Assess the salinity regime (including artificial freshwater flows) and tidal range in the area where restoration is planned; there should be congruence between the physical parameters of the area (salinity, tidal range) and the expected habitat structure.* Modeling of landscape evolution post-breaching related salinity and tidal regimes to expected habitat types for the alternatives. • *Provide unrestricted tidal exchange, except where muted conditions are necessary or desired (see Muted Tidal Marsh discussion). Where full tidal exchange is not possible, encourage maximum tidal amplitude.* Breached ponds will have full tidal action. New Chicago Marsh will remain as muted tidal to protect existing marsh values including salt marsh harvest mouse habitat. • *Rely as much as possible on natural sedimentation processes. Natural sedimentation is preferable if adequate sediment supply is available for timely restoration of desired habitat.* Natural sediment will be the only sediment source used for raising pond bottoms to the eventual marsh plain. The ecotone material will be imported since this feature would not form in the require location on its own. The non-federal sponsors will continue to investigate the possibility of importing dredged material to accelerate marsh formation under conditions of rising sea level, but any such proposal would be a separate project requiring separate permits at a later date. • *Utilize remnant natural channels (if present) as the template for channel formation. Fill borrow ditches when possible to keep them from capturing tidal circulation.* Remnant natural channels will be reconnected to restore drainage patterns, and ditch blocks will restrain tidal action in borrow ditches. • *Provide topographic variation to mimic natural conditions within the marsh. Provide small supratidal islands, at or slightly above MHHW, by leaving remnant levees or placing fill at appropriate elevations.* When levees are graded down, remnants will be left as isolated islands to provide refugial habitat. • *Grade unneeded levees to marsh elevations (at or slightly above MHHW) when restoring diked baylands. Levee remnants will continue to reduce erosion and to provide high-tide roosting habitat, while discouraging predator access and invasion by weedy species.* This will be done. • *Design levees, where required as part of the restoration, to mimic naturally occurring transition zones (the slope should be as flat as possible).* The slope for the ecotone will be 30:1. • *Provide for ongoing control of undesirable species including non-native invasive plants, undesirable predators, and mosquitoes. In the case of smooth cordgrass, undertake control as part of pre-construction.* This is currently occurring on the refuge and will be done on Pond A18 as well. • *Rely in most instances on natural colonization by plants; however, there are some rare plant species that need to be reintroduced.* Planting of the transition zone and upland is expected, to accelerate restoration and discourage exotics, but lower areas will naturally colonize. *Provide broad corridors (300 feet or wider) to connect neighboring marshes, except when the marshes are very small.*

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		The ecotone will be over 300 feet wide, though not all the width will be marsh. As the ponds fill in with marsh, they will link together existing fringe and pocket marshes in the area and greatly increase local habitat connectivity. *• Wherever possible, restore tidal marshes on sites that are contiguous with uplands and alluvial soils, seeps, and streams to facilitate establishment of natural transitions.* The restoration site is contiguous with Alviso Slough and with the Coyote Creek bypass. It was not feasible to link to natural upland areas, so the ecotone provides a substitute. *• Provide a buffer at least 300 feet wide between the upper edge of the marsh/upland transition and neighboring areas of developed use.* This was done where feasible, in the area of New Chicago Marsh. Farther east, options were severely constrained due to the adjacent San Jose-Santa Clara wastewater treatment plant. However, the legacy and operational lagoons on the plant site involve minimal human intrusion and disturbance. To sum up, the LPP incorporates all these features. RECOVERY PLAN Quotes from the report are in italics, and notations and responses in roman. The LPP is compatible with the recovery criteria in Table III-3, Guadalupe Slough-Warm Springs marsh complex: *Minimum acreage: 1,111 ac for Ridgway's rail and Minimum acreage: 1,000 ac, 1 VHA, 75% of VHAs with CE of 5.0 or greater.* Text from page 179 describing VHAs: *VHAs for the salt marsh harvest mouse in the Central/Southern San Francisco Bay Recovery Unit, and San Pablo Bay Recovery Unit are defined as well-developed tidal marshes with the following specific features: 1) extensive Sarcocornia (pickleweed) on a mid to high marsh plain 200 meters (219 yds) or more deep (from shore to bay); 2) adjacent wide high marsh transition zone, wherever possible, that acts as a refugium for the mice during the highest tides with sufficient area and cover to minimize predation risks and; 3) stands of Grindelia (and in San Pablo Bay area, Schoenoplectus spp.) or tall forms of Sarcocornia, interspersed among shorter forms of Sarcocornia to provide additional high tide refugia within the marsh and away from the upland edge....* This describes the eventual condition of the restoration area. *All VHAs within each marsh complex must be 150 acres or more, the minimum acreage thought to sustain a healthy mouse population (Shellhammer in litt. 2005). The VHAs must be connected by corridors broad and complex enough to allow the interconnected VHAs to function as one large population over time; however, these corridors will not be counted in the total marsh complex acreage, unless they are fringing marshes 500 feet deep or deeper, have a high marsh transition zone, and have substantial escape cover, both in the middle and high marsh zones.* The alternatives would fill in gaps between existing marshes; there are no more gaps to be filled within our current study area unless we Pond A16 were converted into marsh. CE refers to capture efficiency of mice which is a consequence of successful restoration, not a design feature. The LPP is compatible with the recovery map (Figure III-22, Segment P) on page 274 of the plan. FEDERAL FUNDING See response to comment 2.
027_RWQCB_2-14	Individual Comment 10 Section 4.4.3 of the F/EIS/EIR discusses potential mitigation measures for the potential impacts of Project-related scour on the Union Pacific Railroad bridge crossing of Coyote Creek. Proposed measures include the following: • Modify the bridge structure, such as by constructing new pilings and underpinnings, to accommodate the scour. • Place rock armoring across the channel for some distance upstream and/or downstream of the bridge to limit scour at the bridge supports and approaches. • Place rock armor along the bed and banks of the channel at the bridge and along the bed and railway embankment on both sides of the bridge to limit scour. Water Board staff would like to point out that all of these proposed measures involve the placement of fill in waters of the State and would require permits from the Water Board and appropriate mitigation. Also, the Water Board does not usually allow armoring that extends from bank to bank across a channel.	The project team is aware of the required permitting, and of the limitations of the proposed measures. The team will continue coordination with the Water Board as future design analyses allows for refinements to any erosion protection recommendations.
027_RWQCB_2-15	Individual Comment 11The Basin Plan, which was developed under the authority of the State's Porter-Cologne Water Quality Control Act, should be added to Table 4.6-1, Regulations and Programs That Apply to Aquatic Biological Resources. In the Basin Plan, waters and wetlands in the South San Francisco Bay have been assigned beneficial uses that include estuarine habitat, fish migration, fish spawning, wildlife habitat, and the preservation of rare and endangered species.	Your comment is acknowledged. The Basin Plan was briefly mentioned in discussion under the Porter-Cologne Water Quality Control Act block, but the following was added to Table 4.6-1 within the Porter-Cologne discussion to expand per your recommendation: "Per the Basin Plan, developed under the authority of the Porter-Cologne Water Quality Control Act, waters and wetlands in the South SF Bay have been assigned beneficial uses that include estuarine habitat, fish migration, fish spawning, wildlife habitat, and the preservation of rare and endangered species."

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027_RWQCB_2-16	Individual Comment 12Section 4.6.2.2 includes the following text:Impact ABR-1: Have a substantial adverse effect, either directly or through habitat modifications on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, or the USFWS; a substantial adverse effect includes an impact that would jeopardize the continued existence of a species listed under the FESA and/or cause substantial adverse effects to EFH; or substantially interfere with the movement of any native resident or migratory fish Please add the National Marine Fisheries Service (NMFS) to the species agencies in this impact discussion. NMFS addresses impacts to EFH and to anadromous fish species (e.g., steelhead and salmon).	Your comment is acknowledged and the text in Section 4.6.2.2, Impact ABR-1 has been revised to include NMFS as a species agency in the discussion.
027_RWQCB_2-17	Individual Comment 13 Section 4.6.2.3.2, Action Alternatives, includes a discussion of operation of the proposed Artesian Slough tide gate (See Page 4-227). Seasonal or event-based operation of the Artesian Slough tide gate could interfere with the movement of aquatic species into and out of Artesian Slough for feeding and rearing. Negative effects for fish could be attributed primarily to potential entrainment and stranding on the landward side of a closed gate and exclusion from the slough for fish on the bayward side of the gate. These effects could temporarily affect survivability and could alter migratory patterns, foraging behavior, and the availability of prey. Restoring tidal habitats would provide conditions for improving the health of the estuarine ecosystem and would substantially outweigh potential effects of temporary exclusion from or entrainment in Artesian Slough. This is the first time in the F/EIS/EIR that the possibility of "seasonal" rather than "event-based" operation of the tide gate is proposed. As is noted in Section 4.6.2.3.2, seasonal operation would be likely to have impacts to habitat values in Artesian Slough and habitat types in Artesian Slough. The Water Board is likely to require mitigation for those impacts. Event-based operation is also likely to have impacts habitats in the slough, but those impacts are anticipated to be of shorter duration. The text also suggests that tidal marsh habitat enhancement would mitigate the tide gate's impacts to brackish marsh and open water habitat. As is noted in prior comments, the tidal marsh restoration would be off-site and out-of-kind mitigation for impacts to Artesian Slough. Seasonal operation of the tide gate is also more likely to impact the WPCP's discharges to Artesian Slough and require modification to the WPCP's NPDES permit.	The tide gate would be not be operated seasonally. The word "seasonal" will be deleted from the paragraph cited. The tide gate would only close during rare events such as floods or extreme high tides. Under current conditions, there is sufficient flow out of the RWF's discharge to keep the gates open the majority of the time and allow movement of aquatic species. During low tide, the tide gate would be open and the water surface elevation in Artesian Slough would reach an equilibrium level with the tidal event, such that the flow through the gate balances the WPCP effluent. During high tide, the gate would only be partially open because the water surface elevation on the downstream side of the gate would be greater than the water surface elevation on the upstream side of the gate, allowing less effluent flow through the gate;(i.e., during high tide some of the WPCP effluent would be stored temporarily in Artesian slough until the tide begins to drop). At a point in the future with the onset of sea level rise, a pump station will likely be required to ensure the WPCP effluent continues to discharge against the tide gate. With a pump station in operation during extreme tidal events, the tide gate will never be closed, since the pump station would assist the discharge of the effluent against the higher tidal pressure under these extreme events. Thus aquatic species would not be entrained or stranded on the landward side of the tide gate. The Shoreline team is currently working closely with the WPCP in the design of the tide gate. More specific details will be provided when submitting a permit application to the RWQCB. It is also important to note that the tide gate would only separate the short uppermost reach of Artesian Slough (not the WPCP effluent channel) from the rest of the slough. As written, the language in the Draft EIS/EIR may suggest that it would interfere with aquatic life movement into or out of the entirety of Artesian Slough, which is incorrect. In addition, given the very limited amount of water present in uppermost Artesian Slough at low tide (restricted to a narrow, shallow channel), upper Artesian Slough is unlikely to be used as an important rearing area for fish. To clarify the tide gate's operation, and the potential effects of the tide gate, Section 4.6.2.3.2 (Page 4-227) of the EIS/EIR has been revised as follows (strikeout is deleted and underline is added): "~~Seasonal or e~~Event-based operation of the Artesian Slough tide gate closure system could interfere with the movement of aquatic species into and out of a short reach of uppermost Artesian Slough for feeding ~~and rearing~~. Negative effects for fish could be attributed primarily to potential entrainment ~~and stranding~~ on the landward side of a ~~closed~~ partially opened gate and exclusion from the uppermost reach of the slough for fish on the bayward side of the gate. However, such effects would occur infrequently (i.e., only during very high tides) and would be of short duration, as the gate would become more opened as the tide subsides at the lower portion of the tidal cycle. Thus, it is unlikely that aquatic species would be entrained landward of the gate, or would be precluded from accessing the uppermost portion of Artesian Slough, for more than a single tide cycle. These effects are therefore not expected to ~~could temporarily~~ affect survivability or substantially ~~and could~~ alter migratory patterns, foraging behavior, or ~~and~~ the availability of prey. Restoring tidal habitats would provide conditions for improving the health of the estuarine ecosystem and would substantially outweigh potential effects of temporary exclusion from or entrainment in Artesian Slough."
027_RWQCB_2-18	Individual Comment 14 The discussion of Ongoing Effects Due to the Presence of Recreation Features on Page 4-229 of Section 4.6.2.3.2 should be expanded to include a discussion of the use of pedestrian bridge railings as perches by avian predators of fish, California clapper rails, and SMHM.	The pedestrian bridge will be designed during the design and engineering phase of the project. The bridge will be required to meet the Refuge's requirements and will be designed to inhibit avian perching. The EIR/S will be changed as follows to address this comment (underline added, strikeout deleted). *Ongoing Effects Due to Presence of Recreation Features* The proposed pedestrian bridge across Artesian Slough would ~~constitute a new over-water structure~~ be incorporated into the tide gate structure. ~~The bridge height would be designed to accommodate the capacity of the 1-percent ACE flood event. For this reason, there would be no increase in the 1-percent ACE floodwater surface elevation, and~~ Under this case, the bridge would not affect instream hydraulics or measurably modify microhabitats with regard to flow patterns or sediment transport.

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		However, should the bridge be an ~~O~~over-water structures, it could have the potential to affect aquatic environments, including changing shading and ambient light in aquatic habitat and, in turn, inducing behavioral responses in fish species and changes in habitat function. Support piles could create hydraulic and physical refuge for piscivorous predators such as striped bass, and this could contribute to increased predation of juvenile fish, including salmonids in ~~Alviso~~ ArtesianSlough. Shade-producing structures can also introduce changes to fish assemblages and distributions and can potentially reduce or modulate the amount of light required by algae or aquatic macrophytes. The extent and intensity of shading caused by over-water structures are dependent on the physical dimensions and orientation of the over-water structure. Light-penetrating structures with a narrower footprint that are located at higher elevations above the water surface produce the least amount of shading (Chmura and Ross 1978; Mulvihill et al. 1980). Because the proposed bridge would be elevated to levee height, effects on aquatic species and habitat due to shading are anticipated to be minor. In addition to shade impacts, bridge-like structures can create avian predator roosts and increase predation of fish, California clapper rails, and SMHM. The pedestrian bridge design will meet the Refuge's requirements and will be designed to inhibit avian perching as much as possible. *Recreation features will have a less than significant long term impact on aquatic resources.*
027_RWQCB_2-19	Individual Comment 15 Page 4-295 of the discussion in Section 4.7.2.4.2.1, Levee Construction Effects, includes the following text. As noted in Table 4.6-8 Post-Construction Tidal Marsh Totals in the Study Area, ecosystem restoration associated with Alternative 3 is expected to result in the creation of 2,783 acres of tidal marsh (assuming the project is implemented as proposed and all ponds are converted). The minor losses of seasonal wetland (saline flat) and muted tidal/diked marsh habitat associated with levee construction effects would be completely offset in the long term by tidal marsh habitat gains associated with the Shoreline Phase I Project. However, it is understood that the immediate direct effect on the habitat would not be mitigated until a later date. Breach of Pond A18 to restore tidal action is scheduled for 2025–2026; creation of fully functioning tidal marsh would depend on natural action and adaptive management, if needed. This process could take many years. Overall, however, this impact would not be significant since the project would not result in a net loss of tidal marsh habitat over time. Impacts on sensitive natural communities, including seasonal wetland and muted tidal/diked marsh habitat as a result of the Alviso North levee segment option would be less than significant. First, we note that the fill of almost 140 acres of waters of the State is not considered a minor loss by the Water Board. The considerable uncertainties associated with the Project's mitigation measures do not support the statement that "losses of seasonal wetland (saline flat) and muted tidal/diked marsh habitat associated with levee construction effects would be completely offset in the long term by tidal marsh habitat gains associated with the Shoreline Phase I Project." As noted in prior comments, there are significant uncertainties associated with the proposed mitigation. The timing of the marsh restoration results in significant temporal losses and the availability of sufficient sediment for tidal marsh restoration at the time of the future salt pond levee breaches cannot be guaranteed. Also, as is noted in the Adaptive Management Plan (Appendix I), it is possible the adaptive management responses may reduce the amount of tidal marsh that is restored by the Project. Therefore, there is considerable uncertainty about the Project's ability to restore 2,783 acres of tidal marsh habitat and about the timing of that restoration. Finally, the lack of federal funding for some of the tidal marsh restoration and all of the ecotone creation adds uncertainty to the full implementation of these Project elements.	We did not mean to imply that 140 acres of fill into waters of the State was a minor issue. The project does not take this amount of fill lightly, but believe it necessary to facilitate a large amount of tidal marsh restoration as well as achieve significant flood risk reduction. Our response regarding your concern over uncertainty about the implementation of restoration is two-fold. In addition to the responses provided to General Comment 2 about the increase in federal cost-sharing for restoration, we are also expediting the amount of tidal marsh to be restored in the first phase. We are now proposing that Ponds A18 and A12 (1,166 acres together) will both be restored as soon as practicable after levee construction. You are correct that the restoration of the remaining ponds will still be subject to the Adaptive Management Plan of the South Bay Salt Pond Restoration project. That plan was developed as an attempt to maximize the habitat benefit to the most species by ensuring species depending on the pond habitat are not inadvertently impacted. In addition, it is also prudent to phase the restoration of these ponds in any case, as the issues such as localized channel scour, sedimentation rates, and mercury methylation can all be better monitored. We hope that the increase in federal funding and initial quantity of tidal restoration help to alleviate some of your concerns related to uncertainty and timing of the restoration.
027_RWQCB_2-20	Individual Comment 16 Page 4-295 of the discussion in Section 4.7.2.4.2.1, Levee Construction Effects, includes the following text under Impact TBR-2: Loss of SMHM and salt marsh wandering shrew habitat due to construction of the FRM levees would be significant absent the provision for the expansion of restored tidal marsh the FRM levees promotes in adjacent ponds. The project would provide high-quality habitat, which would benefit not only these species but other wetland species. Tidal marsh habitat created through Pond A18 ecosystem restoration would provide more habitat for these species than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of habitat. Although the tidal marsh habitat would not be established immediately, this impact is not considered significant since the project would not result in a net loss of habitat over time. The argument that Project impacts on SMHM would not be significant over time appears to be flawed. The length of time between impacts to SMHM and the full functioning of restored tidal marshes should be compared to the life cycle of the SMHM. It appears likely that the time lapse between impacts and the full functioning of mitigation may exceed the lifespan of a SMHM. Therefore the impact may be significant and not fully mitigated. Mitigation provided for impacts to SMHM could be enhanced by including the construction of ecotones in the federally funded project.	We agree that temporal impacts are important. Still, evaluating these impacts in terms of the lifespan of individual animals is not appropriate since wildlife does not persist for any significant period in the absence of suitable habitat. Given that fact, maintaining temporal continuity of habitat must be a high priority to the extent this is feasible. Several actions will be taken to provide replacement habitat for the SMHM during project construction and the initial restoration period since flood protection must be maintained. However, it would not be practical to provide replacement habitat for this species during levee construction. Such habitat will be provided as quickly as reasonably possible through the following measures: *Construction of the ecotone.* Upon completion and restoration of water in adjacent portions of the pond where it is constructed, pickleweed marsh will quickly establish and provide habitat for SMHM. Upon restoration of tidal action, much larger areas of marsh will form on the ecotone. Vegetative cover will be established prior to breaching so SMHM on the ecotone will have cover when faced with tides. *Grading down existing pond levees to approximately MHHW.* This will accomplish several things, including quick establishment of new pickleweed marsh on the lowered surface and reduction in predator access to outboard marshes. With these and other included measures, the LPP is acceptable to the U.S. Fish and Wildlife Service as determined in the Biological Opinion provided by that agency.

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027_RWQCB_ 2-21	Individual Comment 17 The discussion of Impact TBR-4 on page 4-328 includes the following text: To minimize these types of construction-related impacts, the Shoreline Phase I Study includes several avoidance and minimization measures. Work in and adjacent to potential bird nesting habitat would be conducted outside of the avian nesting season to the extent practicable [emphasis added]. Work in these areas that could cause disturbance or direct take (e.g., accidental crushing of individuals or nests) would be limited to the nonbreeding period to the extent practicable [emphasis added] (AMM-TRB-2). This condition would minimize potential impacts on nesting birds. If seasonal avoidance is not possible, preconstruction surveys would be conducted for nesting birds (AMM-TRB-3). If any nesting pond–associated waterbirds are detected in areas that could be disturbed by project related construction activities, project implementation would be delayed or redesigned to minimize potential impacts on actively nesting birds, or other measures may be taken to avoid impacts in consultation with the USFWS and the CDFW. Impacts on population and habitat trends resulting from ecosystem restoration construction activities associated with all alternatives would be less than significant. To better establish the extent to which the proposed mitigation measure would reduce impacts to bird nesting to less than significant levels, please provide the protocol that shall be used to establish the extent practicable for avoidance measures.	In practice on other restoration projects in the area that have very similar constraints, 'to the extent practicable' has meant that construction activities in sensitive areas will be maximized inside the work windows. This must also take into account the appropriate phasing of the construction activities and other constraints such as weather. However, for large scale projects such as these, the temporal impacts of working only within these windows could extend the construction over several more years, with its associated impacts, and delay the benefits of the restoration. Pre-construction surveys have been a very effective way to allow construction to continue, especially in the early and late periods of the work windows, as nesting behavior varies quite a bit inter-annually. If nesting birds are located near construction areas, a FWS-approved buffer will be established around the nest until all birds have fledged in order to avoid impacts.
027_RWQCB_ 2-22	Individual Comment 18 The discussion of Transition Habitat on page 4-329, includes the following text: Alternative 3 includes a 30:1 ecotone type of broad, gently sloping transitional habitat along the FRM levee where it abuts Pond A12 and the corner of Pond A13 and Pond A18. The 30:1 ecotone would be constructed on the bay side of the FRM levee, and the slope would encroach about 345 feet into the ponds. Vegetation in the 30:1 transitional habitat area would be limited to nonwoody and semi-woody plants, but would otherwise be lightly managed (such as noxious weed removal) and would not be subject to the USACE policy on levee vegetation. The exception is a 15-foot band adjacent to the exposed levee slope, which would be maintained to USACE levee standards. Since the ecotone is to be constructed independently of the flood control levee, Water Board staff does not understand why it is necessary to lightly manage vegetation on the ecotone and prevent woody vegetation from establishing on the ecotone. If these vegetation restrictions on the ecotone are not lifted, it will be more difficult for Water Board staff to conclude that the overall Project is self-mitigating.	The question of woody vegetation has been coordinated with the Refuge. Due to the need to protect listed species from avian predators which would perch on woody vegetation, this type of vegetation will not be allowed on the ecotone. This is part of the project description included in the USFWS issued Biological Opinion for this project.
027_RWQCB_ 2-23	Individual Comment 19 AMM-HAZ-1 in Section 4.8.2.1 of the F/EIS/EIR states: All sites listed in Table 4.8-1 that are designated as "having HTRW concerns that are not likely to or with the potential to affect future construction" should be avoided for inclusion in this Proposed Project. Moreover, construction will be avoided in all areas where the presence or potential presence of HTRW has been documented previously. Further coordination with the San José–Santa Clara Regional Wastewater Facility will be conducted in order to accurately locate and avoid all areas with HTRW concerns prior to construction. If contaminants in any of these sites consist mostly of fairly inert and immobile chemicals (e.g., metals in soils) it may be acceptable to route levees through these sites. The placement of significant quantities of engineered fill in a permanent flood control structure may be an acceptable method of capping the remaining wastes in place.	More detailed investigation of HTRW concerns will be conducted during design. As much as possible the project seeks to avoid areas with contamination. However, if necessary, the project will consider actions, as suggested, to cap inert and immobile chemicals in either the levee or ecotone areas as one way of managing HTRW materials if this can be done to the satisfaction of state and federal agencies with jurisdiction over hazardous wastes and water quality.
027_RWQCB_ 2-24	Individual Comment 20 Section 5.5.5, Irreversible and Irretrievable Commitments of Resources (NEPA and CEQA), includes the following text in the third bullet point: Some of the materials used for transitional habitat construction (Pond A12 materials) would come from on-site sources. The majority of the material (transitional habitat fill for A18) would need to be imported, but an agreement between the local project sponsor and the USACE notes that such material would be imported at no cost to the sponsors. For the Proposed Project, if insufficient free fill material to construct the 30:1 ecotone is acquired by proposed construction dates, the transitional habitat would be reduced in size to the 50-foot bench (as included in all other alternatives); in either case there would be no associated investment by the sponsors for transitional habitat material. The possibility that a lack of material could result in Pond A18 being constructed with a 50-foot bench, rather than a 30:1 ecotone, adds an additional level of uncertainty to the Project's ability to meet its mitigation requirements. This adds further doubt to the Project's ability to be self mitigating.	The non-Federal sponsor has committed to constructing a 30:1 slope as part of the Shoreline Project and expects to have enough fill to complete the project. The report describes worse-case scenarios because the ecotone is an innovative feature in wetland restoration. In regards to the self-mitigating nature of the project, while it is likely that much of the ecotone slope will quickly convert to tidal salt marsh, it is important to note that was not the principal intent of this feature. The loss of waters of the state is also being offset by using existing levees as borrow sites and, in doing so, grade them down to marsh plain elevations, thus "jumpstarting" marsh creation on a total area of 18.4 acres. The ecotone is primarily meant to provide immediate high-tide refugia for sensitive marsh species, but also to allow for upslope migration of the tidal marsh in the face of sea-level rise, and therefore increase the project's resilience.
027_RWQCB_ 2-25	Individual Comment 21 In Chapter 9.0, Findings and Tentatively Selected Plan, Section 9.1 includes the following text: The Tentative NED/NER plan is Alternative 2. It includes levees at the same location as Alternative 3, but with a height tentatively identified at 13.5 feet. The Tentative NED/NER acres of tidal marsh, however, it does not include the 30:1 ecotone that is part of the TSP. Like the TSP, the Tentative NED/NER plan includes a pedestrian bridge over Alviso Slough. It is not clear to Water Board staff why an alternative that does not provide 100-year flood protection over the lifetime of the Project was selected as the Tentative NED/NER. Text in Section 4.4.1.2.2.3, Fluvial Flood Hazards, indicates that, although subsidence in the Alviso area has been slowed since groundwater recharge efforts were initiated in the 1970s, the current rate of subsidence is still being monitored. It may be useful to factor the potential for ongoing subsidence in the Alviso area to impact the level of flood control provided by the current Tentative NED/NER plan. Text on page 4-107 also suggests	The NED Plan is that plan that maximizes net national economic development benefits. Since this study includes both flood risk reduction and ecosystem restoration benefits, the level of federal interest is based upon the NED/NER (National Ecosystem Restoration) Plan, which maximizes both net NED and NER benefits. In the Draft Integrated Report, the NED/NER Plan was identified as including a 13.5 foot levee, although the net benefits for a 12.5 foot levee provided similar net benefits. The Final Feasibility Study will verify and document the NED levee height. Another Locally Preferred Plan (LPP) may be recommended if this plan meets certain qualifications and is approved by the Assistant Secretary of the Army for Civil Works (ASACW). For this project, the LPP that has been requested by the non-federal sponsor includes a levee with a 15.2 foot height, which is higher than the levee height that maximizes net NED benefits. A request to approve recommendation of the LPP rather than the NED/NER Plan for project authorization is currently being processed and will be submitted to the ASA(CW). If the ASA(CW) grants this waiver request, the levee with a height of 15.2 feet will be recommended.

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	that construction dewatering and heavy construction activities could produce further subsidence along the Project alignment. Therefore, higher levees may deserve to be selected as the NED/NER plan.	In terms of providing "100-year protection", Corps projects are analyzed and described in terms of their expected performance, not in terms of levels of protection. There is no minimum level of performance or protection or size required for Corps projects. The smaller in size or the lower the level of performance, however, the higher the residual risk. Residual risk must therefore be carefully analyzed and communicated. Departures from the NED plan (or in this case the NED/NER Plan) may be considered options to manage this risk. Documentation requirements for deviation from the NED plan for flood control projects are based primarily on consideration of residual risk. The Feasibility Report fully analyzes and documents residual risk. Further the request for approval to recommend the LPP for project authorization is based substantially on the greater level of risk reduction afforded by the higher levees. Regarding the comment reference to subsidence concerns - the noted statement on page 4-107 is erroneous and has been removed. The short-term nature of construction dewatering will have no measureable impact on long-term subsidence/consolidation processes. Construction dewatering sumps would be surficial and used primarily to remove surface waters entering the excavation from adjacent ponds. Water entering the excavation from very low permeability clays in the levee foundation is anticipated to contribute minimally, if at all, to the dewatering demand during construction.
027_RWQCB_ 2-26	Individual Comment 22 Section 9.5.1, Cost Allocation of the Tentative NED/NER Plan and TSP, contains the following text: For a single purpose FRM project, there would be some environmental impacts. However, the costs for mitigating for such impacts would be insignificant relative to the overall costs. Further, since the ER component of the multipurpose project provides a significant net gain in ecological outputs, a combined plan would not require mitigation and a determination was made that it is not necessary to allocate any ER related costs to the FRM component of the project The FRM only project would impact about 57 acres of waters of the State. This is a very large impact for a single project. The costs associated with providing sufficient mitigation for such a large impact would be considerable. Recent projects with an order of magnitude lower impacts have had great difficulty in finding sufficient mitigation along the South Bay shoreline. The F/EIS/EIR provides no support for the statement that "the costs for mitigating for such impacts would be insignificant relative to the overall costs." The F/EIS/EIR should either be revised to provide current mitigation costs for impacts on the order of 57 acres of jurisdictional waters, or the sentence should be deleted from the document. In general, the F/EIS/EIR could be improved if estimated mitigation costs for future levee raising to 13.5 or 15.2 feet had been included in the comparison of alternatives.	Concur. This statement is Section 9.4.1 has been removed from the text. However, these impacts would be similar for all levee scales. Further, since the ecological restoration component of the multipurpose project provides a significant net gain in ecological outputs, a combined plan would not require mitigation and a determination was made that it is not necessary to allocate any ecosystem restoration related costs to the FRM component of the project. Referenced text has been changed to read: "For a single purpose FRM project, there would be some environmental impacts. However, these impacts would be similar for all levee scales. Further, since the ER component of the multipurpose project provides a significant net gain in ecological outputs, a combined plan would not require mitigation and a determination was made that it is not necessary to allocate any ecosystem restoration related costs to the FRM component of the project."
027_RWQCB_ 2-27	Individual Comment 23 Section 9.6.5.1, Federal Responsibilities, includes the following text: However, with the passage of the WRRDA 2014 and language in Section 1025 relevant to the Shoreline Study, there may be an opportunity to include the ecosystem restoration of the USFWS lands as part of the NED/NER Plan and TSP, to be cost shared between the USACE and the non-Federal sponsor. Water Board staff encourage the USACE to pursue federal funding of the ecosystem restoration elements of the Project, since full implementation of 2,800 acres of tidal marsh restoration and ecotone restoration are likely to be necessary to provide appropriate mitigation for impacts to waters of the State. Federal funding of all tidal marsh restoration and ecotone construction would also reduce the uncertainties associated with implementation of the Project's mitigation elements.	The USACE signed implementation guidance for WRRDA 2014, Section 1025 on 26 February 2015, which allows it to recommend a USACE project that includes the implementation of ecosystem restoration on USFWS lands. The Final Feasibility Study has been revised to reflect this guidance, and explain the implementation responsibilities of the Federal and non-Federal entities, including schedule, cost/funding, construction, monitoring and adaptive management, and operation and maintenance. This information is provided in Chapter 9 and summarized in the Executive Summary. The Feasibility Study recommends USACE cost sharing of the tidal restoration of Ponds A9-15 and A18, but not the ecotone.
027_RWQCB_ 2-28	Individual Comment 24 Section 9.6.5.3, Views of Non-Federal Sponsors, includes the following text: The LPP is supported by the non-Federal sponsors because it meets local planning objectives, addresses regulatory agency concerns regarding environmental impacts, and allows the project to utilize a free source of fill material to establish transitional habitat. The LPP also eliminates the need to pay flood insurance for the community of Alviso and the surrounding area. Although non-Federal sponsors understand that the feasibility report must indicate that ecosystem restoration or recreation on USFWS lands would be implemented by the USFWS, they support legislation that would include the USFWS actions in the authorized USACE project, thereby allowing the USACE to be funded to implement these actions. The non-Federal sponsors believe that the overall ecosystem restoration effort (on USFWS and non-Federal lands) would be more efficiently and effectively implemented by one Federal agency. Although the USACE could construct the flood risk management levee and restore Pond A18 without the implementation of the USFWS project, the USFWS project could not proceed until the flood risk management levee is built. In addition, although the Pond A18 restoration could occur without first restoring Pond A12, it would be contrary to the landscape evolution modeling effort undertaken to evaluate the order in which the ponds should be restored. This analysis determined that Pond A12 should be opened to tidal flows first because it is the deepest pond in the study area. It would require more sediment than the other ponds to bring the pond bottom up to marsh plain elevations. If the project is to rely on natural processes to deposit sediments in Pond A12, it is critical to open this pond as soon as possible before sea levels change and bay sediments decline as is currently predicted. In addition, there is concern from the non-Federal sponsors that due to the large size of Pond A18 (856 acres) there is a larger risk of adverse impacts to the regional landscape. From the perspective of Adaptive Management, it would be better to open A18 after other ponds in the area have been opened and there has been monitoring data collected. This would provide project managers an opportunity to delay or modify the breaching of Pond A18 if there were	Thank you for your comment. The Water Board's concern regarding funding is noted.

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	any adverse impacts to local sediment supplies, wildlife, or infrastructure detected. Finally, the non-Federal sponsors are concerned that without a single funding stream, and the certainty associated with sufficient funding, both the USACE and USFWS projects are at greater risk. If one agency is funded but not the other, it is more likely that there will be costly project modifications or that some projects will not be able to be constructed at all. Water Board staff shares the concerns of the non-Federal sponsors.	
027_RWQCB_2-29	Individual Comment 25 Appendix X to the F/EIS/EIR contains the Shoreline Phase I 404(b)(1) Analysis. Appendix X is only 16 pages long. For a project with potential direct impacts on the order of 140 acres of waters of the U.S. and many potential indirect impacts, this is a fairly brief analysis. Appendix X reads more like a summary of the alternatives discussion on the body of the F/EIS/EIR than a full alternatives analysis. In addition, the analysis inappropriately attempts to minimize the Project's considerable impacts to jurisdictional waters by expressing them as a percentage of the total acres of waters present within the Alviso Complex ponds in the project vicinity. This is not an acceptable means of assessing the Project's impacts. Impacts that range between 57 and 138 acres of jurisdictional waters cannot be described as "small". Also, as is discussed above, the description of many of the Project's impacts as "short term" is not appropriate, since there will be a considerable lag time between impacts and full functioning of restored tidal marshes, and that lag time may be greater than the life cycles of the California clapper rail and the SMHM.	Concur. A much more detailed 404(b)(1) analysis is included in the final Feasibility Study.

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From: C/H High <howardhigh1@comcast.net>
Sent: Monday, February 23, 2015 4:58 PM
To: Shoreline Environment SPN

Cc: Florence LaRiviere; Eileen McLaughlin; Ian Wren; Sejal Choksi; Anne Morkill; Buxton, Brenda@SCC; michaelmartin@valleywater.org
Subject: [EXTERNAL] CCCR/Baykeeper comments re Shoreline Study Interim Feasibility Study, DEIS/DEIR
Attachments: cccr-baykeeper comments and attached memoranda.pdf

Dear Mr. Kendall and Mr. DeJager,

Please find attached the comments of CCCR/SF Baykeeper.
We would appreciate acknowledgement of receipt of our comments and ask that we be notified of any additional comment periods or decision documents.

Regards,
Carin High
CCCR

CITIZENS COMMITTEE TO COMPLETE THE REFUGE

SAN FRANCISCO BAYKEEPER

Thomas R. Kendal, Chief
Planning Branch Engineering and Technical Services Division
U.S. rmy Corps of Engineers San Francisco District
1455 Market St. San Francisco, CA 94103
ATTN: William DeJager Environmental Section A
ShorelineEnvironment@usace.army.mil

February 23, 2015

Re: Draft Interim Feasibility Report and Environmental Impact Statement/Report: South San Francisco Bay Shoreline Phase I Study, Santa Clara County, CA

Dear Mr. Kendal,

This responds to the Draft Interim Feasibility Report and Environmental Impact Statement/Report for the South San Francisco Bay Shoreline Phase I Study (DEIS/DEIR), located in Santa Clara County, CA. The Citizens Committee to Complete the Refuge (CCCR) and San Francisco Baykeeper (Baykeeper) thank you for extending the public comment period deadline.

As a general comment, the document combines the U.S. Army Corps of Engineers (Corps) required Interim Feasibility Study for management of flood risk, with the National Environmental Protection Act (NEPA) and California Environmental Quality Act (CEQA) required environmental review for the proposed construction of a flood control levee and accompanying ecosystem restoration proposed in part, to offset the adverse impacts of the flood control levee. While the purported intent of the effort was to reduce duplication and paperwork, the resulting document is unwieldy in its length and the number of attachments the public must wade through in order to develop some understanding of the project and resulting environmental impacts. Information that could significantly inform the public's understanding of the project impacts on the environment are not provided in concise and organized fashion. For example, it would be extremely useful if the figures indicating the proposed levee alignments, conceptual cross-sections of the levees, levees with benches, levees with ecotones, and conceptual plan and cross-section drawings of the railroad tide gate and pedestrian crossings were provided in one section entitled "Project Description." Instead, the reader is left to search throughout the 1,000 page document and nearly 2,000 pages of appendices for this information. Decision-makers, resource and regulatory agencies, and the general public would have been better served by providing the Interim Feasibility Report as an separate addendum to the DEIS/DEIR. 1

Regarding the actual substance of the Interim Feasibility Report and DEIS/DEIR, and compliance with the National Environmental Protection Act (NEPA), please refer to the attached memorandum prepared on behalf of CCCR, by coastal ecologist and botanist, Dr. Peter Baye. Please also refer to the attached memorandum provided Eileen McLaughlin, CCCR Board Member.

Overall the alternatives analysis presented in the DEIS/DEIR is flawed because, it arbitrarily constrains the geographic scope and phasing of the project alternatives, arbitrarily eliminates consideration of several alternatives within this DEIS/DEIR, such as levee set-back alignments through the San Jose Water Pollution Control Plant without providing 2

sufficient rationale or analysis of impacts. The DEIS/DEIR includes many comments regarding the long-term value of proposed habitat restoration components, but fails to apply this criteria when analyzing the benefits or environmental 3 costs of potential levee alignments. The DEIS/DEIR fails to include alternatives other than construction of a massive flood control levee that are proving effective in providing protection against sea level rise, such as incremental sediment 4 lifts or the introductions of subsurface discharges of wastewater through low-gradient levees.

The compensatory mitigation proposed will not reduce the significant adverse impacts of the proposed levee 5 construction on biological resources to a level that is less than significant. Please clarify, succinctly, what involvement the Corps will have in the actual mitigation of habitat loss resulting from the construction of the flood control levee, and what involvement the Corps will have in actual monitoring of habitat mitigation. It appears from the text, that if alternative 3 is selected for the final design, the Corps will construct the 30:1 ecotone in Pond A18, but that USFWS and 6 the Santa Clara Valley Water District would be responsible for the construction of the 30:1 ecotone in Ponds A12 and A13. Is this correct?

It appears the Corps will only provide its monetary cost share for the actual monitoring of habitat restoration and that 7 the actual monitoring activities will be conducted under the auspices of the South Bay Salt Pond Restoration Project (SBSPRP), is this correct? The DEIS/DEIR also indicates the Corps will only provide its cost share for the 10-year period following the implementation of the various habitat restoration elements, regardless of whether the restoration elements have achieved target success criteria or are trending in the appropriate direction, or not. Please explain why 8 the Corps would not be accountable for a longer period, especially if implementation of adaptive management measures becomes necessary.

The mitigation measures proposed fail to reduce the significant impacts to federally listed and sensitive species to levels that are less than significant. The DEIS/DEIR notes there may be short term impacts, but concludes that the long-term restoration of the adjacent salt ponds will provide significant habitat to mitigate any short-term losses. Nor does the DEIS/DEIR consider the ramifications of implementation of saltpond restoration itself impacts such as fragmentation of the fringe marsh adjacent to outboard saltpond levees proposed for breaching. The DEIS/DEIR acknowledges there is a possibility that fringe marsh could be subject to erosion following levee breaches, it also acknowledges that these fringe marshes provide important habitat and connectivity for species such as the federally-listed endangered salt marsh harvest mouse. How will the impacts of fragmentation of habitat, and potential isolation of SMHM populations be addressed in the near-term, while we wait for long-term development of connected SMHM habitat within the breached saltponds? This failure to address the consequences of short-term, significant adverse impacts of the proposed levee construction to federally listed and special status species is exemplified by the following excerpt from page 4-303 of the 9 document:

> Since the Shoreline Phase I Project would result in a net increase in the amount of tidal marsh in the study area, in the long term, <u>this increase would balance the impact of fill and fragmentation of any alternative</u>, including the 46.2 acres of habitat directly lost as a result of the Alviso Railroad Spur levee segment. Table 4.6-7 *Post-Restoration Conditions in the Study Area* shows the maximum amounts of tidal marsh habitat that would be created through ecosystem restoration. The tidal marsh habitat created through Pond A18 ecosystem restoration would provide more marsh habitat than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of marsh habitat.

> Although the tidal marsh habitat would not be established immediately, this impact is not considered significant since the project would not result in a net loss of marsh habitat over time. [emphasis added]

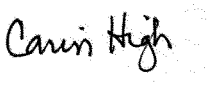
There is no scientific rationale provided to justify such a conclusion. If the project will "fragment habitat," especially for less mobile species (on a geographic scale, e.g. SMHM), and "tidal marsh habitat would not be established immediately" how could this impact not be considered significant?! It is indeed a potentially significant and adverse impact and mitigation measures must be proposed to counter fragmentation of habitat and isolation of populations. 9

The DEIS/DEIR fails to comply with the requirements of NEPA and has not demonstrated that the significant adverse impacts to biological resources can be reduced to levels that are less than significant. 10

The DEIS/DEIR should be revised and re-circulated as a stand-alone document separate from the Corps' Interim Feasibility Report. 11

Thank you for the opportunity to provide comments. We asked that we be notified of any additional comment periods or decision documents.

Sincerely,

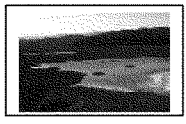


Carin High, Vice-Chair
Citizens Committee to Complete the Refuge

Ian Wren, Staff Scientist
San Francisco Baykeeper

Eileen McLaughlin, Board Member
Citizens Committee to Complete the Refuge
453 Tennessee Lane,
Palo Alto, CA 94306
Email: cccrrefuge@gmail.com

cc: Anne Morkill, USFWS
Brenda Buxton, California Coastal Conservancy
Michael Martin, SCVWD



Peter R. Baye, Ph.D.
Coastal Ecologist, Botanist
33660 Annapolis Road
Annapolis, California 95412

(415) 310-5109

baye@earthlink.net

MEMORANDUM

To: Citizen's Committee to Complete the Refuge (attention: Carin High, Florence LaRiviere
Date: February 23, 2015

SUBJECT: Critical review comments on USACE **Draft Interim Feasibility Report and Environmental Impact Statement / Report South San Francisco Bay Shoreline Phase I, Study Santa Clara County, CA (2014)**

As you requested, I have reviewed the USACE draft interim Feasibility Report (FR) and Environmental Impact Statement (EIS) in terms of NEPA compliance adequacy and substantive wetland conservation and restoration planning. My comments are below, focused on alternatives (geographic scope, range of alternatives, screening and elimination of alternatives not considered in detail, defects in alternatives analysis) and omission of appropriate mitigation or alternative components.

1. Geographic scope and phasing of project alternatives.

The geographic scope of the range of alternatives needs to consider the relationship between project area and whole project area, in terms of alternatives and appropriate mitigation among project segments within the larger project, as shown in Figure 1.4-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas) and Figure 1.4-2. The segmentation of the project to "streamline" it into piecemeal components, as a matter of expedience, does not relieve a NEPA lead agency of the obligation to consider impacts, mitigation, and alternatives that integrate the whole project, if environmental benefits may be gained. The reasons for segmentation give in the FR-EIS are limited to pragmatic considerations that do not constrain the scope of mitigation or alternatives: 12

> The District and non-Federal sponsors agreed that streamlining the study area to a reduced footprint would provide a *more timely* planning and implementation process. Early without-project flood risk analysis identified four of 14 USACE South Bay EIAs (Figure 1.4-3 South San Francisco Bay USACE Economic Impact Areas) that showed the greatest potential for future flood risk: EIAs 2 and 3 (Palo Alto area), EIA 7 (Sunnyvale area), and EIA 11 (Alviso area). The study partners decided to *limit the geographic boundaries of the revised study* area to EIA 11 for the following reasons on p. S-5:

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

1. There are a number of *recent research studies and environmental documents available* on the Alviso area, and these studies and documents were expected to greatly reduce study time and provide necessary tools for analyses.

2. The Alviso and Palo Alto areas both exhibit *high future flood risk to public safety*. However, the Palo Alto area could be covered under the ongoing San Francisquito Creek General Investigation Study, whose geographic scope overlaps that of the Shoreline Study.

3. The *bottom elevations of the Alviso ponds are generally lower* than other complexes around the bay due to subsidence from historical groundwater withdrawals. South of the ponds, extensive areas of urban development are protected by levees that were not originally built for flood risk management, allowing for substantial long-term flood risks.

4. Addressing flood risk in the Alviso area would also *allow for potential restoration* of close to 3,000 acres of former solar salt production ponds, whereas the *other three candidate EIAs do not include potential restoration actions*. These former salt ponds represented a major opportunity for restoration of tidal habitats in San Francisco Bay along with associated ecological functions and habitat for Threatened and Endangered species.

12

But because the Shoreline Phase I Study and the SBSPRP will be implemented as separate projects, "each having its own independent utility and neither dependent on the other to achieve their purpose and need, as defined in separate environmental review processes…", the FR-EIS cannot exclude from a "reasonable range of alternatives" off-site mitigation for project impacts elsewhere in the SBSPRP simply because candidate EIS do not currently include potential (tidal marsh) restoration areas – particularly given the adaptive management provisions of the SBSPRP.

The fact that the FS-EIS affirms its independent utility and independence from the SBSBRP to achieve its own purpose and need is no barrier to considering reasonable alternatives that integrate both projects within the larger Shoreline Study boundaries where they are potentially compatible and mutually modifiable. The FR-EIS must identify potential time-sensitive (*i.e.*, sea level rise curve-sensitive, sedimentation rate/elevation sensitive) opportunities lost or gained within the larger project area, as a result of allocating resources and planning or construction priorities to the Phase 1 study area. There should be a stepwise, hierarchical application of the kind of "geomorphic risk and opportunity" analysis evident in Appendix C (ESA-PWA 2012) extended to the larger project area as a whole. Otherwise, the selection of Phase 1 as a priority area will lack any basis in NEPA, and the range of reasonable alternatives considered for Phase 1 be deficient.

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

2. **Range of reasonable alternatives**. The range of alternatives evaluated in detail in the FR-EIS falls short of a reasonable range under NEPA. This deficiency is due to improper elimination of some potentially feasible and environmentally beneficial or even preferable alternatives due to invalid or unsound elimination procedures (screening criteria). The FR-EIS does not consistently distinguish between alternatives that are simply not the agency's preferred alternative based on lead agency consensus or policy selection criteria (CEQ guidance, Fed Register 46 No. 55 p. 18027, 4a) from alternatives that are not within the range of "reasonable alternatives", including those not necessarily in the jurisdiction of the lead agency (*op. cit.* 2b). In other words, the EIS fails to provide adequate, reasonable accounts of why alternatives that fail one or more agency policy, preference, or "feasibility" criteria (including agency-specific policy criteria narrower than the "reasonableness" criteria of NEPA.

2.1. **Missing information and arbitrary elimination of the WCPC levee alignment**. The FR-EIS treats deficient information as a reason for eliminating from detailed analysis any alternatives involving levee set-back alignments through the wastewater facility. This is not reasonable if there are potentially significant environmental benefits at stake. If there are potential environmental benefits to set-back levee alternatives though oxidation ponds, for example, then the appropriate NEPA lead agency action (or obligation) is to develop that information or assess risks in its absence. The invalid rationalization for screening out wastewater facility footprint alternatives is given on page S-22 of the FR-EIS: 13

> Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. (FR-EIS p. S-22)

> Because of the *limited availability of public information* regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining *uncertainty* regarding the City of San José's future plans for the area, the *footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to the USACE's economic analysis* of flood risk management options. *No further discussion of these alignments is included in this document.* As the Wastewater Facility Master Planning effort proceeds into design, there may be further opportunity to revisit the alignment section.(FR-EIS p. 3-18)

First, the mere fact that the drying beds were eliminated from analysis prior to the USACE NEPA alternatives review provides in itself absolutely NEPA justification for their continued and ongoing exclusion from NEPA alternatives, especially given the potential for non-jurisdictional Section 404 fill in wastewater facility lands. USACE as a NEPA lead agency must explain the reason why this location is not within a reasonable range of

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

alternatives; instead, it merely stated why some other (non-NEPA) agency removed it from the candidate list prior to USACE NEPA review. Indeed, the statement that there may be further opportunity to consider this alignment when planning efforts by another agency "proceeds further into design" begs the question why it can't be done for this EIS, and indicates that missing environmental background information is reasonably obtainable, or was during the EIS draft process for the Shoreline Study.

Second, the nature of the lack of "public" information about this publicly owned and state/federally regulated wastewater facility is both bizarre and unexplained in an EIS. Public infrastructure must be presumed to be open to public information, given due diligence and reasonable effort of a NEPA lead agency. The purpose of an EIS is to provide such information pertinent to significant potential impacts and formulation of environmentally preferable alternatives. Missing information is in itself no justification for excluding a potentially environmentally benign or preferable alternative from analysis. It should be no barrier to environmental analysis if it is pivotal to comparison of otherwise reasonable alternative project alignments with potential for significantly greater long-term environmental benefits; indeed, it would be justified to actively seek missing information or assess risks and potentially feasible mitigation in absence of adequate information. Fed Reg. 46 No 55 Mar 23 1981 p. 18031. 14

2.2. "**Community acceptability" criteria and Alviso South levee alignment (Alternative 5)**. The FR-EIS inconsistently applies "community acceptability" feasibility criteria in a way that arbitrarily eliminates some alternative designs that are reasonable and environmentally advantageous. The FR-EIS invokes "Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G) criteria (FS-EIS p. S-23: completeness, effectiveness, efficiency, and acceptability)" as feasibility criteria. The latter "acceptability" criterion cannot be applied to a NEPA analysis of a "reasonable" range of alternatives because a stand-alone agency "*acceptability*" criterion that, in contrast with "completeness", "effectiveness", or "efficiency", is not *per se* an objective, and may be based on undisclosed purely arbitrary or political considerations unrelated to other environmental consequences and priorities. For example, the Alviso South levee alignment's elimination from NEPA alternatives identified as preferred or environmentally preferable appears to have no environmental justification in the FS-EIS other than unacceptability to representatives the local community (FS-EIS p. 3-81). "Alternative 5, which includes the Alviso South levee alignment, ***is acceptable* from the Federal perspective** (FR-EIS, p. 3-78). Yet the FR-EIS also states that alternatives other than Alternative 3 were other alternatives were "not supported by the **non-Federal** sponsor for the following reasons": 15

> "Alternative 5, which includes the Alviso South levee alignment, is ***not acceptable to the local community*** *because of its proximity to residential and commercial properties.* The community of Alviso would ***prefer*** a levee alignment that is as far away from residences as possible. The community therefore

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

> **prefers** the Alviso North or the Alviso Railroad Spur levee alignments to the Alviso South option, which is adjacent to the community (Table 3.10-3). In this respect, the Alviso North and Alviso Railroad Spur levee alignments were more acceptable than the Alviso South alignment. FR-EIS p. 3-81.

The FR-EIS overall, however, **rejects the Alviso South levee alignment, along with the rest of Alternative** 5, amid contradictions between federal and non-federal (non-NEPA) criteria without reconciling them as stand-alone NEPA conclusions. In effect, the FR-EIS allows the non-federal considerations to veto a valid NEPA alternative, but with no NEPA justification to do so. Even though the FR-EIS states that the Alviso South alignment *is* acceptable from a federal perspective on p. 3-78, it **cites only local community opposition** (and without adequate documentation) as the reason for rejecting Alternative 5 on page 3-81 in stand-alone discussion of Alternative 5, with no reference to wetland impacts or benefits for Alternative 5. Yet in discussion of the LEDPA (Least Environmentally Damaging Practicable Alternative, a Clean Water Act Section 404(b)(1) environmental criterion, compatible in many respects with NEPA, though more restrictive) on page 3-81, however, the FR-EIS states in discussion of Alternative 4 that "Alternatives 4 ***and 5 would have*** **increased** ***impacts to wetlands*** *and other waters of the U.S. (relative to other alternatives)* ***because of the levee alignment through New Chicago Marsh,*** with no offsetting improvements in aquatic resources", without reference to the local Alviso community preference. This conclusion, however appears to be inconsistent with following argument, also on p. 3-81, "Because of recent upgrades to the managed flows into and out of the NCM footprint, the Alviso **North** ***and Alviso South alignment options are anticipated to have fewer impacts on aquatic and terrestrial biological resources*****"**, since Alternative 5 explicitly includes the Alviso South alignment. In any case, there is no valid reason given in the FR-EIS for throwing the Alviso South alignment "baby" out with the Alternative 5 "bathwater". 15

The result of the alternatives discussion regarding Alviso South alignment appears to be rejection of the Alviso South alignment along with Alternative 5, amid unresolved inconsistent arguments about wetland impacts, and a split federal-nonfederal "acceptability" decision that in effect gives non-federal considerations a veto over federal, without any reasonable explanation.

Even if the inconsistencies were reconciled with additional information, this reasoning about the "fatal flaw" for the Alviso South component of Alternative 5 is itself flawed because it fails to distinguish between potentially harmful (fill impacts) and long-term wetland resilience and restoration benefits of fill for a gradual terrestrial ecotone/levee slope. As sea level rise accelerates, New Chicago Marsh itself will be subject to increasing risk of vegetation canopy submergence and mass flooding mortality of federally listed salt marsh harvest mouse populations during episodes of drainage failure. Selective placement of at least some fill designed as flood refuge (restoration) will be as essential to the long-term sustainability of NCM as a diked nontidal salt marsh as it would be for a tidal marsh subject

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

to submergence. The Alviso South alignment could potentially improve long-term habitat resilience of NCM (despite short-term fill impacts) if designed properly for flood refuge habitat and interim mitigation. Thus, there is no reasonable NEPA explanation for eliminating the Alviso South alignment from either a (federal) agency's preferred or environmentally preferable alternative.

The FR-EIR appears to arbitrarily weigh the "community support' criterion above all NEPA environmental considerations, such as comparison of wetland, wildlife, water quality, and erosion risk mitigation against alternative alignments, *without any reasonable explanation.* Moreover, the statement of "community support" **as a planning goal** on page S-15 is limited to "…provide opportunities for **public access, education, and recreation** in the Study Area (California Bay Trail Plan)". Similarly, "**stakeholder perspectives" as stated (S.17.1) does not provide a project policy basis for local preferences trumping national environmental policy**. The planning goal of community support as stated in the FS-EIS does not extend to local popularity /preference of one particular one levee alignment over another if both provide opportunities for public access, education, and recreation. Therefore, reference to "community acceptability" based on purely local community "preference" (over national/NEPA environmental benefits or impacts overall) as a primary or sole reason for eliminating an alternative from rigorous review is arbitrary and inconsistent with the FS-EIS's own statement of project goals. 15

2.5. **Non-structural (relocation) criteria.** The FR-EIS does not adequately explain why non-structural flood management alternatives are not applied to the vast Water Pollution Control Plant that has so much influence on project formulation. The FR-EIS states on p. S-18:

> According to officials from the WPCP, the damage to assets from a flood that at least inundates the underground facilities is estimated to total more than $250 million. This does not include the impacts and costs to health and human safety and the environment from a release of raw sewage into the bay, the cost of fines imposed by the local and state agencies, nor does it include the impact of a loss of service to homes and businesses in the region.
>
> Given the financial, safety, and environmental impacts of a damaging flood at the plant, it is reasonable to assume that in the absence of a larger Federal project the City of San José would invest in flood risk reduction measures at the plant, which would most likely consist of a ring levee and associated features. To be clear, the City of San José has stated that they do not currently have an alternative plan for reducing flood risk to the plant in the absence of a federally-sponsored levee project. Nonetheless, it is important to consider what the City might do rather than just assume no future action and count all expected flood damage over the period of analysis. A preliminary planning-level estimate of the cost of a ring levee shows the construction would cost $25 million not including real estate. This cost is included in the estimate of the cost of the non-structural alternative as well as the value of the damages reduced for the structural alternatives. See the Economics Appendix for more detail. 16

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

The FR-EIS apparently does not evaluate alternatives based on "non-structural" relocation, other than an on-site ring levee in the economic analysis appendix. If, however, the full analysis of environmental benefits and flood risks of relocation were presented, it would be possible to objectively assess the long-term environmental costs and benefits during the entire time-frame of planning (century of sea level rise). The FR-EIS fails to explain why this is not a "reasonable" century-scale alternative (like other alternatives time-frame) pursuant to NEPA, from a federal perspective.

3. Alternatives design and environmental consequences

3.1. **Levee alignments and location-specific long-term environmental consequences for geomorphic and ecological evolution of landscapes**. The potential biological environmental benefits of constructing low-gradient levees as terrestrial ecotones of tidal marshes depends almost entirely on the geomorphic evolution and resilience of wide (fringing or slough system) tidal marsh platforms adjacent to them. Physical benefits of fringing tidal marshes and ecotones for flooding reduction functions (wave attenuation) do not equally depend on configuration of adjacent tidal marsh and broad terrestrial environmental gradients. The geomorphic evolution scenarios rigorously analyzed and evaluated by ESA-PWA (2012) in Appendix C provide a robust and clear assessment of the risks that tidal marshes may fall behind sea level rise, and either stabilize as low marshes (constrained for nesting habitat) or mudflats (no marsh wildlife to benefit from terrestrial ecotones). The circumstances under which high marsh may form and persist to complete the ecotone established by the project levees, are unfortunately tenuous and difficult to predict. This risk is likely to intensify with increasing distance from tidal channel mouths. The risk of tidal marsh "downshifting" (elevation loss due to accretion rates falling behind sea level rise rate) needs mitigation *as part of the project*, to ensure that "complete marsh" (Appendix C, p. 2) ecosystems, not just the dangling levee ecotone half, are the result of the project. One proven method for minimizing the risk that high salt marsh will founder and "downshift" to unsuitably low elevations is to slurry sediment to nourish marsh elevations (see 3.2., next comment). The infrastructure and resource commitments needed for a sediment slurry or water distribution system along the project perimeter should be assessed as part of the alternatives analysis and as mitigation for risks of project long-term performance deficits. 17

3.2. **Phased long-term construction and maintenance using sediment slurry marsh sediment nourishment methods of USACE**. The range of alternatives fails to consider a wetland engineering method of sediment nourishment for tidal marsh maintenance that the USACE has helped develop for subsidence-impacted tidal wetlands elsewhere in the U.S.

The application of thin-layer hydraulic slurry deposits of sediment (Ray 2007: **Thin Layer Placement of Dredged Material on Coastal Wetlands: A Review of the Technical and Scientific Literature, USACE ERDC/EL TN-07-1 December 2007**) has been used to incrementally "lift" subsiding marsh elevations successfully in the Gulf Coast in all marsh zones. The Corps is one of the leading expert agencies nationally in applying this method to 18

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

wetland restoration and management, and is well-suited to adapt this method to SF Bay vegetation and habitats.

Since the cooperating and co-lead State agency is one of the primary sources of dredged sediment from flood control channels (a project purpose closely related to the proposed project), and since the flood channel maintenance sediment potentially suitable for tidal marsh sediment nourishment in the South Bay, it is reasonable to consider its applicability for the proposed project instead of routine disposal as waste rather than beneficial re-use. Thin-layer dredged sediment of suitable quality (including sandy silts or sands) could, for example, be used to incrementally raise terrestrial-tidal marsh ecotone slope elevations gradually as sea level rises, and without eliminating shallow burial-tolerant perennial native marsh or grassland vegetation. This would potentially have direct and indirect flood control benefits as well as environmental enhancement, by increasing the wave-attenuating breadth of high-roughness high marsh vegetation at higher intertidal elevations, offsetting sea level rise submergence of high marsh with lowest impact of fill. Instead, all alternatives consider only single-event fill construction, without integrating flood channel maintenance and new low-gradient habitat-levee maintenance. Despite the USACE national authority on this method, there is no reasonable NEPA explanation in the FR-EIS given for omitting or excluding incremental hydraulic sediment addition as part of phased construction or maintenance of the proposed terrestrial ecotones. 18

3.3. **Long-term ecotone maintenance with surface or subsurface irrigation of treated wastewater to buffer marsh salinity and wave energy**. Even though the San Jose wastewater treatment facility is one of the major stakeholders and flood planning for the proposed project, the NEPA alternatives array fails to consider incorporating treated wastewater discharges as a long-term component of tidal marsh and terrestrial ecotone (levee) maintenance and management. Conventional direct discharge of treated wastewater into tidal sloughs eliminates opportunities for landward edges of tidal marshes to "polish" and transform wastewater nutrients and contaminants in a way that enhances their flood control and habitat functions. This is particularly relevant to the segment of the shoreline study adjacent to the WPCP. 19

Non-channelized (overland) surface or subsurface irrigation discharges of treated wastewater (suitable quality) through tidal marsh-terrestrial ecotones of new low-gradient levees would increase vegetation height and density, and partly buffer impacts of future climate-forced hypersalinity in the tidal marsh ecotone. Increased vegetation height and density would enhance both extent and height of high tide flood refuge canopy of vegetation, and increase wave attenuation (reducing total water levels during flood events, minimizing wave runup). Fresh-brackish back-marsh gradients maintained by beneficial re-distribution of treated wastewater should be incorporated in alternatives within the feasible "service area" of the WPCP.

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

3.4. **Methylmercury management and mitigation in terrestrial-tidal marsh ecotones.**

Mitigation measures for managing methylmercury in constructed low-gradient levees in the tidal marsh-terrestrial ecotone should include (a) evaluation of minimizing sediment carbon content (soil organic matter) and total mercury in the constructed "cap" of the tidal marsh-terrestrial ecotone; (b) design of suitable surface and subsurface drainage of the constructed levee slope to prevent fluctuating anoxic/oxic soil redox (conducive to sulfur-reducing bacterial activity) in the presence of soil organic matter. The design should anticipate gradual SLR submergence of the lower ecotone slope, and prevent undue generation of methylmercury in depressional topography there in the presence of naturally accreted soil organic matter. 20

Peter R. Baye Ph.D.
Coastal Ecologist, Botanist,
baye@earthlink.net
(415) 310-5109

CITIZENS COMMITTEE TO COMPLETE THE REFUGE

Memorandum

February 23, 2015

To: William DeJager, Environmental Section A, U.S. Army Corps of Engineers, San Francisco District
From: Eileen McLaughlin, Board Member, Citizens Committee to Complete the Refuge
RE: Integrated Document, Draft Interim Feasibility Report and Environmental Impact Statement/Report of the South San Francisco Bay Shoreline Phase I Study

Please consider comments below as part of the public comments of the Citizens Committee to Complete the Refuge (CCCR) about the Integrated Document.

General Observations

As is mentioned in the Integrated Document, CCCR has been active and interested in the subject project since its beginning and first public meeting in 2006. We are aware of and have concern about the extent of time passed and about the local need for Federal funding. But more than anything we are interested in seeing that the project have the best outcomes for flood protection, habitat restoration, and wildlife.

It can be said that the United States is in its earliest phases of constructing protection from sea level rise (SLR) or, as used in the Integrated Document, sea level change (SLC). No, low-lying shoreline of the United States is, to our knowledge, protected from SLR. Meanwhile around the globe there is extensive discussion on methods of SLC protection. Mankind is in a learning mode and so it is in the far South Bay.

Phase I is an early stage SLC project in the American experience and the first levee planned to address SLC along the shores of San Francisco Bay. Questions arise that the Integrated Document has not addressed: Has Phase I assessment overlooked perspectives of the entirety of Shoreline Study Area and thereby focused decisions too narrowly? Might the decisions of Phase I impact options for subsequent Phases in the Shoreline Study Area or related actions in Alameda County? By omission, oversight, or process restriction might certain decisions for Phase I ultimately prove to be unfortunate, irreversible mistakes? 21 22 23

These are the most significant uncertainties of the Phase I Study. In that light, the best decisions are dependent on a thorough, best-of-science and locally-specific analysis. The comments below discuss concerns that the Integrated Document has not met that standard.

Defining the Setting of the Project

The Integrated Document explains[1] that after the 2010 Feasibility Scoping Meeting (FSM), the decision was made to reduce the geographic scope to the Shoreline Phase I Study Area. From many perspectives that was a necessity with which we do not essentially disagree. Nor do we disagree with acting on behalf of the Alviso community and of the critical infrastructure provided by WPCP. We note however that the phasing action split the Study Area into a discrete segment between streams without considering the 24

[1] Integrated Document, S.5.1, p. S-5

entirety of each stream nor the impacts on the opposite shore. As a result the Integrated Document omits consideration of certain questions that are relevant to the entire Shoreline Study Area and may be relevant to future, foreseeable integration of Phase I actions with a system of shoreline levees.

Examples of this concern include:

- Estuarine Setting: In its simplest definition, an estuary is the place where the flow of a river or stream meets the sea's tides. The estuary that is the San Francisco Bay is a place with a vast array of watershed-fed rivers and streams draining to meet the tides, mixing along the Bay's edges at mouths and within intertwined sloughs to dynamically deliver varying salinity, sediment and habitat conditions. It is a place that drains some 40% of the waters of the State of California. As a result, it is a water body in which fluvial and tidal influences are complex and, in impact, inseparable. How does a massive levee fit in with the healthy functioning of an estuary and of its watersheds?

  Estuarine characteristics apply to the entire Shoreline Study Area including Phase I. They also relate to fluvial conveyance all along the length of streams and tributaries of each watershed. Once modern era actions constrained our streams, each stream's mouth took on greater significance for drainage efficiency. Accordingly Phase I actions at and near the mouths of Coyote Creek and the Guadalupe River need to consider potential impacts of a massive levee to fluvial flow and do so on a watershed impact basis, not simply within the boundaries of the Shoreline Study Area. For both streams, there is a long history of significant economic impacts from overtopping events in multiple locations including Alviso and central areas of San Jose. Now these streams face future extreme storms induced by global climate change. The Integrated Document is incomplete and inadequate if it remains unknown as to whether its proposals help or hinder the flow efficiency of these streams. 25

  Under Planning Constraints[2], the Integrated Document lists: "Do not increase flood risk in developed areas of the Study Area where loss of life and monetary damages may occur." Subsequently, while identifying Management Measures[3], the Integrated Document states: "After the scope was refined to *include only flood risk from tidal sources*, the study team eliminated measures that addressed only fluvial flood risk management." [Ed. note: emphasis added]

  The question is thereby left unconsidered and unanswered: Do Alternatives in the Final Array or Alternatives considered for and eliminated from the Final Array impact, beneficially or negatively, the functionality of either Coyote Creek or the Guadalupe River? We ask that this question be considered and answered.

- Future Shoreline Actions at Alviso Slough and Coyote Creek: All Alternatives in the Final Array depict the same locations for the Alviso and WPCP levee segment terminations, respectively near Alviso Slough and Coyote Creek. We did not find an explanation for those particular terminal points in the ID. 26

[2] Integrated Document, S.9.1, p. S-16
[3] Integrated Document, S.11.1, p. S-19

A component of Phase I is the tidal flood gate to be installed on Artesian Slough, the only waterway lying fully within the Phase I Study area. This tide gate will link the Alviso and WPCP levee segments. Seeing this component prompts the question: Is there the concept or intent for tide gates to be installed on Alviso Slough and/or Coyote Creek when a SLC levee is built on the other side of the stream? At Alviso Slough that seems quite possible as the Phase I levee, as depicted, could link during Phase II by tide gate with a levee that might border Pond A8.

At Coyote Creek, the terminus is not near a location that would likely align with a SLC levee nearby nor to an existing engineered flood control levee as exists some distance inland. Nor are the lands on the other side of the creek within the Shoreline Study Area. The proposed levee appears to simply end where the existing earthen levee ends. 27

We wonder how these decisions can be made without knowing the greater context of the entire Shoreline Study. Will tide gates be routinely used to span streams? What impacts will an "orphaned" terminus of a levee have on a stream and lands upstream?

Concern: Information about the relationships to the entire Shoreline Study Area, the complexity of the local estuarine setting and specific details as discussed here need to be in the Integrated Document. 28

San Jose/Santa Clara Regional Wastewater Facility Master Plan and Biosolids Ponds/Beds Alignment.

In multiple locations in the Integrated Document the text mentions the San Jose/Santa Clara Regional Wastewater Facility Master Plan (RWF MP) or alternate references to it as the WPCP Master Plan or Plant Master Plan. Some references refer to it as not yet final while others acknowledge that it was approved in 2013. It was approved. Actions to implement the plan were authorized and are underway. 29

Through the Master Plan, the City decided that the lands along Coyote Creek could potentially be used to reduce flood risks and for habitat restoration, possibly in the form of a floodplain directly connecting the creek with Pond A18 and the restoration planned there. This proposal could not occur if any of the Alternatives of the Final Array are built. 30

In August 2014, the Santa Clara Valley Water District released a Revised NOP for the South San Francisco Bay Shoreline Phase I Study. Under CEQA[4], an NOP establishes the *existing* environmental condition and baselines for related analyses:

> 15125. ENVIRONMENTAL SETTING
> (a) An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which a lead agency determines whether an impact is significant. 31

As the approval of the Master Plan and authorization to begin implementation occurred before the Revised NOP, the RWF MP exists as part of the environmental setting and must be integrated into the Phase I Study considerations.

[4] CEQA Guidelines 14 CCR § 15125 Environmental Setting

Unfortunately, in the Executive Summary of the Integrated Document[5], the Phase I Study discusses a preemptive decision regarding a RWF MP Alternative, dropping its biosolids beds/ponds alignment from further discussion:

> "Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. As the Wastewater Facility Master Planning effort proceeds into design, however, there may be further opportunity to revisit the alignment section." 32

While the Executive Summary leaves a door slightly open, it limits it to "may be further opportunity" without explaining the conditions or the process by which that could occur within the Integrated Document. For a regional plan where implementation is underway, the Project partners have a responsibility in the Integrated Document to outline the process and steps by which the objective of the RWF MP can possibly be achieved. In addition it should describe and discuss the alignment across the biosolids ponds/drying beds as a known, potential variation of Alternatives in the Final Array.

It is our understanding that during the current Planning phase of the USACE process, the design level proceeds just to the 15% level. In the next phase, Preliminary Engineering and Design, the design advances in increments and changes can be incorporated up to the 60% point. We understand also that Federal funding normally allows for change for up to 20% of the funded project. If these are criteria by which an active, overlapping plan that is moving forward and can achieve its goals and improve Phase I, then it should be detailed for information purposes in the Integrated Document. 33

We ask that the Integrated Document expressly inform the public about the potential of and the means by which the RWF MP proposal can be integrated within Phase I. 34

Artesian Slough Tide Gate

As a component of Phase I, the flood wall/tide gate structure proposed for Artesian Slough is mentioned frequently throughout the Integrated Document. Unfortunately, these are repetitions of the same information which is remarkable only for the lack of detail. This is a structure proposed for a wildlife tourism and education location virtually adjoining the public facility and parking lot. Annually thousands of tourists visit as do thousands of school kids. This structure will at minimum be very disruptive to the viewing experience especially as the slough is a prime viewing location. The public needs to know what this gate will look like and the Integrated Document doesn't tell us. 35

There will be substantial impacts to habitat, wildlife and the slough during construction and restoration. Information is needed about these activities and their impacts. 36

The most specific detail provided is that the structure will be >=300' from the outfall. A little map checking makes us wonder about the purpose of providing that datum. The outfall is near Los Esteros Road. 300' downstream would still be a good distance before reaching the A18 levee and much further from the aerating pumps that are in the stream closer to the EEC. The alignment maps all place the Tide 37

[5] Integrated Document, S.11.2.3, p. S-22

Gate near the EEC, a location which is nearly 2500' feet downstream of the outfall. In short, the tide gate's location requires a much, much better description.

Adding to that confusion, a great deal of other information is missing about this Tide Gate.

- No graphic representation of the structure.
- No rough structural dimensions
- No description of the extent of permanent intrusion into the slough.
- No specific discussion of the construction methods or duration.
- No presentation of its visual impacts in this tourism and environmental education location.
- No discussion on if and how it may change or cause change to the dual channels of the slough.
- No detail about the associated pedestrian bridge mentioned, presumably to link the levee trail.
- No discussion of Refuge evaluation of the compatibility of this bridge with its wildlife-first policy.

Lacking this information for a high visibility location, members of the public are unable to make informed comments that may be needed to avoid impacts and improve the project. We ask the omitted information be made available in the Integrated Document.

Railroad Tide Gate Pedestrian Bridge

The Partners' presentation at the January public meeting of this project included a photograph of a typical railroad tide gate as proposed in the Integrated Document. Additionally a pedestrian bridge is proposed to cross over that tide gate, described but not pictured. We understand that it has been recommended that a cyclone fencing enclosure be used on the bridge, presumably to assure safety over a railroad crossing.

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The location of the railroad tide gate and pedestrian bridge will connect two sections of the Alviso levee that both lie on Refuge land, providing a prime elevated location for wildlife viewing for tourists or people just enjoying a hike. To be frank, cyclone fencing is just plain ugly. This pedestrian crossing should be safe to people and wildlife, aesthetically attractive and complementary to the uses of the people that cross it. It may also need to comply with Refuge requirements on behalf of wildlife.

Please include these pedestrian bridge recommendations when planning the railroad pedestrian bridge.

We appreciate the opportunity to submit these comments and also the time extension that was provided to do so. Combined, the Integrated Document and Appendices are overwhelming for almost any reader in the public or its agencies, a limiting factor for this writer in terms of topics reviewed. 39

ID	Issue Text	Response Text
028_CCCR.SFB_3-1	As a general comment, the document combines the U.S. Army Corps of Engineers (Corps) required Interim Feasibility Study for management of flood risk, with the National Environmental Protection Act (NEPA) and California Environmental Quality Act (CEQA) required environmental review for the proposed construction of a flood control levee and accompanying ecosystem restoration proposed in part, to offset the adverse impacts of the flood control levee. While the purported intent of the effort was to reduce duplication and paperwork, the resulting document is unwieldy in its length and the number of attachments the public must wade through in order to develop some understanding of the project and resulting environmental impacts. Information that could significantly inform the public's understanding of the project impacts on the environment are not provided in concise and organized fashion. For example, it would be extremely useful if the figures indicating the proposed levee alignments, conceptual cross-sections of the levees, levees with benches, levees with ecotones, and conceptual plan and cross-section drawings of the railroad tide gate and pedestrian crossings were provided in one section entitled "Project Description." Instead, the reader is left to search throughout the 1,000 page document and nearly 2,000 pages of appendices for this information. Decision-makers, resource and regulatory agencies, and the general public would have been better served by providing the Interim Feasibility Report as an separate addendum to the DEIS/DEIR.	The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final Feasibility Study includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process.
028_CCCR.SFB_3-2	Overall the alternatives analysis presented in the DEIS/DEIR is flawed because, it arbitrarily constrains the geographic scope and phasing of the project alternatives, arbitrarily eliminates consideration of several alternatives within this DEIS/DEIR, such as levee set-back alignments through the San Jose Water Pollution Control Plant without providing sufficient rationale or analysis of impacts.	The South San Francisco Shoreline Study Phase I (Shoreline Study) project complies with both NEPA and CEQA prohibitions against 'piecemealing' a project. Lead Agencies have the authority to define a project and its objectives, as long as it passes two tests regarding piecemealing. An Environmental Impact Report (EIR) must include an analysis of future expansion or other actions if (1) it is a reasonably foreseeable consequence of the initial project, and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its environmental effects. For the Shoreline Study, the implementation of Phase 1 between Coyote Creek and Alviso Slough/Guadalupe River does not require future actions elsewhere to occur and does not restrict future alternatives for other areas in the shoreline footprint. Analysis in the Shoreline Study draft Feasibility Report, Environmental Impact Statement and Environmental Impact Report (Integrated Document) show that the Shoreline Study can occur independently of other potential future projects (or phases) in the broader Shoreline Study area as each of the Economic Impact Areas (EIAs shown on p. 1-10 of the Integrated Document) is hydrologically independent and does not increase flooding potential for adjacent areas. It is also important to note that phasing does not mean that other opportunities will be foregone or lost by starting with a smaller subset of restoration than restoring all the former salt ponds in the Alviso area. The Integrated Document provides multiple reasons for making the Alviso segment of the Shoreline Study the first phase of an on-going project, including protecting a large number of residences, businesses, and public infrastructure; and the Alviso Pond cluster (Ponds A9-15 and A18) provides the largest amount of wetland restoration opportunity when compared to other EIAs. These ponds are also the most subsided and will require the greatest amount of time to restore.
028_CCCR.SFB_3-3	The DEIS/DEIR includes many comments regarding the long-term value of proposed habitat restoration components, but fails to apply this criteria when analyzing the benefits or environmental costs of potential levee alignments.	CEQA-specific and NEPA criteria were used to analyze the potential impacts of alternative levee alignments. Discussions of long-term value of proposed habitat support the evaluation and conclusions.
028_CCCR.SFB_3-4	The DEIS/DEIR fails to include alternatives other than construction of a massive flood control levee that are proving effective in providing protection against sea level rise, such as incremental sediment lifts or the introductions of subsurface discharges of wastewater through low-gradient levees.	An EIS/EIS must describe a reasonable range of alternatives that could feasibly attain most of the basic objectives of the project while avoiding or substantially lessening any significant effects of the project (CEQA Guidelines Section 15126.6(a); 40 C.F.R. 1502.14). Many non-structural alternatives were considered in the planning process, including wave attenuators and barrier islands, but these types of alternatives were eliminated since they do not reduce risk for modeled future tidal flooding scenarios. See Chapter 3 for a discussion of alternative plan formulation and evaluation. Table 3.4-1 is a list of alternative measures considered in the planning process.
028_CCCR.SFB_3-5	The compensatory mitigation proposed will not reduce the significant adverse impacts of the proposed levee construction on biological resources to a level that is less than significant.	To provide as much tidal marsh early in the project the project described in the draft Integrated Report was adjusted to have both Pond A12 and A18 breached as soon as practical after completion of the FRM levee and ecotone. In addition, new vegetated marsh will be created in the first phase of pond restoration by using existing A12 and A18 levees as borrow sites and the lower slope of the ecotone area will become vegetated immediately (see also 027_RWQCB_2-9).

028_CCCR.SF B_3-6	Please clarify, succinctly, what involvement the Corps will have in the actual mitigation of habitat loss resulting from the construction of the flood control levee, and what involvement the Corps will have in actual monitoring of habitat mitigation. It appears from the text, that if alternative 3 is selected for the final design, the Corps will construct the 30:1 ecotone in Pond A18, but that USFWS and the Santa Clara Valley Water District would be responsible for the construction of the 30:1 ecotone in Ponds A12 and A13. Is this correct?	Implementation guidance for WRRDA 2014, Sec 1025 was signed by the USACE on 26 February 2015, which allows the USACE to recommend USACE implementation of ecosystem restoration actions on USFWS lands. Under the proposed project, the USACE will cost share in the implementation of restoration actions in Ponds A9 - A15 (on USFWS lands) and Pond A18 (owned by City of San Jose). The restoration of Ponds A12 and A18 is intended in part to compensate for habitat loss resulting from the construction of the flood control levee. The non-Federal sponsors (California Coastal Conservancy and Santa Clara Valley Water District) would be responsible for the construction of the 30:1 ecotone in Ponds A12, A13, and A18. The Corps will cost share monitoring and adaptive management associated with meeting ecosystem restoration objectives for up to ten years following completion of each phase of pond breaching. The ten year limit is defined by law (Section 2039 of the Water Resources Development Act of 2007 - Monitoring Ecosystem Restoration). A copy of the implementation guidance for Section 2039 can be accessed here: http://planning.usace.army.mil/toolbox/library/WRDA/wrda07Sec2039a.pdf

028_CCCR.SFB_3-7	It appears the Corps will only provide its monetary cost share for the actual monitoring of habitat restoration and that the actual monitoring activities will be conducted under the auspices of the South Bay Salt Pond Restoration Project (SBSPRP), is this correct?	This is correct. The proposed project will follow the South Bay Salt Pond Restoration Project's adaptive management program and rely on this already-established process to guide the selection of the final mix of habitats. The Shoreline Study monitoring and adaptive management plan included with the integrated feasibility report and EIS/R was written more narrowly, per Corps requirements, to describe activities that can be cost shared by the Corps, namely those that fall within the project footprint and will determine whether the project has met its ecosystem restoration objectives. Other monitoring and adaptive management activities for the proposed project, such as those that occur outside of the project footprint, are associated with meeting permit requirements, are associated with other project purposes (flood risk management and recreation), or are associated with mercury issues will be implemented by the South Bay Salt Pond Restoration Project's adaptive management program.
028_CCCR.SFB_3-8	The DEIS/DEIR also indicates the Corps will only provide its cost share for the 10-year period following the implementation of the various habitat restoration elements, regardless of whether the restoration elements have achieved target success criteria or are trending in the appropriate direction, or not. Please explain why the Corps would not be accountable for a longer period, especially if implementation of adaptive management measures becomes necessary.	The ten year limit of USACE cost sharing is defined by law (Section 2039 of the Water Resources Development Act of 2007 - Monitoring Ecosystem Restoration). Any additional monitoring required beyond ten years would be a non-Federal responsibility. A copy of the implementation guidance for Section 2039 can be accessed here: http://planning.usace.army.mil/toolbox/library/WRDA/wrda07Sec2039a.pdf
028_CCCR.SFB_3-9	The mitigation measures proposed fail to reduce the significant impacts to federally listed and sensitive species to levels that are less than significant. The DEIS/DEIR notes there may be short term impacts, but concludes that the long-term restoration of the adjacent salt ponds will provide significant habitat to mitigate any short-term losses. Nor does the DEIS/DEIR consider the ramifications of implementation of saltpond restoration itself impacts such as fragmentation of the fringe marsh adjacent to outboard saltpond levees proposed for breaching. The DEIS/DEIR acknowledges there is a possibility that fringe marsh could be subject to erosion following levee breaches, it also acknowledges that these fringe marshes provide important habitat and connectivity for species such as the federally-listed endangered salt marsh harvest mouse. How will the impacts of fragmentation of habitat, and potential isolation of SMHM populations be addressed in the near-term, while we wait for long-term development of connected SMHM habitat within the breached saltponds? This failure to address the consequences of short-term, significant adverse impacts of the proposed levee construction to federally listed and special status species is exemplified by the following excerpt from page 4-303 of the document: Since the Shoreline Phase I Project would result in a net increase in the amount of tidal marsh in the study area, in the long term, this increase would balance the impact of fill and fragmentation of any alternative, including the 46.2 acres of habitat directly lost as a result of the Alviso Railroad Spur levee segment. Table 4.6-7 Post- Restoration Conditions in the Study Area shows the maximum amounts of tidal marsh habitat that would be created through ecosystem restoration. The tidal marsh habitat created through Pond A18 ecosystem restoration would provide more marsh habitat than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of marsh habitat. Although the tidal marsh habitat would not be established immediately, this impact is not considered significant since the project would not result in a net loss of marsh habitat over time. [emphasis added] There is no scientific rationale provided to justify such a conclusion. If the project will "fragment habitat," especially for less mobile species (on a geographic scale, e.g. SMHM), and "tidal marsh habitat would not be established immediately" how could this impact not be considered significant?! It is indeed a potentially significant and adverse impact and mitigation measures must be proposed to counter fragmentation of habitat and isolation of populations.	To jumpstart the restoration of tidal marsh, the Project will now open both Ponds A12 and A18 to tides in the first phase of restoration immediately after the construction of the FRM (see Section 3.8.3). The ecotone in these ponds will quickly develop tidal marsh on its own in the tidal zone. The portion of the ecotone at the elevation of upper marsh and marsh-upland transition will be planted to accelerate refugia habitat formation. This is expected to create approximately 46 acres of marsh habitat within a year of breaching. The outboard levees of these ponds will be lowered to approximately MHHW as the ponds are breached. This lowered levee surface would be quickly colonized by pickleweed as is expected to provide another 18 acres of habitat. This 64 acres of tidal marsh will provide important habitat and connectivity while the ponds accumulate sediment necessary to transform to a full tidal marsh.
028_CCCR.SFB_3-10	The DEIS/DEIR fails to comply with the requirements of NEPA and has not demonstrated that the significant adverse impacts to biological resources can be reduced to levels that are less than significant.	The EIS/EIR provides adequate analysis to show that biological resources will not be adversely affected with facts and analysis to support the conclusion. The ecosystem restoration portion of the project will restore approximately 2,900 acres of tidal marsh habitat to protect and conserve species. The Biological Opinion issued by the USFWS agrees that impacts to listed species can be reduced to less than significant.
028_CCCR.SFB_3-11	The DEIS/DEIR should be revised and re-circulated as a stand-alone document separate from the Corps' Interim Feasibility Report.	The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final Feasibility Study includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process. The Final EIS/EIR does not include significant new information that would require recirculation pursuant to Section 15088.5 of the CEQA Guidelines.
028_CCCR.SFB_3-12	1. Geographic scope and phasing of project alternatives. The geographic scope of the range of alternatives needs to consider the relationship between project area and whole project area, in terms of alternatives and appropriate mitigation among project segments within the larger project, as shown in Figure 1.4-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas) and Figure 1.4-2. The segmentation of the project to "streamline" it into piecemeal components, as a matter of expedience, does not relieve a NEPA lead agency of the obligation to consider impacts, mitigation, and alternatives that integrate the whole project, if environmental benefits may be gained. The reasons for segmentation give in the FR-EIS are limited to pragmatic considerations that do not constrain the scope of mitigation or alternatives: The District and non-Federal sponsors agreed that	Lead Agencies have authority and discretion to develop the scope of a project based on objectives that the project is intended to achieve. When determining whether the environmental analysis may include only a portion or earlier phases of an arguably larger project without running afoul of the prohibition of piecemealing, courts have concluded that there is no piecemealing under CEQA when (a) the potential later actions or activities would not be reasonably foreseeable consequences of the limited project and (b) the limited project has independent utility. Similarly, NEPA does not require a federal lead agency to consider other potential activities as a "connected action" when the proposed action in the NEPA document and the other action are independently justified and the other action is not a foreseeable future phase of the proposed action. An EIS or EIR should analyze a reasonable range of alternatives to the proposed action/project but only those alternatives that could feasibly attain most of the basic project objectives while avoiding or substantially lessening

streamlining the study area to a reduced footprint would provide a more timely planning and implementation process. Early without-project flood risk analysis identified four of 14 USACE South Bay EIAs (Figure 1.4-3 South San Francisco Bay USACE Economic Impact Areas) that showed the greatest potential for future flood risk: EIAs 2 and 3 (Palo Alto area), EIA 7 (Sunnyvale area), and EIA 11 (Alviso area). The study partners decided to limit the geographic boundaries of the revised study area to EIA 11 for the following reasons on p. S-5: 1. There are a number of recent research studies and environmental documents available on the Alviso area, and these studies and documents were expected to greatly reduce study time and provide necessary tools for analyses. 2. The Alviso and Palo Alto areas both exhibit high future flood risk to public safety. However, the Palo Alto area could be covered under the ongoing San Francisquito Creek General Investigation Study, whose geographic scope overlaps that of the Shoreline Study. 3. The bottom elevations of the Alviso ponds are generally lower than other complexes around the bay due to subsidence from historical groundwater withdrawals. South of the ponds, extensive areas of urban development are protected by levees that were not originally built for flood risk management, allowing for substantial long-term flood risks. 4. Addressing flood risk in the Alviso area would also allow for potential restoration of close to 3,000 acres of former solar salt production ponds, whereas the other three candidate EIAs do not include potential restoration actions. These former salt ponds represented a major opportunity for restoration of tidal habitats in San Francisco Bay along with associated ecological functions and habitat for Threatened and Endangered species.

But because the Shoreline Phase I Study and the SBSPRP will be implemented as separate projects, "each having its own independent utility and neither dependent on the other to achieve their purpose and need, as defined in separate environmental review processes…", the FR-EIS cannot exclude from a "reasonable range of alternatives" off-site mitigation for project impacts elsewhere in the SBSPRP simply because candidate EIS do not currently include potential (tidal marsh) restoration areas – particularly given the adaptive management provisions of the SBSPRP.

The fact that the FS-EIS affirms its independent utility and independence from the SBSBRP to achieve its own purpose and need is no barrier to considering reasonable alternatives that integrate both projects within the larger Shoreline Study boundaries where they are potentially compatible and mutually modifiable. The FR-EIS must identify potential time-sensitive (i.e., sea level rise curve-sensitive, sedimentation rate/elevation sensitive) opportunities lost or gained within the larger project area, as a result of allocating resources and planning or construction priorities to the Phase 1 study area. There should be a stepwise, hierarchical application of the kind of "geomorphic risk and opportunity" analysis evident in Appendix C (ESA-PWA 2012) extended to the larger project area as a whole. Otherwise, the selection of Phase 1 as a priority area will lack any basis in NEPA, and the range of reasonable alternatives considered for Phase 1 be deficient.

any of the project's significant effects need to be analyzed. For the Shoreline Study the implementation of Phase 1 between Coyote Creek and Alviso Slough does not require future actions elsewhere to occur and does not restrict future alternatives for other areas in the Shoreline footprint. In addition, the flood management and restoration activities in the Phase 1 area would serve a viable purpose on their own and thus have "independent utility" justifying the separate processing and approval. The selection of the Phase 1 area of the overall Shoreline Project as the proposed action/project is a policy decision of the project partners on how to best utilize available resources based on consideration of areas that need to be addressed more immediately than others and also areas that might achieve the most environmental benefits. The sections of the Shoreline Study Integrated Document cited by the commenter provide multiple reasons for making the Alviso segment of the Shoreline Study the first phase of an on-going project. The Corps' Feasibility Study considers and prioritizes the Phase 1 area from a flood risk as well as an ecological perspective. The feasibility study indicates that Phase 1 can occur as a priority and independently of other potential future projects (or phases) in the broader Shoreline Study area for several reasons: • Each of the EIA (Economic Impact Areas shown on p. 1-10 of the Integrated Document) is hydrologically independent. Therefore there is little likelihood of increasing flooding potential for adjacent areas. • A phased, adaptive management approach is the best way to prevent impacts to the environment as it gives managers time to correct problems or to hold off on future phases if turns out to be necessary to avoid unintended impacts. Phased implementation is an approach consistent with that of the South Bay Salt Pond Restoration Project (SBSP Restoration Project). • In terms of environmental benefits to be gained, paragraph no. 4 from p. S-5 of the Integrated Document cited by the commenter, points out that the Alviso Pond cluster (Ponds A9-15 and A18) provides the largest amount of wetland restoration opportunity when compared to other EIAs in the Shoreline Study. Since the greatest amount of environmental benefit (not counting flood protection as an environmental benefit) that could be generated by the Shoreline Study is the restoration of former salt ponds to tidal wetlands, it makes sense to focus the project's restoration efforts initially on the area with the most potential environmental benefit. It is also important to note that while the project phases can be implemented independently, phasing does not mean that other opportunities will be foregone or lost by starting with a smaller subset of restoration than restoring all the former salt ponds in the Alviso area. The development of the Phase 1 project to include the ecosystem restoration components was coordinated with the SBSP Restoration Project and does not preclude the SBSP Restoration Project from proceeding with additional phases of work. During Phase 2 planning of the SBSP Restoration Project, the entire SBSP Restoration Project footprint was considered. As a part of that planning process, the SBSP Restoration Project team worked with FWS and DFW land managers who have an intimate knowledge of the landscape and the ecological value of the SBSP Restoration Project area to consider what were the next set of possible restoration actions in the Alviso, Ravenswood, and Eden Landing Ponds. In Alviso, as part of the Phase 1 of the SBSP Restoration Project, Ponds A6, 16, 17, 19, 20 and 21 were restored or reconfigured, and Ponds A5, 7, 8, and 8S were partially restored. The SBSP Restoration Project Phase 2 planning effort evaluated the remaining ponds in the Alviso Complex in addition to the remaining areas in Ravenswood and Eden Landing. (A Public Draft EIR/S for SBSP Restoration Project Phase 2 projects was released during Summer 2015.) The SBSP Restoration Project assumed during Phase 2 planning that the A9-15 system would be restored by the Shoreline project. These ponds are one of the highest priorities for restoration for the SBSP Restoration Project because they are some of the most deeply subsided ponds in the south bay and will require a greater amount of time to reach marsh plain elevations from natural sedimentation processes. Yet restoration of these ponds is problematic because breaching has the potential to greatly increase the flood risk in the Alviso area. Restoration has to be done in conjunction with addressing the flood risk and it would be extremely challenging for the SBSP Restoration Project to undertake restoration of these ponds and address flood risk with just the existing project partners. Thus, the Shoreline Project Phase 1 Study is consistent with the larger planning effort conducted by SBSP Restoration Project because it allows the SBSP Restoration Project to meet its goal of restoring the Ponds A9-15 sooner while not putting the surrounding community at risk. Once the proposed action/project is defined, the environmental review document (in this case the EIR/EIS) is required to analyze the impacts associated with the project activities and propose feasible mitigation measures to reduce any significant impacts. The commenter is correct that it is necessary to look outside the immediate project boundaries when analyzing impacts on certain resource areas. For example, wildlife and fish move within larger areas and thus, the appropriate environmental analysis may not be limited to the project boundaries. The environmental analysis in Section 4 does this by defining appropriate landscape-scales for the affected environment and environmental consequences. For example, the entire south bay is examined when impacts to protected species are evaluated. Regarding the commenter's suggestion to identify offsite mitigation for project impacts, there is no need to look beyond the project boundaries for mitigation opportunities to address impacts on wetlands and other waters as all significant impacts can be mitigated on-site with the creation of nearly 3,000 acres of tidal marsh habitat. In addition, there are no off-site mitigation opportunities available to reduce significant impacts from temporary construction noise, cumulative impacts to pond habitat for pond-specialist birds, and the Alviso Salt Ponds Historic Landscape.

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028_CCCR.SF B_3-13	2. Range of reasonable alternatives. The range of alternatives evaluated in detail in the FR-EIS falls short of a reasonable range under NEPA. This deficiency is due to improper elimination of some potentially feasible and environmentally beneficial or even preferable alternatives due to invalid or unsound elimination procedures (screening criteria). The FREIS does not consistently distinguish between alternatives that are simply not the agency's preferred alternative based on lead agency consensus or policy selection criteria (CEQ guidance, Fed Register 46 No. 55 p. 18027, 4a) from alternatives that are not within the range of "reasonable alternatives", including those not necessarily in the jurisdiction of the lead agency (op. cit. 2b). In other words, the EIS fails to provide adequate, reasonable accounts of why alternatives that fail one or more agency policy, preference, or "feasibility" criteria (including agency-specific policy criteria narrower than the "reasonableness" criteria of NEPA. 2.1. Missing information and arbitrary elimination of the WCPC levee alignment. The FR-EIS treats deficient information as a reason for eliminating from detailed analysis any alternatives involving levee set-back alignments through the wastewater facility. This is not reasonable if there are potentially significant environmental benefits at stake. If there are potential environmental benefits to set-back levee alternatives though oxidation ponds, for example, then the appropriate NEPA lead agency action (or obligation) is to develop that information or assess risks in its absence. The invalid rationalization for screening out wastewater facility footprint alternatives is given on page S-22 of the FR-EIS: Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. (FR-EIS p. S-22) Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to the USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. As the Wastewater Facility Master Planning effort proceeds into design, there may be further opportunity to revisit the alignment section.(FR-EIS p. 3-18) First, the mere fact that the drying beds were eliminated from analysis prior to the USACE NEPA alternatives review provides in itself absolutely NEPA justification for their continued and ongoing exclusion from NEPA alternatives, especially given the potential for non-jurisdictional Section 404 fill in wastewater facility lands. USACE as a NEPA lead agency must explain the reason why this location is not within a reasonable range of alternatives; instead, it merely stated why some other (non-NEPA) agency removed it from the candidate list prior to USACE NEPA review. Indeed, the statement that there may be further opportunity to consider this alignment when planning efforts by another agency "proceeds further into design" begs the question why it can't be done for this EIS, and indicates that missing environmental background information is reasonably obtainable, or was during the EIS draft process for the Shoreline Study.	The Coyote Creek Alignment Master Response discusses why a levee alignment that would move the last "leg" of the eastern-side of the Pond A18 levee from its northern terminus on the Coyote Creek Flood Protection levee, to a more eastern terminus on the Coyote Creek Flood Protection levee further upstream was eliminated from consideration. An EIR/EIS must describe a reasonable range of alternatives (CEQA Guidelines, section 15126.6(a); 40 C.F.R. 1502.14). The range of alternatives to be analyzed are those that could feasibly attain most of the basic objectives of the project while avoiding or substantially lessening any of the significant effects of the project (CEQA Guidelines, section 15126.6(a)). Among the factors that may be taken into account when evaluating feasibility of alternatives are site suitability, economic viability, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries, and whether the project proponent can reasonably acquire, control or otherwise have access to the alternative site (CEQA Guidelines, section 15126.6(f)(1)). Similarly, NEPA requires reasonable alternatives that may be feasibly carried out based on technical, economic, environmental, and other factors (see, for example, Sierra Club v. Froehlke, 534 F.2d 1289, 8th Cir. 1976, where flood plain acquisition was found to not be a feasible alternative to building a dam because of excessive cost, local opposition, loss of revenue producing capacity of the land, and loss of local tax base). Alternatives that are speculative are not required to be included in an EIS (see, for example, Seacoast Anti- Pollution League v. Nuclear Regulatory Commission, 598 F.2d 1221, 1st Cir. 1979). The eastern terminus alignment was not carried forward as a feasible alternative for consideration in the Draft EIS/R because San Jose's current plan is to retain the existing sludge lagoons which currently occupy the area needed to implement an eastern terminus alignment. The City of San Jose adopted the Plant Master Plan for the San Jose/Santa Clara Water Pollution Control Plant in November 2013. The Master Plan is a planning document to guide improvements at the plant for the next 30 years, including defining future treatment needs and designating future land use on plant lands. The Master Plan identified a tentative levee alignment which would allow the plant's continuous use of the sludge lagoons for the dewatering treatment process. The eastern terminus alignment would require in the removal of some of the lagoons.
028_CCCR.SF B_3-14	Second, the nature of the lack of "public" information about this publicly owned and state/federally regulated wastewater facility is both bizarre and unexplained in an EIS. Public infrastructure must be presumed to be open to public information, given due diligence and reasonable effort of a NEPA lead agency. The purpose of an EIS is to provide such information pertinent to significant potential impacts and formulation of environmentally preferable alternatives. Missing information is in itself no justification for excluding a potentially environmentally benign or preferable alternative from analysis. It should be no barrier to environmental analysis if it is pivotal to comparison of otherwise reasonable alternative project alignments with potential for significantly greater long-term environmental benefits; indeed, it would be justified to actively seek missing information or assess risks and potentially feasible mitigation in absence of adequate information. Fed Reg. 46 No 55 Mar 23 1981 p. 18031.	The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final Feasibility Study includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process. The Final EIS/EIR does not include significant new information that would require recirculation pursuant to Section 15088.5 of the CEQA Guidelines.

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028_CCCR.SFB_3-15	2.2. "Community acceptability" criteria and Alviso South levee alignment (Alternative 5). The FR-EIS inconsistently applies "community acceptability" feasibility criteria in a way that arbitrarily eliminates some alternative designs that are reasonable and environmentally advantageous. The FR-EIS invokes "Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G) criteria (FS-EIS p. S-23: completeness, effectiveness, efficiency, and acceptability)" as feasibility criteria. The latter "acceptability" criterion cannot be applied to a NEPA analysis of a "reasonable" range of alternatives because a stand-alone agency "acceptability" criterion that, in contrast with "completeness", "effectiveness", or "efficiency", is not per se an objective, and may be based on undisclosed purely arbitrary or political considerations unrelated to other environmental consequences and priorities. For example, the Alviso South levee alignment's elimination from NEPA alternatives identified as preferred or environmentally preferable appears to have no environmental justification in the FS-EIS other than unacceptability to representatives the local community (FS-EIS p. 3-81). "Alternative 5, which includes the Alviso South levee alignment, is acceptable from the Federal perspective (FR-EIS, p. 3-78). Yet the FR-EIS also states that alternatives other than Alternative 3 were other alternatives were "not supported by the non-Federal sponsor for the following reasons"; "Alternative 5, which includes the Alviso South levee alignment, is not acceptable to the local community because of its proximity to residential and commercial properties. The community of Alviso would prefer a levee alignment that is as far away from residences as possible. The community therefore prefers the Alviso North or the Alviso Railroad Spur levee alignments to the Alviso South option, which is adjacent to the community (Table 3.10-3). In this respect, the Alviso North and Alviso Railroad Spur levee alignments were more acceptable than the Alviso South alignment. FR-EIS p. 3-81. The FR-EIS overall, however, rejects the Alviso South levee alignment, along with the rest of Alternative 5, amid contradictions between federal and non-federal (non-NEPA) criteria without reconciling them as stand-alone NEPA conclusions. In effect, the FR-EIS allows the non-federal considerations to veto a valid NEPA alternative, but with no NEPA justification to do so. Even though the FR-EIS states that the Alviso South alignment is acceptable from a federal perspective on p. 3-78, it cites only local community opposition (and without adequate documentation) as the reason for rejecting Alternative 5 on page 3-81 in stand-alone discussion of Alternative 5, with no reference to wetland impacts or benefits for Alternative 5. Yet in discussion of the LEDPA (Least Environmentally Damaging Practicable Alternative, a Clean Water Act Section 404(b)(1) environmental criterion, compatible in many respects with NEPA, though more restrictive) on page 3-81, however, the FR-EIS states in discussion of Alternative 4 that "Alternatives 4 and 5 would have increased impacts to wetlands and other waters of the U.S. (relative to other alternatives) because of the levee alignment through New Chicago Marsh, with no offsetting improvements in aquatic resources", without reference to the local Alviso community preference. This conclusion, however appears to be inconsistent with following argument, also on p. 3-81, "Because of recent upgrades to the managed flows into and out of the NCM footprint, the Alviso North and Alviso South alignment options are anticipated to have fewer impacts on aquatic and terrestrial biological resources", since Alternative 5 explicitly includes the Alviso South alignment. In any case, there is no valid reason given in the FREIS for throwing the Alviso South alignment "baby" out with the Alternative 5 "bathwater". The result of the alternatives discussion regarding Alviso South alignment appears to be rejection of the Alviso South alignment along with Alternative 5, amid unresolved inconsistent arguments about wetland impacts, and a split federal-nonfederal "acceptability" decision that in effect gives non-federal considerations a veto over federal, without any reasonable explanation. Even if the inconsistencies were reconciled with additional information, this reasoning about the "fatal flaw" for the Alviso South component of Alternative 5 is itself flawed because it fails to distinguish between potentially harmful (fill impacts) and long-term wetland resilience and restoration benefits of fill for a gradual terrestrial ecotone/levee slope. As sea level rise accelerates, New Chicago Marsh itself will be subject to increasing risk of vegetation canopy submergence and mass flooding mortality of federally listed salt marsh harvest mouse populations during episodes of drainage failure. Selective placement of at least some fill designed as flood refuge (restoration) will be as essential to the long-term sustainability of NCM as a diked nontidal salt marsh as it would be for a tidal marsh subject to submergence. The Alviso South alignment could potentially improve long-term habitat resilience of NCM (despite short-term fill impacts) if designed properly for flood refuge habitat and interim mitigation. Thus, there is no reasonable NEPA explanation for eliminating the Alviso South alignment from either a (federal) agency's preferred or environmentally preferable alternative. The FR-EIR appears to arbitrarily weigh the "community support' criterion above all NEPA environmental considerations, such as comparison of wetland, wildlife, water quality, and erosion risk mitigation against alternative alignments, without any reasonable explanation. Moreover, the statement of "community support" as a planning goal on page S-15 is limited to "...provide opportunities for public access, education, and recreation in the Study Area (California Bay Trail Plan)". Similarly, "stakeholder perspectives" as stated (S.17.1) does not provide a project policy basis	We agree that Alternative 5 is a valid NEPA alternative and therefore it was retained and fully analyzed in Chapter 4. Action Alternatives 2 through 5 all meet the Corps' Principles and Guidelines (P&G) acceptability criterion and were therefore retained and analyzed in Chapter 4. The commenter is correct in stating that the "acceptability" criterion from the P&G relates to consistency with Federal laws, not community or non-Federal acceptability. The use of the term "acceptable" in discussing non-Federal and community preferences was not meant to be in context of P&G criterion for screening. To avoid confusion over use of the term "acceptable", the Final Feasibility Study has been revised to use "prefer" or other term instead of "acceptable" when not referring to the P&G criterion. Although community preference is not an environmental criterion for evaluating a project, it is a factor that should be and was considered when making decisions about project implementation. For this reason, it is important to note the community's opinion in Chapter 3 as this Chapter provides an overview of the project alternatives. The community objections to Alternative 5 are not documented in writing but have been stated at the August 17, 2011 and June 21, 2012 Alviso Santa Clara County Working Group meetings. This Working Group is a subcommittee of both the SBSP Restoration Project's Stakeholder Forum and the South San Francisco Bay Shoreline Study and Working Group meetings are open to the general public. Alternative 5 was not deemed to be the environmentally preferable alternative under CEQA in Section 5.5.5 or in the 404(b)(1) analysis (Appendix B-10) for several reasons: 1) It results in significant impacts to New Chicago Marsh (20 acres of fill), an amount only exceed by Alternative 4 (22 acres). Because NCM is the largest pickleweed marsh in the area with endangered species habitat, it is considered one of the most sensitive resources in the area. This significant impact is discussed on page 4-311-13 in Chapter 4.7. 2) It results in significant, unavoidable aesthetic impacts with no available mitigation to public views points in Alviso, (see page 4-522 in Chapter 4.12). 3) Alternative 5 does not feature environmental benefits. Due its subsided nature (approximately 75 percent of the marsh lies between the -1 to -3 feet NGVD range and elevations extend as low as -5 feet NGVD) it would be extremely difficult to restore NCM to a tidal salt marsh. Under Alternative 5, with a direct connection to the Bay, the most likely result would be in the site converting to a pond (see discussion of likely futures for NCM page 4-299) and the resulting loss of existing habitat. Thus the greatest potential benefit of Alternative 5, allowing restoration of NCM to tidal salt marsh or brackish marsh, is highly unlikely to ever be realized, leaving only significant negative impacts. 4) It is not consistent with the US FWS's New Chicago Marsh Water Management Plan because it will not protect NCM from flooding and will overwhelm water management systems (page 4-77 in Chapter 4.3 Land Use and Planning). The statement "Because of recent upgrades to the managed flows into and out of the NCM footprint, the Alviso North and Alviso South alignment options are anticipated to have fewer impacts on aquatic and terrestrial biological resources" was in the context of comparing them to the Alviso Railroad Spur alignment of Alternative 4. Since a new siphon has been installed in NCM, improving its water quality and habitat, the Alviso North or Alviso South levee alignments, setting aside their other advantages or disadvantages, would at least not fragment this enhanced NCM habitat. This paragraph is clarified in the final Integrated Document. The Integrated Document does not allow community preferences to trump environmental considerations. It weighed the environmental impacts with the benefits of the Alviso South levee alignment in Alternative 5 and found it not environmentally preferable. Chapter 3 of the Integrated Document is changed as follows to clarify: Underline added, strike out deleted. [sending in separate email due to formatting being lost here] pp. 3-80-1 Because of recent upgrades to the managed flows into and out of the NCM footprint, a new siphon has been installed in NCM in order to improve water quality and circulation, this marsh no longer depends on a constricted channel for its connection to Bay waters. By either maintaining the siphon or avoiding it, the Alviso North and Alviso South alignment options are anticipated to have fewer impacts on aquatic and terrestrial biological resources when compared to the Alviso Railroad Spur alignment. Both the Alviso North and South alignments go around NCM and do not fragment the habitat. Alternative 5, which includes the Alviso South levee alignment, is the least preferred by to the local community because of its proximity to residential and commercial properties. The community of Alviso would prefer a levee alignment that is as far away from residences as possible. The community therefore prefers the Alviso North or the Alviso Railroad Spur levee alignments to the Alviso South option, which is adjacent to the community (Table 3.10-3). In terms of aesthetic impacts to the community this respect, the Alviso North and Alviso Railroad Spur levee alignments were more acceptable as these two alternatives would result in fewer impacts than the Alviso South alignment. Alternative 5 also has significant environmental impacts from filling NCM and is not consistent with the Refuge plans for long-term management of NCM (see Chapter 4 Section 7 for further discussion of impacts to NCM). In summary, Alternative 5 was not eliminated based solely on the consideration that the community does not prefer that alternative: Alternative 5 was not considered as the environmental preferable alternative under both CEQA and NEPA because it would result in more significant impacts when compared to other alternatives.

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	for local preferences trumping national environmental policy. The planning goal of community support as stated in the FS-EIS does not extend to local popularity /preference of one particular one levee alignment over another if both provide opportunities for public access, education, and recreation. Therefore, reference to "community acceptability" based on purely local community "preference" (over national/NEPA environmental benefits or impacts overall) as a primary or sole reason for eliminating an alternative from rigorous review is arbitrary and inconsistent with the FS-EIS's own statement of project goals.	
028_CCCR.SF B_3-16	2.5. Non-structural (relocation) criteria. The FR-EIS does not adequately explain why non-structural flood management alternatives are not applied to the vast Water Pollution Control Plant that has so much influence on project formulation. The FR-EIS states on p. S- 18: According to officials from the WPCP, the damage to assets from a flood that at least inundates the underground facilities is estimated to total more than $250 million. This does not include the impacts and costs to health and human safety and the environment from a release of raw sewage into the bay, the cost of fines imposed by the local and state agencies, nor does it include the impact of a loss of service to homes and businesses in the region. Given the financial, safety, and environmental impacts of a damaging flood at the plant, it is reasonable to assume that in the absence of a larger Federal project the City of San José would invest in flood risk reduction measures at the plant, which would most likely consist of a ring levee and associated features. To be clear, the City of San José has stated that they do not currently have an alternative plan for reducing flood risk to the plant in the absence of a federally-sponsored levee project. Nonetheless, it is important to consider what the City might do rather than just assume no future action and count all expected flood damage over the period of analysis. A preliminary planning-level estimate of the cost of a ring levee shows the construction would cost $25 million not including real estate. This cost is included in the estimate of the cost of the non-structural alternative as well as the value of the damages reduced for the structural alternatives. See the Economics Appendix for more detail. The FR-EIS apparently does not evaluate alternatives based on "non-structural" relocation, other than an on-site ring levee in the economic analysis appendix. If, however, the full analysis of environmental benefits and flood risks of relocation were presented, it would be possible to objectively assess the long-term environmental costs and benefits during the entire time-frame of planning (century of sea level rise). The FR-EIS fails to explain why this is not a "reasonable" century-scale alternative (like other alternatives time-frame) pursuant to NEPA, from a federal perspective.	Section 3.5 discusses the flood risk management options that were considered. This includes a nonstructural FRM plan formulation strategy that includes the relocation of the community of Alviso and all major infrastructure within the 1-percent ACE floodplain (Section 3.5.2). The nonstructural flood risk management option met the completeness, effectiveness, efficiency, and acceptability criteria from the Federal perspective, but was not carried into the final alternatives array because of much higher cost and fewer NED benefits than many of the structural FRM options (Section 3.5.5.1). The nonstructural analysis does not include re-locating the WPCP because the Shoreline team determined it was much more likely that the City would construct a ring-levee to protect the Facility than to relocate it. An EIS/EIR need not speculate about future events that are uncertain. In addition, an EIS/EIR only needs to inlcude feasible alternatives. Since it is speculative at this time to assume the City could relocate the treatment plant, not including this as an alternative is appropriate.
028_CCCR.SF B_3-17	3. Alternatives design and environmental consequences 3.1. Levee alignments and location-specific long-term environmental consequences for geomorphic and ecological evolution of landscapes. The potential biological environmental benefits of constructing low-gradient levees as terrestrial ecotones of tidal marshes depends almost entirely on the geomorphic evolution and resilience of wide (fringing or slough system) tidal marsh platforms adjacent to them. Physical benefits of fringing tidal marshes and ecotones for flooding reduction functions (wave attenuation) do not equally depend on configuration of adjacent tidal marsh and broad terrestrial environmental gradients. The geomorphic evolution scenarios rigorously analyzed and evaluated by ESA-PWA (2012) in Appendix C provide a robust and clear assessment of the risks that tidal marshes may fall behind sea level rise, and either stabilize as low marshes (constrained for nesting habitat) or mudflats (no marsh wildlife to benefit from terrestrial ecotones). The circumstances under which high marsh may form and persist to complete the ecotone established by the project levees, are unfortunately tenuous and difficult to predict. This risk is likely to intensify with increasing distance from tidal channel mouths. The risk of tidal marsh "downshifting" (elevation loss due to accretion rates falling behind sea level rise rate) needs mitigation as part of the project, to ensure that "complete marsh" (Appendix C, p. 2) ecosystems, not just the dangling levee ecotone half, are the result of the project. One proven method for minimizing the risk that high salt marsh will founder and "downshift" to unsuitably low elevations is to slurry sediment to nourish marsh elevations (see 3.2., next comment). The infrastructure and resource commitments needed for a sediment slurry or water distribution system along the project perimeter should be assessed as part of the alternatives analysis and as mitigation	All reference to lack of public information has been removed from the document. This text was a relic of early draft text when the Regional Wastewater Facility had not yet released a draft or final Plant Master Plan, and related to as yet unreleased planning and designs of the proposed Regional Wastewater Facility footprint more so than to materials that would be available in publicly accessible facility records. The monitoring and adaptive management plan includes as a possible adaptive management measure importing sediment if sedimentation is inadequate in breached ponds to ensure that a 'complete marsh' is achieved.

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	for risks of project long-term performance deficits.	
028_CCCR.SF B_3-18	3.2. Phased long-term construction and maintenance using sediment slurry marsh sediment nourishment methods of USACE. The range of alternatives fails to consider a wetland engineering method of sediment nourishment for tidal marsh maintenance that the USACE has helped develop for subsidence-impacted tidal wetlands elsewhere in the U.S. The application of thin-layer hydraulic slurry deposits of sediment (Ray 2007: Thin Layer Placement of Dredged Material on Coastal Wetlands: A Review of the Technical and Scientific Literature, USACE ERDC/EL TN-07-1 December 2007) has been used to incrementally "lift" subsiding marsh elevations successfully in the Gulf Coast in all marsh zones. The Corps is one of the leading expert agencies nationally in applying this method to wetland restoration and management, and is well-suited to adapt this method to SF Bay vegetation and habitats. Since the cooperating and co-lead State agency is one of the primary sources of dredged sediment from flood control channels (a project purpose closely related to the proposed project), and since the flood channel maintenance sediment potentially suitable for tidal marsh sediment nourishment in the South Bay, it is reasonable to consider its applicability for the proposed project instead of routine disposal as waste rather than beneficial re-use. Thin-layer dredged sediment of suitable quality (including sandy silts or sands) could, for example, be used to incrementally raise terrestrial-tidal marsh ecotone slope elevations gradually as sea level rises, and without eliminating shallow burial-tolerant perennial native marsh or grassland vegetation. This would potentially have direct and indirect flood control benefits as well as environmental enhancement, by increasing the wave-attenuating breadth of high-roughness high marsh vegetation at higher intertidal elevations, offsetting sea level rise submergence of high marsh with lowest impact of fill. Instead, all alternatives consider only single-event fill construction, without integrating flood channel maintenance and new low-gradient habitat-levee maintenance. Despite the USACE national authority on this method, there is no reasonable NEPA explanation in the FR-EIS given for omitting or excluding incremental hydraulic sediment addition as part of phased construction or maintenance of the proposed terrestrial ecotones.	Tidal regimes and resulting tidal marsh morphology are very different in San Francisco Bay in comparison to the Gulf of Mexico coastline. Local tidal marshes have large channels which allow rapid penetration of floodwaters from the bay. Sediment lifts of tidal marsh would not provide substantial flood risk management for areas below high tide range in San Francisco Bay (especially subsided areas), although it could reduce wave action in suitable locations. Levee crest elevations for the alternatives were based on tidal data and did not consider short-period wind waves, due to the study area location which filters out most wave energy. In addition, the method proposed in the comment would take many construction seasons, and thus would leave the community of Alviso at risk from tidal flooding during this period, in addition to extending the duration of other construction related impacts such as noise, traffic, air quality, and aesthetics. The selected method could be constructed in one to two construction seasons. The Monitoring and Adaptive Management Plan includes a provision for addition of sediment if this is needed to achieve project goals.
028_CCCR.SF B_3-19	3.3. Long-term ecotone maintenance with surface or subsurface irrigation of treated wastewater to buffer marsh salinity and wave energy. Even though the San Jose wastewater treatment facility is one of the major stakeholders and flood planning for the proposed project, the NEPA alternatives array fails to consider incorporating treated wastewater discharges as a long-term component of tidal marsh and terrestrial ecotone (levee) maintenance and management. Conventional direct discharge of treated wastewater into tidal sloughs eliminates opportunities for landward edges of tidal marshes to "polish" and transform wastewater nutrients and contaminants in a way that enhances their flood control and habitat functions. This is particularly relevant to the segment of the shoreline study adjacent to the WPCP. Non-channelized (overland) surface or subsurface irrigation discharges of treated wastewater (suitable quality) through tidal marsh-terrestrial ecotones of new low-gradient levees would increase vegetation height and density, and partly buffer impacts of future climate-forced hypersalinity in the tidal marsh ecotone. Increased vegetation height and density would enhance both extent and height of high tide flood refuge canopy of vegetation, and increase wave attenuation (reducing total water levels during flood events, minimizing wave runup). Fresh-brackish back-marsh gradients maintained by beneficial re-distribution of treated wastewater should be incorporated in alternatives within the feasible "service area" of the WPCP.	The Shoreline Study does not discuss incorporating treated wastewater discharges as either part of a tidal marsh restoration project or through ecotone discharge because the WTF does not have any plans to change their current permitted discharge. The flood protection benefits of a constructed ecotone noted by the commenter (e.g. minimizing wave runup) will still be realized with the proposed preferred alternative. Adding additional project elements to improve water quality is beyond the scope of the Shoreline Study and the analysis finds no water quality impacts resulting from the Project that would require additional mitigation.
028_CCCR.SF B_3-20	3.4. Methylmercury management and mitigation in terrestrial-tidal marsh ecotones. Mitigation measures for managing methylmercury in constructed low-gradient levees in the tidal marsh-terrestrial ecotone should include (a) evaluation of minimizing sediment carbon content (soil organic matter) and total mercury in the constructed "cap" of the tidal marsh terrestrial ecotone; (b) design of suitable surface and subsurface drainage of the constructed levee slope to prevent fluctuating anoxic/oxic soil redox (conducive to sulfur-reducing bacterial activity) in the presence of soil organic matter. The design should anticipate gradual SLR submergence of the lower ecotone slope, and prevent undue generation of methylmercury in depressional topography there in the presence of naturally accreted soil organic matter.	The results of the SBSP Restoration Project's mercury studies to date have strongly indicated that the primary drivers of methylation of mercury have been aquatic organisms so management actions have focused on improving circulation within ponds to minimize the algae growth. For this reason there are no identified mitigation measures regarding methylmercury management in regards to the ecotones. (See "Food Web Dynamics" in the Water Quality Section 4.5 (pp. 4-132-134 of the Integrated Document for further discussion of mercury.) The commenter notes, however, that the material used for the ecotone should minimize total mercury content and the design should avoid creating physical or biological processes that could drive methylation. This input is noted and will be considered during the design of the transition zone.
028_CCCR.SF B_3-21	Phase I is an early stage SLC project in the American experience and the first levee planned to address SLC along the shores of San Francisco Bay. Questions arise that the Integrated Document has not addressed: Has Phase I assessment overlooked perspectives of the entirety of Shoreline Study Area and thereby focused decisions too narrowly?	Analysis in the Shoreline Study draft Feasibility Report, Environmental Impact Statement and Environmental Impact Report (Integrated Document) show that the Shoreline Study can occur independently of other potential future projects (or phases) in the broader Shoreline Study area as each of the Economic Impact Areas (EIAs shown on p. 1-10 of the Integrated Document) is hydrologically independent and does not increase flooding potential for adjacent areas. It is also

		important to note that phasing does not mean that other opportunities will be foregone or lost by starting with a smaller subset of restoration than restoring all the former salt ponds in the Alviso area. The Integrated Document provides multiple reasons for making the Alviso segment of the Shoreline Study the first phase of an on-going project including protecting a large number of residences, businesses and public infrastructure and the Alviso Pond cluster (Ponds A9-15 and A18) provides the largest amount of wetland restoration opportunity when compared to other EIAs. These ponds are also the most subsided and will require the greatest amount of time to restore. The Santa Clara Valley Water District has begun preliminary planning efforts on the remaining EIAs 1 to 10 in Santa Clara County. The Shoreline Study effort for EIAs 1 to 10 will consider coastal flooding induced by tides and storm surge as well as fluvial breakout flows. Both coastal and fluvial (within the tidal influence zone) flood protection levee elevation will be studied with three future sea level rise scenarios. The current recommended EIA 1-10 preliminary coastal protection levee alignment is based on the input from City of Palo Alto, City of Mountain View, City of Sunnyvale, City of San Jose, US Air Force Moffett Field, US Fish and Wildlife Service, and Coastal Conservancy. The Charleston Slough and Palo Alto Flood Basin issue was already discussed between City of Palo Alto, City of Mountain View, Coastal Conservancy, US Fish and Wildlife Service, and District. The area within Moffett field coastal area was discussed between US Air Force Moffett, Coastal Conservancy, US Fish and Wildlife Service, and District.
028_CCCR.SFB_3-22	Might the decisions of Phase I impact options for subsequent Phases in the Shoreline Study Area or related actions in Alameda County?	As discussed in Section 1.5 Project Background and Physical Study Area Setting, for a timelier planning and implementation process the Project partners decided to focus on the Alviso Area for Phase 1. The reasons for minimizing the scope of Phase 1 are described in Section 1. Focusing on the Alviso area provides the greatest amount of flood protection and habitat restoration given the resources available. There is always uncertainty planning a large project, which is why the Monitoring and Adaptive Management Plan is such an important element to ensure that later phases of the Project can be adjusted based on data gathered and lessons learned in the initial phase.
028_CCCR.SFB_3-23	By omission, oversight, or process restriction might certain decisions for Phase I ultimately prove to be unfortunate, irreversible mistakes?	As discussed in Section 1.5 Project Background and Physical Study Area Setting, for a timelier planning and implementation process the Project partners decided to focus on the Alviso Area for Phase 1. The reasons for minimizing the scope of Phase 1 are described in that section starting on page 1-10. The Phase 1 project does not increase risks to other areas, as they are hydrologically independent. An EIR is required to assess the potential direct and indirect impacts of a project. The Phase 1 project will not have an impact on the potential flood risk for the City of Sunnyvale or other areas in the greater Shoreline footprint. Future flood risk is an on-going, baseline condition. It is important to note that phasing does not mean that other opportunities will be foregone or lost by starting with a smaller subset of flood protection and restoration.
028_CCCR.SFB_3-24	Defining the Setting of the Project The Integrated Document explains that after the 2010 Feasibility Scoping Meeting (FSM), the decision was made to reduce the geographic scope to the Shoreline Phase I Study Area. From many perspectives that was a necessity with which we do not essentially disagree. Nor do we disagree with acting on behalf of the Alviso community and of the critical infrastructure provided by WPCP. We note however that the phasing action split the Study Area into a discrete segment between streams without considering the entirety of each stream nor the impacts on the opposite shore. As a result the Integrated Document omits consideration of certain questions that are relevant to the entire Shoreline Study Area and may be relevant to future, foreseeable integration of Phase I actions with a system of shoreline levees.	Your comment is acknowledged; for responses to each of your specific concern examples, please see responses 028_CCCR.SFB-25 through 028_CCCR.SFB-27.
028_CCCR.SFB_3-25	• Estuarine Setting: In its simplest definition, an estuary is the place where the flow of a river or stream meets the sea's tides. The estuary that is the San Francisco Bay is a place with a vast array of watershed-fed rivers and streams draining to meet the tides, mixing along the Bay's edges at mouths and within intertwined sloughs to dynamically deliver varying salinity, sediment and habitat conditions. It is a place that drains some 40% of the waters of the State of California. As a result, it is a water body in which fluvial and tidal influences are complex and, in impact, inseparable. How does a massive levee fit in with the healthy functioning of an estuary and of its watersheds? Estuarine characteristics apply to the entire Shoreline Study Area including Phase I. They also relate to fluvial conveyance all along the length of streams and tributaries of each watershed. Once modern era actions constrained our streams, each stream's mouth took on greater significance for drainage efficiency. Accordingly Phase I actions at and near the mouths of Coyote Creek and the Guadalupe River need to consider potential impacts of a massive levee to fluvial flow and do so on a watershed impact basis, not simply within the boundaries of the Shoreline Study Area. For both streams, there is a long history of significant economic impacts from overtopping events in multiple locations including Alviso and central areas of San Jose. Now these streams face future extreme storms induced by global climate change. The Integrated Document is incomplete and inadequate if it remains unknown as to whether its proposals help or hinder the flow efficiency of these streams. Under Planning Constraints2, the Integrated Document lists: "Do not increase flood risk in developed areas of the Study Area where loss of life and monetary damages may occur." Subsequently, while identifying Management Measures3, the Integrated Document states: "After the scope was refined to include only flood risk from tidal sources, the study team eliminated measures that addressed only fluvial flood risk management." [Ed. note: emphasis added] The question is thereby left unconsidered and	The proposed levee would be located in an area not currently accessible to fluvial flood waters. Construction of this levee, together with breaching of existing levees, would allow floodwaters from the Guadalupe River and Coyote Creek to spread over much larger areas (the breached ponds), thereby enhancing estuarine functions relative to current conditions.

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	unanswered: Do Alternatives in the Final Array or Alternatives considered for and eliminated from the Final Array impact, beneficially or negatively, the functionality of either Coyote Creek or the Guadalupe River? We ask that this question be considered and answered. 2 Integrated Document, S.9.1, p. S-16 3 Integrated Document, S.11.1, p. S-19	
028_CCCR.SF B_3-26	• Future Shoreline Actions at Alviso Slough and Coyote Creek: All Alternatives in the Final Array depict the same locations for the Alviso and WPCP levee segment terminations, respectively near Alviso Slough and Coyote Creek. We did not find an explanation for those particular terminal points in the ID.	The western termination of each alternative coincides with the existing area of high ground near the former Alviso Marina. This area is sufficiently high and wide to provide a continuous line of flood protection between the downstream extent of the existing Guadalupe River FRM features and the proposed levee. The eastern termination of each alternative coincides with the existing Coyote Creek Bypass FRM Levee on the left bank of Coyote Creek.
028_CCCR.SF B_3-27	A component of Phase I is the tidal flood gate to be installed on Artesian Slough, the only waterway lying fully within the Phase I Study area. This tide gate will link the Alviso and WPCP levee segments. Seeing this component prompts the question: Is there the concept or intent for tide gates to be installed on Alviso Slough and/or Coyote Creek when a SLC levee is built on the other side of the stream? At Alviso Slough that seems quite possible as the Phase I levee, as depicted, could link during Phase II by tide gate with a levee that might border Pond A8. At Coyote Creek, the terminus is not near a location that would likely align with a SLC levee nearby nor to an existing engineered flood control levee as exists some distance inland. Nor are the lands on the other side of the creek within the Shoreline Study Area. The proposed levee appears to simply end where the existing earthen levee ends. We wonder how these decisions can be made without knowing the greater context of the entire Shoreline Study. Will tide gates be routinely used to span streams? What impacts will an "orphaned" terminus of a levee have on a stream and lands upstream?	A tide gate on Artesian Slough is proposed due to circumstances unique to that location and is not an indication of a preferred approach to managing flood flows. The reasons for a tide gate in this location, as opposed to other types of flood protection structures, are further discussed in the Artesian Slough Alignment Master Response. In regards to future Shoreline Study phases, no additional levees or tide gates would be needed for the Coyote Creek area. The SCVWD completed the Coyote Creek flood protection project in the early 90's to address 1-percent fluvial (stream) flooding in this area. The Shoreline Study Phase I Project would tie into the existing Coyote Creek flood protection project levee. The project does not have any "orphaned" termini – see Figure 3.10-1 of fluvial flood protection levees in relation to the Project. Rather it would complete coastal and fluvial (stream) flood protection in the eastern limits of Santa Clara County and no additional actions would be required in the lower Coyote Creek area. For the Alviso Slough area, there is also an existing flood protection project on the Guadalupe River/Alviso Slough that terminates at the Alviso Marina County Park. The Shoreline Study Phase I project would tie into this existing flood protection project and thus would complete coastal and fluvial (stream) flood protection to the east in the Alviso area. Once the proposed project is built, flood waters coming down the Guadalupe River will be able to enter either the ponds or restoring wetlands on either side of Alviso Slough, while the newly constructed levee that ties into the Alviso Slough/Guadalupe River protects the town of Alviso from both coastal and/or fluvial flooding. No additional actions will be needed east of the Alviso Slough/Guadalupe River area. Future Shoreline Study efforts will next examine how best to protect the area to the west of the Alviso Slough/Guadalupe River. In future phases of the Shoreline Study, the Shoreline team will propose solutions based on local conditions. The Shoreline team will then weigh the environmental impacts, opportunities for restoration, construction costs, and operation and maintenance obligations of all proposed solutions when considering how to manage flood flows.
028_CCCR.SF B_3-28	Concern: Information about the relationships to the entire Shoreline Study Area, the complexity of the local estuarine setting and specific details as discussed here need to be in the Integrated Document.	Your comment is acknowledged; please see responses to Issues 25, 26, and 27 of this same comment letter for discussion regarding each of your individual concerns.
028_CCCR.SF B_3-29	San Jose/Santa Clara Regional Wastewater Facility Master Plan and Biosolids Ponds/Beds Alignment. In multiple locations in the Integrated Document the text mentions the San Jose/Santa Clara Regional Wastewater Facility Master Plan (RWF MP) or alternate references to it as the WPCP Master Plan or Plant Master Plan. Some references refer to it as not yet final while others acknowledge that it was approved in 2013. It was approved. Actions to implement the plan were authorized and are underway.	Your comment is acknowledged and all statements regarding the Wastewater Facility PMP have been updated to reflect the document status as being final and approved as of 2013.
028_CCCR.SF B_3-30	Through the Master Plan, the City decided that the lands along Coyote Creek could potentially be used to reduce flood risks and for habitat restoration, possibly in the form of a floodplain directly connecting the creek with Pond A18 and the restoration planned there. This proposal could not occur if any of the Alternatives of the Final Array are built.	The final adopted version of the San Jose/Santa Clara Water Pollution Control Plant's Plant Master Plan (PMP, November 2013) states as a goal of the land use plan "Habitat: 170 acres of land that contain riparian habitat, including the Coyote Creek Riparian Habitat and the Artesian Slough corridor, would be restored or maintained." The plan does not specifically address restoring lands adjacent to Coyote Creek to riparian habitat or expanding the floodplain by connecting Coyote Creek with Pond A18. The EIR for the Master Plan states "SCVWD maintains the levee west of Coyote Creek. No changes are proposed to this levee. As part of the PMP, the City proposes to reserve open space along the levee to accommodate a potential widening of the Coyote Creek channel should the Water District and other agencies propose to do so in the future" (p. 3-50). Thus the PMP accommodates a possible future restoration of the Coyote Creek floodplain to be done by others but does not adopt specific project recommendations. The commenter is correct to note that with the construction of the Shoreline Study proposed alternative, the restoration of the Coyote Creek floodplain by setting back the existing levees would be more difficult to implement.

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028_CCCR.SF B_3-31	In August 2014, the Santa Clara Valley Water District released a Revised NOP for the South San Francisco Bay Shoreline Phase I Study. Under CEQA4, an NOP establishes the existing environmental condition and baselines for related analyses: 15125. ENVIRONMENTAL SETTING (a) An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, from both a local and regional perspective. This environmental setting will normally constitute the baseline physical conditions by which a lead agency determines whether an impact is significant. As the approval of the Master Plan and authorization to begin implementation occurred before the Revised NOP, the RWF MP exists as part of the environmental setting and must be integrated into the Phase I Study considerations. 4 CEQA Guidelines 14 CCR § 15125 Environmental Setting	The City of San Jose approved the Plant Master Plan and certified the EIR on November, 19, 2013. As the approval is prior to the release of the Water District's NOP, the Master Plan is considered part of the CEQA baseline for the Project. However, it should be noted that only certain elements of the proposed improvements to the physical plant are presented and assessed at a project level of detail in the Final EIR. Most of the Master Plan, including the future alignment of levees along the northern border of the plant lands, is presented at a programmatic level (see Master Response regarding WPCP levee alignment). In its analysis, the Feasibility Study for the Shoreline Study considers elements from the Master Plan that are reasonably certain as part of existing conditions. The Master Plan provides a broad outline of how San Jose may develop plant lands in the future, but it is speculative to draw out too many details of future development.
028_CCCR.SF B_3-32	Unfortunately, in the Executive Summary of the Integrated Document 5, the Phase I Study discusses a preemptive decision regarding a RWF MP Alternative, dropping its biosolids beds/ponds alignment from further discussion: "Because of the limited availability of public information regarding the Wastewater Facility drying ponds (e.g., hazardous materials), as well as remaining uncertainty regarding the City of San José's future plans for the area, the footprints crossing the Wastewater Facility drying beds were eliminated from consideration prior to USACE's economic analysis of flood risk management options. No further discussion of these alignments is included in this document. As the Wastewater Facility Master Planning effort proceeds into design, however, there may be further opportunity to revisit the alignment section." While the Executive Summary leaves a door slightly open, it limits it to "may be further opportunity" without explaining the conditions or the process by which that could occur within the Integrated Document. For a regional plan where implementation is underway, the Project partners have a responsibility in the Integrated Document to outline the process and steps by which the objective of the RWF MP can possibly be achieved. In addition it should describe and discuss the alignment across the biosolids ponds/drying beds as a known, potential variation of Alternatives in the Final Array. 5 Integrated Document, S.11.2.3, p. S-22	See Master Response regarding Coyote Creek Levee Alignment
028_CCCR.SF B_3-33	It is our understanding that during the current Planning phase of the USACE process, the design level proceeds just to the 15% level. In the next phase, Preliminary Engineering and Design, the design advances in increments and changes can be incorporated up to the 60% point. We understand also that Federal funding normally allows for change for up to 20% of the funded project. If these are criteria by which an active, overlapping plan that is moving forward and can achieve its goals and improve Phase I, then it should be detailed for information purposes in the Integrated Document.	The commenter is correct that changes to the project could occur during the design and engineering phase of the project. For example, as part of the design and engineering phase, the Corps will conduct a Value Engineering analysis which will investigate possible ways to lower construction costs of the authorized project. In addition, the project may be further refined as a result of permit negotiations with regulatory and trustee agencies. The design and engineering phase will incorporate the most current information available and include additional technical investigations in order to complete the design. As the commenter noted, modifications of the authorized project are allowed as long as the modifications do not materially alter the scope or functions of the authorized project and do not result in more than 20% increase in project costs or scope (Section 902 of the Water Resources Development Act of 1986). This flexibility allows the Army Corps and its local project sponsors to modify an authorized project to respond to new information or accommodate unexpected technical challenges.
028_CCCR.SF B_3-34	We ask that the Integrated Document expressly inform the public about the potential of and the means by which the RWF MP proposal can be integrated within Phase I.	As described in the Master Response to the Coyote Creek Alignment, a levee alignment through the biosolid lagoons as shown in Figure 3-1 of the RWF MP EIR is not addressed because these lands are not currently available to the Project and it is speculative at this time to assume that such lands would become available. As discussed in the response to comment #33, changes to authorized projects can be made as long as they do not materially alter the scope or functions of the project and do not result in more than 20% increase in costs. If in the future the City of San Jose determines that the RWF no longer needs these biosolid lagoons for its treatment process, and the City can make the land available to the Shoreline project, it may be possible to modify the Pond A18 levee. At that time, the project team would evaluate the feasibility, benefits, and other environmental considerations of implementing such alternative.
028_CCCR.SF B_3-35	Artesian Slough Tide Gate As a component of Phase I, the flood wall/tide gate structure proposed for Artesian Slough is mentioned frequently throughout the Integrated Document. Unfortunately, these are repetitions of the same information which is remarkable only for the lack of detail. This is a structure proposed for a wildlife tourism and education location virtually adjoining the public facility and parking lot. Annually thousands of tourists visit as do thousands of school kids. This structure will at minimum be very disruptive to the viewing experience especially as the slough is a prime viewing location. The public needs to know what this gate will look like and the Integrated Document doesn't tell us.	The Artesian Slough flood gate is described in further detail in Chapter 3 of the Final Feasibility Report. There will be a pedestrian bridge over the gate, which will allow for public access across Artesian Slough.
028_CCCR.SF B_3-36	There will be substantial impacts to habitat, wildlife and the slough during construction and restoration. Information is needed about these activities and their impacts.	mpacts to aquatic species from the proposed tide gate are discussed throughout Section 4.6 and impacts to terrestrial species and habitats are discussed in Section 4.7.2.4.2 under "WPCP South Levee Section and Artesian Slough Tide Gate". Additional information is also provided in the Master Response regarding Artesian Slough.

028_CCCR.SFB_3-37	The most specific detail provided is that the structure will be >=300' from the outfall. A little map checking makes us wonder about the purpose of providing that datum. The outfall is near Los Esteros Road. 300' downstream would still be a good distance before reaching the A18 levee and much further from the aerating pumps that are in the stream closer to the EEC. The alignment maps all place the Tide Gate near the EEC, a location which is nearly 2500' feet downstream of the outfall. In short, the tide gate's location requires a much, much better description. Adding to that confusion, a great deal of other information is missing about this Tide Gate. • No graphic representation of the structure. • No rough structural dimensions • No description of the extent of permanent intrusion into the slough. • No specific discussion of the construction methods or duration. • No presentation of its visual impacts in this tourism and environmental education location. • No discussion on if and how it may change or cause change to the dual channels of the slough. • No detail about the associated pedestrian bridge mentioned, presumably to link the levee trail. • No discussion of Refuge evaluation of the compatibility of this bridge with its wildlife-first policy. Lacking this information for a high visibility location, members of the public are unable to make informed comments that may be needed to avoid impacts and improve the project. We ask the omitted information be made available in the Integrated Document.	The Integrated Document incorrectly refers to the EEC as "the outfall". Specific dimensions, layout, and foundation system of the gate are shown the Civil Design Appendix (NED Plan Set and LPP Plan Set). Potential construction means and methods for all project features are discussed in the Geotechnical Investigation and Analysis Appendix, albeit in very general terms. Given the design is at "concept level" the team is confident that project is constructable via a number of prevailing construction techniques within a bulk construction time frame (i.e. ~ 3 years for FRM measures). However, specific durations or techniques for discrete elements of the project have not been fully developed to a "design or bid level". See the Artesian Slough Master Response for more information.
028_CCCR.SFB_3-38	Railroad Tide Gate Pedestrian Bridge The Partners' presentation at the January public meeting of this project included a photograph of a typical railroad tide gate as proposed in the Integrated Document. Additionally a pedestrian bridge is proposed to cross over that tide gate, described but not pictured. We understand that it has been recommended that a cyclone fencing enclosure be used on the bridge, presumably to assure safety over a railroad crossing. The location of the railroad tide gate and pedestrian bridge will connect two sections of the Alviso levee that both lie on Refuge land, providing a prime elevated location for wildlife viewing for tourists or people just enjoying a hike. To be frank, cyclone fencing is just plain ugly. This pedestrian crossing should be safe to people and wildlife, aesthetically attractive and complementary to the uses of the people that cross it. It may also need to comply with Refuge requirements on behalf of wildlife. Please include these pedestrian bridge recommendations when planning the railroad pedestrian bridge.	The pedestrian bridge design and the railroad tide gate will be designed during the design and engineering phase of the project. The pedestrian bridge will likely be integrated into the railroad tide gate; for example, the tide gate could provide supports for the bridge. Since neither structure has been designed it is difficult to find examples that would provide a reasonable likeness of what the pedestrian bridge would look like and for this reason the Integrated Document does not have plans or drawings. The commenter's desire to have a bridge that is aesthetically attractive (i.e. no cyclone fencing) and meets the Refuge's standards regarding safety and wildlife (i.e. no perches) is shared by the Shoreline Project team. Since the structure will be built on Refuge property the structure will meet their design regulations and policies and will match the aesthetic style of the Refuge's facilities.
028_CCCR.SFB_3-39	We appreciate the opportunity to submit these comments and also the time extension that was provided to do so. Combined, the Integrated Document and Appendices are overwhelming for almost any reader in the public or its agencies, a limiting factor for this writer in terms of topics reviewed.	The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final Feasibility Study includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process.

1538

029_SV

From: Melody Tovar <MTovar@sunnyvale.ca.gov>
Sent: Monday, February 23, 2015 4:58 PM
To: Shoreline Environment SPN
Cc: John Stufflebean; Bhavani Yerrapotu

Subject: [EXTERNAL] Sunnyvale Comments on SB Shoreline Ph Study EIR
Attachments: Sunnyvale Comments on Shoreline Phase I EIR (Alviso) - 022315.pdf

Please see attached comments from the City of Sunnyvale. Kindly confirm receipt by replying to this email.

Thank you,

--
Melody Tovar
Regulatory Programs Division Manager
City of Sunnyvale | Environmental Services Department
(408) 730-7808
mtovar@sunnyvale.ca.gov

via email:
ShorelineEnvironment@usace.army.mil

February 23, 2015

Thomas R. Kendall
Chief, Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers
San Francisco District
1455 Market St.
San Francisco, CA 94103

ATTN: William DeJager
Environmental Section A

Subject: Comments on EIR for South San Francisco Bay Shoreline Phase I Study

Dear Mr. DeJager,

The City of Sunnyvale respectfully submits the following comments on the subject EIR. Recognizing that the scope of study was refined down to a specific area within the South Bay and no longer includes Sunnyvale directly, we submit these comments as a neighboring community that may incur indirect impacts from the subject project. For the two substantive issues below, Sunnyvale staff has posed inquiries as part of the South Bay Salt Pond Restoration Project and Shoreline Study stakeholder meetings. Project staff has responded informally that these issues would not result in impacts. The City of Sunnyvale is seeking to have that feedback more explicitly included in the environmental review process.

1) Potential impacts to the South Bay Salt Pond Restoration Project: The EIR establishes that these two efforts are separate and independent. Sunnyvale recommends that the EIR explicitly state that providing protection to the study area will not result in impacts to the Restoration Project. 1

2) Potential impacts to neighboring communities through adjacent tidal areas: The EIR notes both Milpitas and Santa Clara as neighboring communities, given their direct adjacency. The City of Sunnyvale drains to the same South Bay tributary as Santa Clara, Guadalupe Slough. Sunnyvale recognizes that this Phase I study is a part of a larger Shoreline Study which does include Sunnyvale. Given the difference in timing for action 2

on this first segment compared to the remaining segments, Sunnyvale requests that the EIR address the potential impacts of providing protection to one area of the South Bay while other areas remain unprotected. This analysis should disclose and address impacts incurred longer term (should the remaining segments be substantially delayed) or mid-term (during the period between construction of various segments.

3) Reference to Sunnyvale Treatment Ponds: Page 4-64 of the EIR includes a confusing reference to these Ponds under Section 4.3.1.2 as being used the Wastewater Facility (which is read to mean the San Jose/Santa Clara facility) in the study area. While a portion of the Ponds is located in the San Jose jurisdiction, they are owned by the City of Sunnyvale for use as part of the Sunnyvale Water Pollution Control Plant. 3

Thank you for your consideration of our comments. The City of Sunnyvale recognizes and appreciates the tremendous level of effort and care taken to prepare the study documents. If you have any questions regarding these comments, please contact Melody Tovar, Regulatory Division Manager, at (408) 730-7808 or mtovar@sunnyvaleca.gov.

Sincerely,

for

John Stufflebean
Director, Environmental Services

ID	Issue Text	Response Text
029_SV-1	1) Potential impacts to the South Bay Salt Pond Restoration Project: The EIR establishes that these two efforts are separate and independent. Sunnyvale recommends that the EIR explicitly state that providing protection to the study area will not result in impacts to the Restoration Project.	The South Bay Salt Pond Restoration project and the South San Francisco Bay Shoreline Study are separate, but closely coordinated, projects. Ponds A9-15 are a part of both projects, and the Shoreline Study proposed levee will in fact facilitate the restoration of those ponds. The earthen berms of each of those ponds cannot be breached until adequate back-side flood protection is in place, and the Shoreline Study project will provide that protection. The projects are directly complimentary, and the Shoreline Study will have no effect (positive or negative) on any other phase or location of the South Bay Salt Pond Restoration project. The EIR/S states on p. 1-11 "The Shoreline Phase I Study and the SBSPRP will be implemented as separate projects, each having its own independent utility and neither dependent on the other to achieve their purpose and need, as defined in separate environmental review processes."
029_SV-2	2) Potential impacts to neighboring communities through adjacent tidal areas: The EIR notes both Milpitas and Santa Clara as neighboring communities, given their direct adjacency. The City of Sunnyvale drains to the same South Bay tributary as Santa Clara, Guadalupe Slough. Sunnyvale recognizes that this Phase I study is a part of a larger Shoreline Study which does include Sunnyvale. Given the difference in timing for action EIR address the potential impacts of providing protection to one area of the South Bay while other areas remain unprotected. This analysis should disclose and address impacts incurred longer term (should the remaining segments be substantially delayed) or midterm (during the period between construction of various segments.	As discussed in Section 1.5 Project Background and Physical Study Area Setting, for a timelier planning and implementation process the Project partners decided to include only the Alviso Area for Phase 1. The reasons for minimizing the scope of Phase 1 are described in that section starting on page 1-10. This leaves other areas in the overall Shoreline footprint subject to tidal flooding, but the Phase 1 project does not increase risks to other areas. An EIR is required to assess the potential direct and indirect impacts of a project. The Phase 1 project will not have an impact on the potential flood risk for the City of Sunnyvale or other areas in the greater Shoreline footprint. Future flood risk is an on-going, baseline condition. It is important to note that phasing does not mean that other opportunities will be foregone or lost by starting with a smaller subset of flood protection and restoration.
029_SV-3	3) Reference to Sunnyvale Treatment Ponds: Page 4-64 of the EIR includes a confusing reference to these Ponds under Section 4.3.1.2 as being used the Wastewater Facility (which is read to mean the San Jose/Santa Clara facility) in the study area. While a portion of the Ponds is located in the San Jose jurisdiction, they are owned by the City of Sunnyvale for use as part of the Sunnyvale Water Pollution Control Plant.	Your comment is acknowledged and the text in Section 4.3.1.2 has been revised so there is no reference to the Sunnyvale ponds being used by the (San José-Santa Clara Regional) Wastewater Facility.

1542

From: Berry, Whitney <Whitney.Berry@sanjoseca.gov>
Sent: Monday, February 23, 2015 5:03 PM
To: Shoreline Environment SPN; michael.martin@valleywater.org
Cc: Davies, Ken; Piasecki, Steve; Hughey, Rosalynn
Subject: [EXTERNAL] Comment Letter for Shoreline Study DEIS/DEIR
Attachments: City of San Jose Comment Letter on Shoreline Study DEIS DEIR.pdf

Dear Mr. DeJager, Mr. Martin,

Please find the City of San Jose's comment letter on the draft EIS/EIR attached. Thank you for the opportunity for continued involvement in this project.

Best,

Whitney

Whitney Berry
Planner | Planning, Building and Code Enforcement
City of San Jose
(408) 535-7829

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

Department of Planning, Building and Code Enforcement
HARRY FREITAS, DIRECTOR

February 23, 2015

Mr. Bill DeJager
1455 Market Street
San Francisco, CA 94103

Re: South San Francisco Bay Shoreline Phase 1 Project Draft Environmental Impact Statement/Report (DEIS/DEIR)

Dear Mr. DeJager,

Staff of the City of San José has received the above referenced DEIS/DEIR. As discussed in the DEIS/DEIR, the City of San José is a major landowner within the project area, owning Pond A18 and the lands of the Santa Clara/San Jose Regional Wastewater Facility (RWF). Under the California Environmental Quality Act (CEQA), the City of San José is a Responsible Agency this project.

The City of San José would like to submit the following comments on the DEIS/DEIR:

- The document mentions that the RWF is outside the 1% ACE, but within the 0.2% ACE. The current flood maps show the RWF to be within the 1% floodplain. Please clarify which maps or study the 0.2% ACE was drawn from. 1
- The San Jose-Santa Clara Regional Wastewater Facility is currently considering a long-term arrangement that would allow the San Jose Police Department's Bomb Disposal Facility (BDF) to remain on-site. The PMP EIR accounted for the BDF as an existing use, but subsequent decisions regarding the location of new biosolids processing and the regional value that the BDF provides to local law enforcement, have led to discussions about its continued presence. The northern portion of the BDF is less than a quarter mile from a section of the proposed levee, so should be evaluated in regards to structural integrity and public access. 2
- What storm event is considered for the "existing" level of flood protection? 3
- Are the salt marshes expected to be naturally occurring in the future? What measures, if any, are proposed to minimize any future maintenance that might reduce the effectiveness of the project? 4
- The railroad is a spur owned by the City and any shipment needed at the RWF is coordinated with Union Pacific Railroad (UPRR). If a railroad gate is constructed, would the City be able to control the gate for future use? 5
- What is the potential cost for the overall project and how will it be maintained? 6

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

Department of Planning, Building and Code Enforcement
HARRY FREITAS, DIRECTOR

- The community of Alviso once had a thriving boating and shipping port industry. With the proposed levee in place, what is the potential for the community to have a port in the future? 7
- How will the height of the levees affect the landscape of the Alviso community? 8

Thank you for the opportunity to provide these comments. The City of San José looks forward to working with the project proponents of the Shoreline Phase I Project as environmental review of the Project proceeds. Please feel free to contact me with any questions you may have.

Sincerely,

Whitney Berry

Planner II, Environmental Review
Planning, Building and Code Enforcement

cc: Ken Davies, Environmental Compliance Officer, Environmental Services Department
Rosalynn Hughey, Assistant Director Planning, Building and Code Enforcement
Steve Piasecki, Planning Official, Planning Division

200 E. Santa Clara Street, 3rd Floor Tower, San José, CA 95113-1905 *tel* (408) 535-7900 **www.sanjoseca.gov**

ID	Issue Text	Response Text
030_SJ-1	The document mentions that the RWF is outside the 1% ACE, but within the 0.2% ACE. The current flood maps show the RWF to be within the 1% floodplain. Please clarify which maps or study the 0.2% ACE was drawn from.	The statement referenced in your comment comes from the Economics Appendix, Section 2.3, and was based upon the hydraulic analysis given in the Tidal Flood Risk Analysis Appendix (specifically the Tables 18 through 20 for year 2017 Interior values for the 1% ACE and 0.2% ACE). The statement was based on the 1% ACE event relative to the elevation of the buildings and facilities at the plant. By "current flood maps" we assume you are referring to FEMA's Flood Insurance Rate Map dated February 19, 2014, which shows the entire ground surface area within the 1% ACE, but does not consider the elevation of the structures. However, it is recognized that there are portions of the plant's property that are not elevated above the 1% ACE water surface elevation. The text in the Economic Appendix has been revised to state: "Most of the plant's buildings and infrastructure are elevated above of the 1% ACE floodplain, but some are within the 0.2% ACE floodplain."
030_SJ-2	The San Jose-Santa Clara Regional Wastewater Facility is currently considering a long-term arrangement that would allow the San Jose Police Department's Bomb Disposal Facility (BDF) to remain on-site. The PMP EIR accounted for the BDF as an existing use, but subsequent decisions regarding the location of new biosolids processing and the regional value that the BDF provides to local law enforcement, have led to discussions about its continued presence. The northern portion of the BDF is less than a quarter mile from a section of the proposed levee, so should be evaluated in regards to structural integrity and public access.	Thank you for this additional information. We have updated the land use, recreation, and cumulative impacts sections in the EIR/S to include this facility.
030_SJ-3	What storm event is considered for the "existing" level of flood protection?	The current level of tidal flood risk reduction cannot be determined with certainty, since the salt pond-dike system is a non-engineered system not designed for the purpose of flood risk reduction.
030_SJ-4	Are the salt marshes expected to be naturally occurring in the future? What measures, if any, are proposed to minimize any future maintenance that might reduce the effectiveness of the project?	Yes, the salt marsh is expected to be naturally occurring in the future. Future vegetation maintenance, such as mowing, would only take place on the land side of the levee and 15 feet bayward of the maintenance road on the levee crest.
030_SJ-5	The railroad is a spur owned by the City and any shipment needed at the RWF is coordinated with Union Pacific Railroad (UPRR). If a railroad gate is constructed, would the City be able to control the gate for future use?	The proposed tide gate structure across the UPRR track will be operated by Santa Clara Valley Water District staff. During an extreme tidal event, the tide gate would be closed to prevent tidal flows from flowing inland. There would be no major disruptions to the railroad if the tide gate is closed, since UPPR would need to shut down the operation of this track during an extreme tidal event with or without the Project.
030_SJ-6	What is the potential cost for the overall project and how will it be maintained?	Cost information is provided in Chapter 9 and detailed in the Appendices.
030_SJ-7	The community of Alviso once had a thriving boating and shipping port industry. With the proposed levee in place, what is the potential for the community to have a port in the future?	The proposed levee would not block Coyote Creek or Alviso Slough from boat traffic, and therefore will have no effect on boating. However, the restoration component of the project will likely increase the depth and width of these channels over time, allowing greater boat access. There will however be localized increases in tidal velocities in the vicinity of the pond breaches, as currently experienced at Pond A6 at the mouth of Alviso Slough
030_SJ-8	How will the height of the levees affect the landscape of the Alviso community?	Unlike the existing berms around the ponds, the proposed flood protection levees will not feature steeply sloping sides. The levee will be much wider and have a gentler slope. The trails on top of the constructed levee will be wider than the existing trails on top of the salt pond berms. The flood protection levee is not expected to noticeably affect the views of the surrounding landscape and the horizon from the town of Alviso. It will be more noticeable at the Alviso Marina County Park and at the US FWS's Environmental Education Center because these visitor destinations will be much closer to the levee; but even there it is not expected to be significant. Please see Chapter 4.12 Aesthetics for additional discussion of the levee appearance and visual simulations of the proposed levees from various points in Alviso. Please also note that the levee will feature a trail on top which will provide enhanced (from slightly higher up) views of the surrounding landscape. In addition, the ponds will be restored to tidal marshes, bringing back more of what was originally the natural landscape in the Alviso area.

From: Munson, James <MUNSON.JAMES@EPA.GOV>
Sent: Monday, February 23, 2015 5:16 PM

To: Morkill, Anne; DeJager, William R SPN; DeJager, William R SPN; Kendall, Thomas R SPN
Cc: Shoreline Environment SPN; Buxton, Brenda@SCC; Amato, Melisa
Subject: [EXTERNAL] EPA Comment letter for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study Project DEIS
Attachments: EPA Comment letter for the South San Francisco Bay Shoreline Study_Alviso Ponds and Santa Clara County Interim Feasibility Study Project DEIS.pdf

Please find attached our comment letter for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study Project DEIS.

Hard copy to follow…

James M. Munson, CFM
Environmental Protection Specialist
Enforcement Division, NEPA Section
U.S. EPA, Region IX
75 Hawthorne Street ENF- 4-2
San Francisco, Ca 94105
(415) 972-3852, Fax: (415) 947-8026

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 23, 2015

Thomas R. Kendall
Chief, Planning Branch
Engineering and Technical Services Division
U.S. Army Corps of Engineers San Francisco District
1455 Market St. San Francisco, CA 94103
ATTN: William DeJager

Anne Morkill, Refuge Manager
Don Edwards San Francisco Bay NWR
U.S. Fish and Wildlife Service
1 Marshlands Rd.
Fremont, CA 94555

Subject: Draft Environmental Impact Statement for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study Project, Santa Clara and Alameda Counties, California. (CEQ # 20140371)

Dear Mr. Kendall and Ms. Morkill:

The U.S. Environmental Protection Agency has reviewed the Draft Environmental Impact Statement for the South San Francisco Bay Shoreline Study: Alviso Ponds and Santa Clara County Interim Feasibility Study Project, pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500 1508) and Section 309 of the Clean Air Act.

The DEIS analyzes proposed restoration strategies for approximately 9,000 acres of former commercial salt ponds in the Alviso pond complex and includes, as the project purpose, both flood risk management and tidal habitat ecosystem restoration. The complex is part of the San Francisco Bay Estuary, which is one of the largest and most important estuarine systems in the western hemisphere. It is a significant component of the Pacific Flyway, supporting a high level of native wildlife diversity and providing a broad range of ecosystem services. The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service propose to undertake a large scale levee and tidal marsh restoration project that would be resilient to sea level rise for at least the 50 year life of the project.

The DEIS identifies Alternative 3 as the Tentatively Selected Plan and, on February 2, 2015, we received a letter from the Corps clarifying that it is the Preferred Alternative for this EIS (see attached letter). The DEIS also identifies Alternative 3 as the least environmentally damaging practicable alternative for this project. EPA supports the selection of Alternative 3. We recognize that Alternative 3, due to its restoration project design, calls for more fill than do the other action alternatives; however, we believe that "least environmentally damaging" does not mean least amount of fill in this case. Alternative 3 has the potential to provide essential flood protection for the Alviso community, create critical habitat for sensitive species, and allow for the Baylands to migrate over time, thereby providing adaptive capacity for species that need to move to more suitable range elevations as sea level rises.

Although we reviewed all of the alternatives evaluated in the DEIS, our rating of the DEIS is based on our evaluation of Alternative 3. We have rated Alternative 3 and the DEIS document as Environmental Concerns - Insufficient Information (EC-2) (see enclosed "Summary of Rating Definitions"). EPA

would have substantially greater concerns if any of the other alternatives were selected. While we support the selection of Alternative 3, we recommend that the Final EIS include more information concerning when and how restoration of ponds A9 - A15 would occur, as well as how this restoration would be funded. We understand that the Corps is awaiting Water Resources Development Act implementation guidance regarding restoration on U.S. Fish and Wildlife Service lands. We recommend that the FEIS commit to full restoration of all ponds in the project area, explain how it would be funded, and provide a timeline for this tidal restoration. We also recommend that the FEIS provide additional information regarding operation of the Artesian Slough tide gates and any potential impacts of such operation on the San Jose-Santa Clara Water Pollution Control Plant. Regarding air quality, we recommend that the FEIS describe how the project would comply with EPA's General Conformity Rule.

Recognizing that the South San Francisco Bay is a mercury rich environment, EPA recommends that actions associated with the Project be closely monitored to avoid remobilization of mercury laden sediment or the creation of environmental conditions that promote bioaccumulation. We recommend that the lead agencies use the most current information available to evaluate the project's design and construction methods to minimize mercury mobilization.

Given the high flood risk in the Alviso Community, we suggest that the FEIS explain how the proposed design complies with the recent Executive Order 13690 – "Establishing a Federal Flood Risk Management" signed by President Obama on January 30, 2015.

Page 1-1 of the DEIS incorrectly identifies EPA as a Cooperating Agency. Please correct this in the Final EIS. EPA has not received any request to serve as a Cooperating Agency for this project. Please see the attached Detailed Comments for further discussion of our concerns and recommendations.

EPA appreciates the opportunity to review this DEIS. When the FEIS is released, please send one hard copy and three CDs to the address above (mail code: ENF-4-2). If you have any questions, please contact me at (415) 972-3521, or have your staff contact James Munson, the lead reviewer for this project. James can be reached at (415) 972-3852 or Munson.James@epa.gov.

Sincerely,

Kathleen Martyn Goforth, Manager
Environmental Review Section

Enclosures: Summary of the EPA Rating System
Corps Preferred Alternative Clarification Letter

cc: Cay Goude, Assistant Field Supervisor, USFWS
Larry Goldzband, Executive Director, BCDC
Bruce Wolfe, Executive Officer, SF Bay Regional Water Quality Control Board
Sam Schuchat, Executive Officer, California Coastal Conservancy
Beau Goldi, Chief Executive Officer, Santa Clara Valley Water District
Napp Fukuda, Deputy Director, Department of Environmental Services, City of San Jose

SUMMARY OF EPA RATING DEFINITIONS*

This rating system was developed as a means to summarize the U.S. Environmental Protection Agency's (EPA) level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the Environmental Impact Statement (EIS).

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

ADEQUACY OF THE IMPACT STATEMENT

"Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, Policy and Procedures for the Review of Federal Actions Impacting the Environment.

EPA DETAILED COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT/ ENVIRONMENTAL IMPACT REPORT FOR THE SOUTH SAN FRANCISCO BAY SHORELINE STUDY: ALVISO PONDS AND SANTA CLARA COUNTY INTERIM FEASIBILITY STUDY PROJECT, SANTA CLARA AND ALAMEDA COUNTIES, CALIFORNIA. (CEQ # 20140371) February 23, 2015

LEDPA Determination

Page 3-81 of the DEIS identifies Alternative 3 as the least environmentally damaging practicable alternative for this project. While a LEDPA determination is not necessary for authorization of this project, EPA supports the selection of Preferred Alternative 3 as the environmentally preferable alternative, and believes it is fully consistent with the standards of the 404(b)(1) Guidelines, including the LEDPA. To facilitate permitting, we recommend that the Final EIS and the 404(b)(1) analysis (Appendix X) more fully demonstrate that Alternative 3 meets these criteria. While alternatives other than Alternative 3 would involve less fill, EPA believes that they would result in other adverse environmental consequences. A fuller documentation of the reasons Alternative 3 has been identified as the LEDPA would be helpful, as it is important for the public and other stakeholders to understand the greater risk of harm and damage inherent in the other action alternatives.

Recommendations:
In order to better demonstrate the environmental benefits of Alternative 3:

Revise the 404(b)(1) analysis (Appendix X) to address three components of the project: levee alignment, levee height, and ecotone vs bench design. Because these components are theoretically independent from each other, discussing each in turn could be a clear way to demonstrate that the final alternative chosen is composed of the least damaging alignment, height, and transition habitat choices. The revised analysis should include an estimate of the acres of fill and the acres of special aquatic sites provided after construction is complete.

Fully address, in Appendix X, the overall impacts to waters of the U.S., impacts to special aquatic sites (e.g. wetlands and mudflats), non-waters impacts, and whether a given component meets the stated project purpose and objectives.

More clearly describe, in Appendix X, how the project area would be restored to a more natural high quality habitat, such as tidal wetlands and high-tide refugia, and provide benefits to species of concern.

Include, in the FEIS, an estimate of the acres of wetlands likely to form in the ecotone after construction. The DEIS includes restoration estimates for various habitat types; however, it does not appear that these numbers account for wetlands likely to develop in the ecotone.

Benefits of Ecotone Design for Habitat Restoration

Alternative 3 includes the establishment of an ecotone adjacent to the Flood Risk Management levees. It does not appear that that Alternative 2, 4 or 5, each of which relies on a bench design and would not provide an ecotone, would meet the stated goal of restoring ecological function and habitat quantity, quality, and connectivity for special status species. It is not clear from the document that the bench habitat would provide adequate high tide refugia or buffer for salt marsh harvest mouse or clapper rail, which is identified in U.S.

FWS "The Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California" (Recovery Plan) as a necessary component of marsh restoration for these species[1].

> ***Recommendation:***
> Discuss, in the FEIS and Appendix X, the habitat recommendations in the Recovery Plan and clarify whether the bench design would meet high tide refugia and buffer needs for the target species. If not, the FEIS should explain whether/how these alternatives would meet the stated objectives for special status species. Provide a comparative analysis of how the ecotone alternative vs. bench alternatives would meet the stated objectives of restoring special status species habitat.

Alternatives/Levee Height

The DEIS identifies Alternative 2, with a 12.5 foot or 13.5 foot levee height, as the tentative National Economic Development Plan. EPA understands that the NED Plan represents the alternative identified by the Corps as having the most cost effective levee alignment and the levee height that would generate the greatest net benefits. Section 3.5.4 of the DEIS identifies screening criteria for evaluation of the flood protection measures, such as completeness, effectiveness, efficiency, and acceptability. Alternatives carried forward, including the NED Plan, must meet these screening criteria. The acceptability criterion includes consideration of whether an alternative will be consistent with federal laws and codes. Page 3-80 of the DEIS states that a 13.5' levee height would not meet FEMA levee certification criteria at the end of the plan period in 2067. It is unclear how a levee design that does not meet FEMA accreditation requirements would qualify as an acceptable alternative under the Corps screening criteria.

> ***Recommendations:***
> In the FEIS, clarify how FEMA requirements affect the Corps' acceptability screening criteria and explain how the proposed NED Plan levee height of 12.5' or 13.5' would meet the screening criteria, given the apparent conflict with FEMA accreditation requirements.

Water Quality

Sediment Supply
As stated in the DEIS, recent United States Geological Survey research indicates a trend in San Francisco Bay, whereby levels of suspended sediments are steadily decreasing and the Bay is becoming less turbid (p. 3-87). However, it should be noted that these studies also indicate that suspended sediment levels vary in the different regions of the Bay, and perhaps fortuitously for the proposed project, the South Bay still retains high suspended sediment concentrations and generally high sedimentation rates. For example, sedimentation in some locations in Pond A21 accumulated over 220 mm in 2 to 3 years.

> ***Recommendation:***
> Given the beneficial accretion rates seen in similar adjacent projects, we suggest that the construction implementation be designed to maximize marsh sediment deposit, thus utilizing tidal marsh's natural potential to keep up with sea level rise.

[1] http://www.fws.gov/sacramento/es/recovery-planning/tidal-marsh/Documents/TMRP_Volume1_RP.pdf

Nutrients
San Francisco Bay is a nutrient-enriched estuary, but has been buffered from the potential negative consequences of elevated nutrient levels by a variety of factors. In the future, projected increases in water clarity and water temperatures will create conditions that could result in adverse impacts in the Bay as a result of high nutrient concentrations, including the potential proliferation of harmful algal species.

Recommendations:
Discuss, in the FEIS, the benefits of levee designs that incorporate transitional zone features, including the creation of tidal marshes, and the ability of these ecosystems to take up nutrients at a high rate.

Add the following information to Table 4.5-10, entitled, "Likely Future Status of Water Quality Contaminants in the Shoreline Phase I Study Area":

1. For the "Nutrients" block, add the Regional Monitoring Program's Nutrients Strategy: The San Francisco Bay Nutrient Science and Management Strategy is a regional initiative for developing the science needed for informed decisions about managing nutrient loads and maintaining beneficial uses within the Bay in response to the apparent changes in the Bay's resilience to nutrient loading.
2. For the "Algae" block, add the National Coastal Condition Assessment, which will be sampling for harmful algal species in the Bay in 2015.

Monitoring and Adaptive Management
The DEIS includes a thorough monitoring and adaptive management plan developed based upon the 2006 South Bay Salt Pond Restoration Project (SBSPRP). EPA supports the scientific and adaptive management approach adopted by the SBSPRP to manage the phased restoration of the salt ponds, given the uncertainty that exists in the project area. We are pleased to see the same approach is being applied to the Project. However, the DEIS is unclear on who has responsibility to ensure that the monitoring and adaptive management plan is implemented. The functioning of the levee is integral to the restoration of the salt ponds, and the Corps is responsible for restoration of at least Pond A18; therefore, it appears that the Corps bears at least some responsibility for implementing the plan. Yet, it is unclear how the Corps, FWS, State and the local sponsors will share this responsibility.

Recommendation:
Clarify, in the FEIS, who would maintain responsibility, including financial responsibility, for implementing the monitoring and adaptive management plan and ensuring the project's success. The FEIS should clearly state which agencies/stakeholders, such as the Corps, FWS, State of California, and/or local sponsors, would take on which responsibilities throughout the fifty year life of the project.

Artesian Slough Tide Gates and Wastewater Facility NPDES permit
All action alternatives in the DEIS include constructing tide gates across Artesian Slough just downstream from the San Jose-Santa Clara Water Pollution Control Plant (Wastewater Facility) outfall. According to page 4-211 of the DEIS, these gates could be closed "in extreme storm events," but the document does not provide sufficient operational information about the tide gates beyond this vague description. We, therefore, cannot evaluate the impact this component of the project may have on water quality and the Wastewater Facility's ability to comply with its NPDES permit (permit # CA0037842).

Recommendations:
Provide additional information in the FEIS on operation of the Artesian Slough tide gates, including the estimated frequency of closure now and in the future, estimated duration of closure, estimated volume of water the Wastewater Facility would need to hold or otherwise discharge during gate closure, and whether or not gate closure could result in violation of the Wastewater Facility effluent limitations, receiving water limitations, or other permit conditions. Consider identifying how coordination on this project element would be accomplished should extreme storm events occur.

Construction and operation of this project element would require extensive coordination with the Wastewater Facility and, possibly, the Regional Water Quality Control Board. We suggest that the FEIS identify how the Corps and local sponsors would coordinate with these entities on this component of the project.

Air Quality

General Conformity
EPA's General Conformity Rule, established under Section 176(c)(4) of the Clean Air Act, provides a specific process for ensuring federal actions will conform with State Implementation Plans to achieve National Ambient Air Quality Standards. Although the DEIS states; "As the project would not result in population or employment growth there would be no conflict with, or obstruction of, air quality plans" (p. 4-460 and elsewhere), this is not the analysis required by the General Conformity Rule. The rule sets de minimis thresholds, depending on the nonattainment status of the region where a federal action will occur. The Bay Area Air Basin is designated moderate non-attainment for EPA's 1997 1-hour ozone standard. As specified in 40 CFR 93.153, the de minimis threshold for federal actions in moderate ozone nonattainment areas is 100 tons per year for NOx and VOCs. Emissions from any of the alternatives might exceed these de minimis standards. For example, under Alternative 2, emissions in 2017 are estimated as 773 lbs per day of NOx (Table 4.10-7), which converts to 141 tons per year if construction occurs over 365 days a year, or 96 tons if construction occurs over 250 days per year. If annual project emissions exceed the de minimis concentrations, the Corps/FWS are required to prepare a general conformity analysis, demonstrating conformity with the applicable State Implementation Plan by one of the methods specified in 40 CFR 93.158. Additionally, the rule requires public notice of a general conformity determination, as stated in 40 CFR 93.156.

Recommendation:
Determine whether annual project emissions would exceed the de minimus concentrations established for federal actions in moderate ozone attainment areas, thereby requiring a general conformity analysis. If an analysis is required, specify one of the methods provided by 40 CFR 93.158 to demonstrate conformity with the applicable State Implementation Plan. In addition, discuss public participation that may be required.

Construction Mitigation Measures

We are pleased that the DEIS includes air quality avoidance and minimization measures, such as limiting idling to a maximum of 5 minutes, limiting vehicle speeds to 15 mph, and administering traffic control (page: 4-455). Additional measures are available to further reduce air quality impacts.

Recommendations:
Ensure that construction vehicles use newer and cleaner construction equipment (e.g. Tier 4), or diesel particulate filters on older construction equipment.

Use electricity from the grid, rather than portable diesel-powered generators, if possible.

Flood Protection (Executive Order 13690)

On January 30, 2015 President Obama issued Executive Order 13690 – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, which amends Executive Order 11988 – Floodplain Management. Section 6(c) of Executive Order 13690 requires that, rather than basing the floodplain on the area subject to a one percent or greater chance of flooding in any given year, the floodplain be established using one of the following approaches:

(1) Unless an exception is made under paragraph (2), the floodplain shall be:
(i) the elevation and flood hazard area that result from using a climate-informed science approach that uses the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science. This approach will also include an emphasis on whether the action is a critical action as one of the factors to be considered when conducting the analysis;
(ii) the elevation and flood hazard area that result from using the freeboard value, reached by adding an additional 2 feet to the base flood elevation for non-critical actions and by adding an additional 3 feet to the base flood elevation for critical actions;
(iii) the area subject to flooding by the 0.2 percent annual chance flood; or
(iv) the elevation and flood hazard area that result from using any other method identified in an update to the Federal Flood Risk Management Standards.

For more information on go to: https://www.fema.gov/federal-flood-risk-management-standard-ffrms

Recommendation:
Clarify how Alternative 3 would meet the goals of Executive Order 13690, and discuss any changes to the project necessary to meet the stated goals. Compare the ability of Alternative 3 to to meet the goals of the EO with that of the other alternatives. For more information on go to: https://www.fema.gov/federal-flood-risk-management-standard-ffrms.

The DEIS identifies a 50 year planning horizon for the project; however, the useful life of the levees could extend well beyond 50 years, if designed appropriately to accommodate expected sea level rise. Because the analysis only extends to 2067, it is not clear how the levees would perform beyond this period, especially given the expected acceleration of sea level rise.

Recommendation:
Discuss the level of flood protection provided by the alternate levee heights (12.5', 13.5', and 15.2') under each of the three sea level rise scenarios out to year 2100.

Species of Concern and Habitat Assessment/Valuation

Transition Zone Habitat
The establishment of an ecotone adjacent to the levee, as proposed in Alternative 3, can be expected to provide substantial ecological benefits, especially for special status species such as the steelhead trout, salt marsh harvest mouse, western snowy plover, california least tern, and california clapper rail, which are identified as possibly using the project site (page 2-7). The DEIS references the Tidal Marsh Recovery Plan, which states that lack of high tide refugia habitat is a threat for both salt marsh harvest mouse and California clapper rail. The Recovery Plan also identifies creation of ecotone habitat as necessary for delisting (see specifically Sections II.b.7, II.e.7, and III.a in the Recovery Plan). The bench habitat described in Alternatives 2, 4, and 5 does not appear to provide suitable high tide refugia or buffer habitat for salt marsh harvest mouse and California clapper rail, as called for in the Recovery Plan. Page 28 of the Recovery Plan states that, "Levees generally are too steep, narrow, and weedy to be high quality high-tidal refugia for tidal marsh animals."

> ***Recommendations:***
> In the FEIS, expand on the habitat restoration recommendations in the Recovery Plan, including the need for high tide refugia and buffer habitat, and explain how they would be supported by Alternative 3 versus the other alternatives
>
> Describe the total width, the width minus the 15' vegetation maintenance zone, and the expected vegetative condition of unmaintained habitat for each alternative.

Habitat Assessment
The DEIS does not clearly explain how the habitat assessment/valuation was performed. Specifically, the Combined Habitat Assessment Protocols Summary in Appendix J does not sufficiently describe the action alternatives, making it difficult to assess how the habitat values of the different alternatives were evaluated. Further, EPA is aware that an assessment using the California Rapid Assessment Method was performed for this project, yet it is not clear how this information was used in the habitat valuation.

It appears that the habitats were scored independently and then summed to provide an estimated benefit for a given alternative. The benefit of the ecotone habitat is not just the value of that habitat type alone. The greater value of this habitat is that its presence increases the value of the adjacent marsh habitat. Many species found within tidal marshes need high tide refugia, including salt marsh harvest mouse and california clapper rail. Without high tide refugia, i.e., ecotone habitat, the marsh habitat is of lower quality for these species. In addition, ecotone habitat can filter pollutants and provide a buffer between urbanized areas and the marsh, thereby increasing the overall quality and functioning of the marsh itself. Therefore, restored marsh habitat in alternatives without ecotone habitat (i.e. alternatives 2, 4, and 5) should have been given lower scores than restored marsh habitat in alternatives with ecotone habitat (i.e. preferred alternative 3). Appendix A references the 1999 Baylands Ecosystem Habitat Goals Report which "presents recommendations for the kinds, amounts, and distribution of wetlands and related habitats". We note that a technical update to the Baylands Ecosystem Habitat Goals Report is expected March 2015.

> ***Recommendations:***
> Expand on the discussion of ecotone habitat value by incorporating habitat restoration recommendations in the Recovery Plan. If the updated Baylands Ecosystem Habitat Goals Report Technical Update is released before the FEIS is completed, the FEIS should reference ecotone habitat recommendations from this report as well. The Baylands Ecosystem Habitat

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Goals Report Technical Update is expected March 2015. http://www.sfbayjv.org/about-strategy.php

The FEIS should discuss how the restored marsh habitat was valued for each alternative. The restored marsh habitat in Alternatives 2, 4, and 5 should be scored lower than that of Alternative 3 due to the lack of suitable ecotone habitat.

This comparison should also identify whether the bench and or ecotone habitat will meet high tide refugia and buffer recommendations identified the Recovery Plan.

Update Appendix J to include all action alternatives.

Compensatory Mitigation
The DEIS indicates that the Corps is not proposing compensatory mitigation for wetland impacts because the project will result in the eventual restoration of many hundreds of acres. However, it can take many decades for tidal marsh habitat to develop and the DEIS identifies a time lag between anticipated project impacts and successful habitat restoration. While this impact is identified as less than significant because the project will result in a net increase in wetlands in the long term, the discussion in the DEIS is not adequate to demonstrate that mitigation is not needed for the loss of wetlands in the near-term.

Recommendations:
The FEIS should include additional discussion of likely short-term wetland impacts and further justification for the conclusion that compensatory mitigation is not required. Specifically, the FEIS should identify the acres of wetlands likely to develop within 3-5 years after predicted construction-related impacts. This can be done by estimating the acreage that will fall within the tidal range known to support marsh vegetation. If this acreage of expected short-term wetland development is less than the acreage of wetlands fill, then the FEIS should estimate how long it will take to achieve no net loss of wetlands.

Methylmercury
Page 4-162 of the DEIS states that, as part of the South Bay Salt Pond Restoration Project (SBSPRP), "studies are currently underway to evaluate the long-term effects, recent data suggest that methymercury (MeHg) concentration would decrease after restoration of tidal habitat". These studies also indicate MeHg increases following levee breaches to restore tidal action to salt ponds are temporary. In addition, the South San Francisco Bay is located in a mercury (Hg)-rich environment due to historic and continuing run off from the New Almaden Quicksilver Mine. Given these conditions, management actions associated with the salt pond restoration (e.g. levee breaches) may remobilize mercury laden sediments. This remobilization of mercury could create environmental conditions that increase or decrease MeHg production and bioaccumulation. In order to continue to restore tidal wetlands, the SBSPRP monitors changes in the distribution, speciation and bioaccumulation of Hg that could be caused by project actions.

Recommendations:
Use the most current information from the SBSPRP to evaluate the South Bay Shoreline levee's design and construction to minimize Hg mobilization and bioaccumulation.

The discussion in the DEIS of the potential for increased exposure to methylmercury (MeHg) resulting from the project was focused primarily on construction-related mobilization of MeHg. The document did not

discuss whether fish, birds, and invertebrates using the restored marshes would likely be exposed to higher levels of MeHg than under current conditions.

> ***Recommendations:***
> Clarify, in the FEIS, whether fish, birds, and invertebrates using the restored marshes would likely be exposed to higher levels of MeHg than under pre-construction conditions. We recommend that the FEIS demonstrate whether restored marshes would have lower rates of MeHg production than under pre-construction conditions.

Aquatic Biological Resources/State Permitting
The Aquatic Biological Resources (ABR) Section identifies consistency with the Recovery Plan as a significance criterion; however, the impact discussion simply states that, since the Recovery Plan does not cover aquatic species, the project will not conflict with its provisions (pag: 4-234). In addition, consistency with the Recovery Plan is not sufficiently discussed in the Terrestrial Biological Resources (TBR) Section. The Recovery Plan clearly addresses habitats covered under the proposed project, and one of the primary objectives of the project is to restore habitat for special status species addressed in the Recovery Plan (i.e. salt marsh harvest mouse and California clapper rail). The impact significance thresholds for the Aquatic and Terrestrial Biological Resources sections should also identify any conflicts with Regional Board and BCDC policies or regulations since the project would require permitting by both of these state agencies.

> ***Recommendations:***
> Discuss project consistency with the Recovery Plan either in the Aquatic and Terrestrial Biological Resources Sections of the FEIS. This analysis should include discussion of whether the ecotone and bench habitats are consistent with the recommendations for high tide refugia and buffer habitats.
>
> Incorporate Regional Board and BCDC policy and regulation considerations in the impact analysis.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94103-1399

2 February 2015

Ms. Kathleen Goforth
Environmental Review Section
U.S. EPA Region IX
75 Hawthorne Street ENF-4-2
San Francisco, CA, 94105

Attention: Mr. James Munson

Dear Ms. Goforth:

I am writing to clarify the terminology used in the South San Francisco Shoreline Phase I Study Draft Environmental Impact Statement/Report (DEIS/DEIR) to facilitate your office's review of the document.

The Draft Interim Feasibility Report/Environmental Impact Statement for the South San Francisco Shoreline Phase I Study (Shoreline Study) is an integrated document to meet the requirements of both National Environmental Policy Act (NEPA) and the US Army Corps of Engineers' (Corps) planning documents. Integrated documents meet all requirements under NEPA, but the terminology is different in some cases. In accordance with the Corps' SMART Planning Guidance, which is available at http://planning.usace.army.mil/toolbox/smart.cfm, we have adopted the term Tentatively Selected Plan (TSP) for Preferred Alternative at the DEIS stage. In a feasibility study, the TSP is the plan that the Corps is recommending as the Preferred Alternative during the draft public review stage, therefore the TSP is equivalent to the Preferred Alternative. Once this document becomes a Final Feasibility Study/EIS, the TSP/Preferred Alternative will become the Selected Plan/Recommended Plan.

For the Shoreline Study, the TSP/Preferred Alternative is Alternative 3, which is also the Locally Preferred Plan (LPP). In the DEIS/DEIR it is referred to as a TSP to reflect the idea that plan selection or features of the plan may change based on public and agency input.

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If you have any questions, please contact me at (415) 503-6822 or Thomas.R.Kendall@usace.army.mil. You may also contact William DeJager at (415) 503-6866 or William.R.DeJager@usace.army.mil.

Sincerely,

Thomas R Kendall, P.E.
Chief, Planning Branch

ID	Issue Text	Response Text
031_EPA_2-1	EPA would have substantially greater concerns if any of the other alternatives were selected. While we support the selection of Alternative 3, we recommend that the Final EIS include more information concerning when and how restoration of ponds A9 - A15 would occur, as well as how this restoration would be funded.	EPA's preference for the selection of Alternative 3 is noted. A description of the restoration of Ponds A9-A15 is included in Section 3.8.2, and the schedule for restoration is in Table 3.8-7. More detailed plans for the restoration of the ponds will be developed in design.
031_EPA_2-2	We understand that the Corps is awaiting Water Resources Development Act implementation guidance regarding restoration on U.S. Fish and Wildlife Service lands. We recommend that the FEIS commit to full restoration of all ponds in the project area, explain how it would be funded, and provide a timeline for this tidal restoration.	The USACE signed implementation guidance for WRRDA 2014, Section 1025 on 26 February 2015, which allows it to recommend a USACE project that includes the implementation of ecosystem restoration on USFWS lands. The Final Integrated Document has been revised to reflect this guidance, and explain the implementation responsibilities of the Federal and non-Federal entities, including schedule, cost/funding, construction, monitoring and adaptive management, and operation and maintenance. Funding and scheduling is provided in Chapter 9 and summarized in the Executive Summary. The project partners are committed to full restoration of all the ponds.
031_EPA_2-3	We also recommend that the FEIS provide additional information regarding operation of the Artesian Slough tide gates and any potential impacts of such operation on the San Jose-Santa Clara Water Pollution Control Plant.	The San Jose Regional Wastewater Facility is anticipating the need to pump effluent in the future as a response to sea level rise with or without the proposed project. The project team is continuing to analyze the configuration and operations of the proposed closure on Artesian Slough to avoid negatively impacting current plant operations or inducing the installation of pumps sooner than would otherwise occur in a "without-project" condition.
031_EPA_2-4	Regarding air quality, we recommend that the FEIS describe how the project would comply with EPA's General Conformity Rule.	Table 4.10-7 (for alternatives 2, 4 and 5) and Table 4.10-8 (for alternative 3) report the maximum daily emissions from construction. Maximum daily emissions were estimated consistent with the Bay Area Air Quality Management District CEQA Guidelines which has thresholds of significance based on daily maximum. This is the emissions from the day within a given year with the maximum emissions based on the CalEEMod model. Other days within that year would have fewer emissions. Therefore multiplying the maximum daily emissions by the number of work days in a year drastically over- estimates annual emissions. Appendix A5 includes the model output for both daily and annual emissions. The maximum annual NOx and ROG for alternatives 2, 4 and 5 is 24 tons per year, and the maximum annual NOx and ROG for alternative 3 is 41 tons per year. These emissions are under the de minimis threshold for federal actions in moderate ozone nonattainment areas. This analysis has been added to Section 4.10.
031_EPA_2-5	Recognizing that the South San Francisco Bay is a mercury rich environment, EPA recommends that actions associated with the Project be closely monitored to avoid remobilization of mercury laden sediment or the creation of environmental conditions that promote bioaccumulation. We recommend that the lead agencies use the most current information available to evaluate the project's design and construction methods to minimize mercury mobilization.	The Shoreline Study is closely coordinated with the SBSP Restoration Project. The SBSP Restoration Project has been concerned about the presence of mercury and the potential for increased methylation of mercury since the beginning of the project in 2003. The results of the SBSP Restoration Project's 10 years of mercury studies is summarized in the Water Quality Section of the Integrated Document (Section 4.5) and discussed in more detail at www.southbayrestoration.org/science/Summary Update on Pond A8 Mercury Studies_Jan 2015 _Final.pdf. This information has been considered by the Shoreline Study team when designing the restoration of the ponds to tidal wetlands. We agree with the commenter that construction should minimize mercury mobilization as much as possible, and would add that it is possibly even more important to minimize the biochemical process that convert mercury into methylmercury (thus making it more available to wildlife). The results of the SBSP Restoration Project indicate, so far, that tidal restoration and improved circulation reduce these process that drive methylation. The monitoring proposed to be included under the Shoreline Study is outlined in the Monitoring and Adaptive Management Plan (Appendix I). The Shoreline Study does not propose to include mercury monitoring as the project will not have a significant impact to mercury mobilization or methylmercury production (see Section 4.5). However, the SBSP Restoration Project's mercury studies will continue until there is additional data to better understand the effects of tidal restoration on the processes that drive methylation and mercury bioaccumulation. The Shoreline Study will coordinate with the SBSP Restoration Project on using the most current data available as part of the project's on-going adaptive management.
031_EPA_2-6	Given the high flood risk in the Alviso Community, we suggest that the FEIS explain how the proposed design complies with the recent Executive Order 13690 - "Establishing a Federal Flood Risk Management" signed by President Obama on January 30, 2015.	EO 13690 amends the existing EO 11988 decision making process. However, as stated in Section 3 of EO 13690, agencies are not to implement the revised process until additional input from stakeholders is solicited and final revised Implementing Guidelines are issued by the Water Resources Council. Upon issuance of final revised Implementing Guidelines, agencies will issue agency specific policies and regulations to implement the revised process. As such, analysis of how the revised policies impact current implementation of EO 11988 has yet to be done. Post Hurricane Katrina and Hurricane Sandy, the USACE incorporates best available science and data, including sea level projects and climate resilience, into our water resources project planning and design. USACE incorporates authorized levels of risk reduction, loading and factors of safety, and risk considerations beyond the criteria and options required by the Federal Flood Risk Management Standard (FFRMS). USACE complies with EO 11988 to include its 8-step decision making process and will use the FFRMS to inform our team's engineering and analysis expertise in developing flood risk management solutions once we are able to implement the revised process. Alternative 3, the USACE Locally Preferred Plan, a 15.2 levee and 30:1 Ecotone, meets the goals of EO 11988. The USACE Locally Preferred Plan or Alternative 3, represents a future 1% design based on the USACE high scenario in 2067. The design elevation of 15.2 feet NAVD88 was determined by the following: Base construction year (2017) 1% water level at Coyote Creek 10.76* Relative Sea

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		Level Rise (1992.5** to 2067), USACE High SLR @ 2.06 mm/yr 2.59 Less observed RSLR (1992.5 to 2017) - 0.17 2067 1% water level at Coyote Creek (10.76 + 2.42) 13.18 FENA certification standard (add 2 feet freeboard) 2.00 Alt. 3 design 15.18 , say 15.20 * NAVD88 ** Midpoint of 1983 to 2001 tidal epoch Alternative 3 incorporates the best available science and data, including sea level rise projections and climate resilience, project planning and design by recommending a design base on the USACE high SLR scenario which will meet the FEMA Certification criteria of adding 2 feet to a projected 1% base flood elevation in the year 2067. The 30:1 ecotone represents a nature based flood risk reduction feature for a levee subject to coastal forcing, while creating habitat and providing ecosystem services. Alternative 3 best meets the goals of EO 11988. However, under USACE planning and sea level change polices and guidance, Alternative 3 was not the National Economic Development (NED) plan, which was a 12.5 levee design without the ecotone. This alternative was economically viable and in the federal interest. Additional details on the analysis may be found in Appendix F.
031_EPA_2-7	Page 1-1 of the DEIS incorrectly identifies EPA as a Cooperating Agency. Please correct this in the Final EIS. EPA has not received any request to serve as a Cooperating Agency for this project. Please see the attached Detailed Comments for further discussion of our concerns and recommendations.	The suggested revision to Chapter 1.0 has been made and reference to USEPA as a cooperating agency on this project has been removed.
031_EPA_2-8	LEDPA Determination Page 3-81 of the DEIS identifies Alternative 3 as the least environmentally damaging practicable alternative for this project. While a LEDP A determination is not necessary for authorization ofthis project, EPA supports the selection of Preferred Alternative 3 as the environmentally preferable alternative, and believes it is fully consistent with the standards of the 404(b)(1) Guidelines, including the LEDP A. To facilitate permitting, we recommend that the Final EIS and the 404(b)(1) analysis (Appendix X) more fully demonstrate that Alternative 3 meets these criteria. While alternatives other than Alternative 3 would involve less fill, EPA believes that they would result in other adverse environmental consequences. A fuller documentation of the reasons Alternative 3 has been identified as the LEDP A would be helpful, as it is important for the public and other stakeholders to understand the greater risk of harm and damage inherent in the other action alternatives. Recommendations: In order to better demonstrate the environmental benefits of Alternative 3: - Revise the 404(b)(1) analysis (Appendix X) to address three components of the project: levee alignment, levee height, and ecotone vs bench design. Because these components are theoretically independent from each other, discussing each in turn could be a clear way to demonstrate that the final alternative chosen is composed of the least damaging alignment, height, and transition habitat choices. The revised analysis should include an estimate of the acres of fill and the acres of special aquatic sites provided after construction is complete. - Fully address, in Appendix X, the overall impacts to waters of the U.S., impacts to special aquatic sites (e.g. wetlands and mudflats), non-waters impacts, and whether a given component meets the stated project purpose and objectives. - More clearly describe, in Appendix X, how the project area would be restored to a more natural high quality habitat, such as tidal wetlands and high-tide refugia, and provide benefits to species of concern. - Include, in the FEIS, an estimate of the acres of wetlands likely to form in the ecotone after construction. The DEIS includes restoration estimates for various habitat types; however, it does not appear that these numbers account for wetlands likely to develop in the ecotone.	Pursuant to USACE requirements for a 404(b)(1) Analysis, the evaluation is completed on the Recommended Plan. Since the Recommended Plan includes the ecotone, the bench is not discussed in the 404(b)(1). The 404(b)(1) Evaluation has been revised and has added information regarding a comparison of the Alternatives for the LEPDA.
031_EPA_2-9	Benefits of Ecotone Design for Habitat Restoration Alternative 3 includes the establishment of an ecotone adjacent to the Flood Risk Management levees. It does not appear that that Alternative 2,4 or 5, each of which relies on a bench design and would not provide an ecotone, would meet the stated goal of restoring ecological function and habitat quantity, quality, and connectivity for special status species. It is not clear from the document that the bench habitat would provide adequate high tide refugia or buffer for salt marsh harvest mouse or clapper rail, which is identified in U.S. FWS "The Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California" (Recovery Plan) as a necessary component of marsh restoration for these species Recommendation: Discuss, in the FEIS and Appendix X, the habitat recommendations in the Recovery Plan and clarify whether the bench design would meet high tide refugia and buffer needs for the target species. If not, the FEIS should explain whether/how these alternatives would meet the stated objectives for special status species. Provide a comparative analysis of how the ecotone alternative vs. bench alternatives would meet the stated objectives of restoring special status species habitat.	Text has been added to the report to address this issue in Section 4.7.2.4.2.2

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031_EPA_2-10	Alternatives/Levee Height The DEIS identifies Alternative 2, with a 12.5 foot or 13.5 foot levee height, as the tentative National Economic Development Plan. EPA understands that the NED Plan represents the alternative identified by the Corps as having the most cost effective levee alignment and the levee height that would generate the greatest net benefits. Section 3.5.4 of the DEIS identifies screening criteria for evaluation of the flood protection measures, such as completeness; effectiveness, efficiency, and acceptability. Alternatives carried forward, including the NED Plan, must meet these screening criteria. The acceptability criterion includes consideration of whether an alternative will be consistent with federal laws and codes. Page 3-80 of the DEIS states that a 13.5' levee height would not meet FEMA levee certification criteria at the end of the plan period in 2087. It is unclear how a levee design that does not meet FEMA accreditation requirements would qualify as an acceptable alternative under the Corps screening criteria. Recommendations: In the FEIS, clarify how FEMA requirements affect the Corps' acceptability screening criteria and explain how the proposed NED Plan levee height of 12.5' or 13.5' would meet the screening criteria, given the apparent conflict with FEMA accreditation requirements.	In terms of providing "100-year protection", Corps projects are analyzed and described in terms of their expected performance, not in terms of levels of protection. There is no minimum level of performance or protection or size required for Corps projects. This is in contrast to FEMA requirements to meet a certain benchmark for insurance purposes. The USACE evaluation process weighs the costs of constructing a project against the benefits, that is, the damages that are prevented. The USACE uses this information to determine the "Federal interest" or the National Economic Development (NED) Plan. The USACE is required to identify the NED Plan as the plan that has the highest benefits for the costs in order to maximize the net national economic development benefits. The NED plan is the default recommendation, but a different plan (called a "locally preferred plan" (LPP)) can be requested for consideration by the USACE and its study partners based on local needs. This LPP request must be approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)). With the Shoreline Phase I Project, the 12.5' levee height identified as the NED Plan would meet the FEMA "100-year protection" for the initial life of the project. However, as sea-level rises, the level of protection will decrease. This change in benefit level over time was factored into the cost-benefit analysis that established the 12.5' height as the NED Plan. The Non-Federal Sponsor (NFS) has requested consideration of an LPP that includes a higher levee height of 15.2'. If approved by the ASA(CW), the NFS would pay the cost difference between the NED Plan and the LPP. The additional levee height would maintain the performance level of the levee throughout the entire 50 year life of the project at the equivalent of the "100-year protection" level.
031_EPA_2-11	Sediment Supply As stated in the DEIS, recent United States Geological Survey research indicates a trend in San Francisco Bay, whereby levels of suspended sediments are steadily decreasing and the Bay is becoming less turbid (p. 3-87). However, it should be noted that these studies also indicate that suspended sediment levels vary in the different regions of the Bay, and perhaps fortuitously for the proposed project, the South Bay still retains high suspended sediment concentrations and generally high sedimentation rates. For example, sedimentation in some locations in Pond A21 accumulated over 220 mm in 2 to 3 years. Recommendation: Given the beneficial accretion rates seen in similar adjacent projects, we suggest that the construction implementation be designed to maximize marsh sediment deposit, thus utilizing tidal marsh's natural potential to keep up with sea level rise.	Your comment is noted. Accretion rates and sediment availability will be considered during the next stages of engineering and design. We agree that the construction plan should maximize the use of tidal marsh sediment deposits and take advantage of its natural potential to keep up with sea level change.
031_EPA_2-12	Nutrients - San Francisco Bay is a nutrient-enriched estuary, but has been buffered from the potential negative consequences of elevated nutrient levels by a variety of factors. In the future, projected increases in water clarity and water temperatures will create conditions that could result in adverse impacts in the Bay as a result of high nutrient concentrations, including the potential proliferation of harmful algal species. Recommendations: Discuss, in the FEIS, the benefits of levee designs that incorporate transitional zone features, including the creation of tidal marshes, and the ability of these ecosystems to take up nutrients at a high rate. Add the following information to Table 4.5-10, entitled, "Likely Future Status of Water Quality Contaminants in the Shoreline Phase I Study Area":1. For the "Nutrients" block, add the Regional Monitoring Program's Nutrients Strategy: The San Francisco Bay Nutrient Science and Management Strategy is a regional initiative for developing the science needed for informed decisions about managing nutrient loads and maintaining beneficial uses within the Bay in response to the apparent changes in the Bay's resilience to nutrient loading.2. For the "Algae" block, add the National Coastal Condition Assessment, which will be sampling for harmful algal species in the Bay in 2015.	The Shoreline Study project will include a large amount of tidal wetland restoration, including a broadly sloped transition zone (ecotone) that will result in the expedited establishment of fringing marsh. Wetlands have long been cited as being effective at reducing nutrient loading in aquatic systems by encouraging sedimentation, taking up nutrients into plant biomass, and through enhanced denitrification. By greatly increasing the amount of tidal wetlands in the South Bay, the project will ultimately enhance the buffering ability of the Bay to offset the projected future trends in water clarity and temperature. The additional plans have been added to Table 4.5-10 as suggested by the reviewer.
031_EPA_2-13	Monitoring and Adaptive Management The DEIS includes a thorough monitoring and adaptive management plan developed based upon the 2006 South Bay Salt Pond Restoration Project (SBSPRP). EPA supports the scientific and adaptive management approach adopted by the SBSPRP to manage the phased restoration of the salt ponds, given the uncertainty that exists in the project area. We are pleased to see the same approach is being applied to the Project. However, the DEIS is unclear on who has responsibility to ensure that the monitoring and adaptive management plan is implemented. The functioning of the levee is integral to the restoration of the salt ponds, and the Corps is responsible for restoration of at least Pond A18; therefore, it appears that the Corps bears at least some responsibility for implementing the plan. Yet, it is unclear how the Corps, FWS, State and the local sponsors will share this responsibility. Recommendation: Clarify, in the FEIS, who would maintain responsibility, including financial responsibility, for implementing the monitoring and adaptive management plan and ensuring the project's success. The FEIS should clearly state which agencies/stakeholders, such as the Corps, FWS, State of California, and/or local sponsors, would take on which responsibilities throughout the fifty year life of the project.	Chapter 9 of the FEIS has been revised to clarify which agencies/stakeholders will be responsible for monitoring, adaptive management, and operation/maintenance/repair/replacement/rehabilitation of the project after construction.

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031_EPA_2-14	Artesian Slough Tide Gates and Wastewater Facility NPDES permit All action alternatives in the DEIS include constructing tide gates across Artesian Slough just downstream from the San Jose-Santa Clara Water Pollution Control Plant (Wastewater Facility) outfall. According to page 4-211 of the DEIS, these gates could be closed "in extreme storm events," but the document does not provide sufficient operational information about the tide gates beyond this vague description. We, therefore, cannot evaluate the impact this component of the project may have on water quality and the Wastewater Facility's ability to comply with its NPDES permit (permit # CA0037842). Recommendations: Provide additional information in the FEIS on operation of the Artesian Slough tide gates, including the estimated frequency of closure now and in the future, estimated duration of closure, estimated volume of water the Wastewater Facility would need to hold or otherwise discharge during gate closure, and whether or not gate closure could result in violation of the Wastewater Facility effluent limitations, receiving water limitations, or other permit conditions. Consider identifying how coordination on this project element would be accomplished should extreme storm events occur. Construction and operation of this project element would require extensive coordination with the Wastewater Facility and, possibly, the Regional Water Quality Control Board. We suggest that the FEIS identify how the Corps and local sponsors would coordinate with these entities on this component of the project.	The project team is working with the city of San Jose to analyze the configuration and operations of the proposed closure on Artesian Slough to avoid negatively impacting plant operations. The Master Response for Artesian Slough includes additional information about the proposed tide gates, but the concept level design does not include all the requested operational details requested by EPA. Detailed design is under development.
031_EPA_2-15	Air Quality General Conformity EPA's General Conformity Rule, established under Section 176(c)(4) of the Clean Air Act, provides a specific process for ensuring federal actions will conform with State Implementation Plans to achieve National Ambient Air Quality Standards. Although the DEIS states; "As the project would not result in population or employment growth there would be no conflict with, or obstruction of, air quality plans" (p. 4-460 and elsewhere), this is not the analysis required by the General Conformity Rule. The rule sets de minimis thresholds, depending on the nonattainment status of the region where a federal action will occur. The Bay Area Air Basin is designated moderate non-attainment for EPA's 1997 l-hour ozone standard. As specified in 40 CFR 93.153, the de minimis threshold for federal actions in moderate ozone nonattainment areas is 100 tons per year for NOx and VOCs. Emissions from any of the alternatives might exceed these de minimis standards. For example, under Alternative 2, emissions in 2017 are estimated as 773 lbs per day of NOx (Table 4.10-7), which converts to 141 tons per year if construction occurs over 365 days a year, or 96 tons if construction occurs over 250 days per year. If annual project emissions exceed the de minimis concentrations, the Corps/FWS are required to prepare a general conformity analysis, demonstrating conformity with the applicable State Implementation Plan by one of the methods specified in 40 CFR 93.158. Additionally, the rule requires public notice of a general conformity determination, as stated in 40 CFR 93.156. Recommendation: Determine whether annual project emissions would exceed the de minimus concentrations established for federal actions in moderate ozone attainment areas, thereby requiring a general conformity analysis. If an analysis is required, specify one of the methods provided by 40 CFR 93.158 to demonstrate conformity with the applicable State Implementation Plan. In addition, discuss public participation that may be required.	Table 4.10-7 (for alternatives 2, 4 and 5) and Table 4.10-8 (for alternative 3) report the maximum daily emissions from construction. Maximum daily emissions were estimated consistent with the Bay Area Air Quality Management District CEQA Guidelines which has thresholds of significance based on daily maximum. This is the emissions from the day within a given year with the maximum emissions based on the CalEEMod model. Other days within that year would have fewer emissions. Therefore multiplying the maximum daily emissions by the number of work days in a year drastically over- estimates annual emissions. Appendix S includes the model output for both daily and annual emissions. The maximum annual NOx and ROG for alternatives 2, 4 and 5 is 24 tons per year, and the maximum annual NOx and ROG for alternative 3 is 41 tons per year. These emissions are under the de minimis threshold for federal actions in moderate ozone nonattainment areas. This analysis has been added to Section 4.10.
031_EPA_2-16	Construction Mitigation Measures We are pleased that the DEIS includes air quality avoidance and minimization measures, such as limiting idling to a maximum of 5 minutes, limiting vehicle speeds to 15 mph, and administering traffic control (page: 4-455). Additional measures are available to further reduce air quality impacts. Recommendations: Ensure that construction vehicles use newer and cleaner construction equipment (e.g. Tier 4), or diesel particulate filters on older construction equipment. Use electricity from the grid, rather than portable diesel-powered generators, if possible.	To minimize air quality emission impacts the suggested practices were added as Avoidance and Minimization Measures for Air Quality, as follows: AMM-AIR-5 "Ensure that construction vehicles use newer and cleaner construction equipment (e.g. Tier 4), or diesel particulate filters are installed on older construction equipment." AMM-AIR-6 "Use electricity from the grid, rather than portable diesel-powered generators, where possible."

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031_EPA_2-17	Flood Protection (Executive Order 13690) On January 30,2015 President Obama issued Executive Order 13690 - Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, which amends Executive Order 11988 - Floodplain Management. Section 6(c) of Executive Order 13690 requires that, rather than basing the floodplain on the area subject to a one percent or greater chance of flooding in any given year, the floodplain be established using one of the following approaches: (1) Unless an exception is made under paragraph (2), the floodplain shall be: (i) the elevation and flood hazard area that result from using a climate-informed science approach that uses the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science. This approach will also include an emphasis on whether the action is a critical action as one of the factors to be considered when conducting the analysis; (ii) the elevation and flood hazard area that result from using the freeboard value, reached by adding an additional 2 feet to the base flood elevation for non-critical actions and by adding an additional 3 feet to the base flood elevation for critical actions; (iii) the area subject to flooding by the 0.2 percent annual chance flood; or (iv) the elevation and flood hazard area that result from using any other method identified in an update to the Federal Flood Risk Management Standards. For more information on go to: https://www.fema.gov/federal-flood-risk-management-standard-ffrms Recommendation: Clarify how Alternative 3 would meet the goals of Executive Order 13690, and discuss any changes to the project necessary to meet the stated goals. Compare the ability of Alternative 3 to to meet the goals of the EO with that of the other alternatives. For more information on go to : https://www.fema.gov/federal-flood-risk-management-standard-ffrms.	EO 13690 amends the existing EO 11988 decision making process. However, as stated in Section 3 of EO 13690, agencies are not to implement the revised process until additional input from stakeholders is solicited and final revised Implementing Guidelines are issued by the Water Resources Council. Upon issuance of final revised Implementing Guidelines, agencies will issue agency specific policies and regulations to implement the revised process. As such, analysis of how the revised policies impact current implementation of EO 11988 has yet to be done. Post Hurricane Katrina and Hurricane Sandy, the USACE incorporates best available science and data, including sea level projects and climate resilience, into our water resources project planning and design. USACE incorporates authorized levels of risk reduction, loading and factors of safety, and risk considerations beyond the criteria and options required by the Federal Flood Risk Management Standard (FFRMS). USACE complies with EO 11988 to include its 8-step decision making process and will use the FFRMS to inform our team's engineering and analysis expertise in developing flood risk management solutions once we are able to implement the revised process. Alternative 3, the USACE Locally Preferred Plan, a 15.2 levee meets the goals of EO 11988. The USACE Locally Preferred Plan or Alternative 3, represents a future 1% design based on the USACE high scenario in 2067. The design elevation of 15.2 feet NAVD88 was determined by the following: Base construction year (2017) 1% water level at Coyote Creek 10.76* Relative Sea Level Rise (1992.5** to 2067), USACE High SLR @ 2.06 mm/yr 2.59 Less observed RSLR (1992.5 to 2017) - 0.17 2067 1% water level at Coyote Creek (10.76 + 2.42) 13.18 FENA certification standard (add 2 feet freeboard) 2.00 Alt. 3 design 15.18 , say 15.20 * NAVD88 ** Midpoint of 1983 to 2001 tidal epoch Alternative 3 incorporates the best available science and data, including sea level rise projections and climate resilience, project planning and design by recommending a design base on the USACE high SLR scenario which will meet the FEMA Certification criteria of adding 2 feet to a projected 1% base flood elevation in the year 2067. Alternative 3 best meets the goals of EO 11988. However, under USACE planning and sea level change polices and guidance, Alternative 3 was not the National Economic Development (NED) plan, which was a 12.5 levee design without the ecotone. This alternative was economically viable and in the federal interest. Additional details on the analysis may be found in Appendix F.
031_EPA_2-18	The DEIS identifies a 50 year planning horizon for the project; however, the useful life of the levees could extend well beyond 50 years, if designed appropriately to accommodate expected sea level rise. Because the analysis only extends to 2067, it is not clear how the levees would perform beyond this period, especially given the expected acceleration of sea level rise. Recommendation: Discuss the level of flood protection provided by the alternate levee heights (12.5 ', 13.5', and 15.2') under each of the three sea level rise scenarios out to year 2100.	USACE ETL 100-2-1, Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation prescribes a project planning horizon of 100 years. Performance of the Alternatives against the 1% bayside water level were assessed across the range of sea level rise scenarios. The future 1% water level is uncertain, and dynamic. Alternatives 2 and 3 will provide a level of risk reduction for the 1 % bayside water level through the year 2100 under the low or observed SLR scenario. The current FEMA certification requirement of 2 feet of freeboard will also be maintained, with the 2100 1% projected bayside water level at 11.3, Alternatives 2 and 3 are above the required 1% + 2 foot of freeboard (11.3 + 2 = 13.2). Alternatives 2 and 3 will provide a level of risk reduction for the 1 % bayside water level through the year 2100 under the high SLR scenario. Both alternatives provide risk reduction against the 1% bayside water level through 2071 and 2094 where the projected 1% water level reaches the design elevations for Alternatives 2 and 3 respectively. The 2 foot FEMA certification requirement is maintained until 2033 and 2067 for Alternatives 2 and 3. Alternative 2 and all lower levee alternatives potentially would have adaptive capacity until 2079 under a high SLR scenario up to elevation 16.0 NAVD 88 which has been established as an adaptation threshold for the project. Considering this threshold, the 2 foot FEMA freeboard requirement could not be maintained past 2079 without a significant expansion of the project to include fluvial and stormwater interior drainage in the project area.
031_EPA_2-19	Species of Concern and Habitat Assessment/Valuation Transition Zone Habitat The establishment of an ecotone adjacent to the levee, as proposed in Alternative 3, can be expected to provide substantial ecological benefits, especially for special status species such as the steelhead trout, salt marsh harvest mouse, western snowy plover, california least tern, and california clapper rail, which are identified as possibly using the project site (page 2-7). The DEIS references the Tidal Marsh Recovery Plan, which states that lack of high tide refugia habitat is a threat for both salt marsh harvest mouse and California clapper rail. The Recovery Plan also identifies creation of ecotone habitat as necessary for deli sting (see specifically Sections ILb.7, ILe.7, and IILa in the Recovery Plan). The bench habitat described in Alternatives 2, 4, and 5 does not appear to provide suitable high tide refugia or buffer habitat for salt marsh harvest mouse and California clapper rail, as called for in the Recovery Plan. Page 28 of the Recovery Plan states that, "Levees generally are too steep, narrow, and weedy to be high quality high-tidal refugia for tidal marsh animals." Recommendations: In the FEIS, expand on the habitat restoration recommendations in the Recovery Plan, including the need for high tide refugia and buffer habitat, and explain how they would be supported by Alternative 3 versus the other alternatives. Describe the total width, the width minus the 15' vegetation maintenance zone, and the expected vegetative condition of unmaintained habitat for each alternative.	Text has been added to the report to address this issue in Section 4.7. See also the response to comment 027_RWQCB_2-13 for discussion of project features in relation to the Recovery Plan.

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031_EPA_2-20	Habitat Assessment The DEIS does not clearly explain how the habitat assessment/valuation was performed. Specifically, the Combined Habitat Assessment Protocols Summary in Appendix J does not sufficiently describe the action alternatives, making it difficult to assess how the habitat values ofthe different alternatives were evaluated. Further, EPA is aware that an assessment using the California Rapid Assessment Method was performed for this project, yet it is not clear how this information was used in the habitat valuation. It appears that the habitats were scored independently and then summed to provide an estimated benefit for a given alternative. The benefit of the ecotone habitat is not just the value of that habitat type alone. The greater value of this habitat is that its presence increases the value of the adjacent marsh habitat. Many species found within tidal marshes need high tide refugia, including salt marsh harvest mouse and california clapper rail. Without high tide refugia, i.e., ecotone habitat, the marsh habitat is of lower quality for these species. In addition, ecotone habitat can filter pollutants and provide a buffer between urbanized areas and the marsh, thereby increasing the overall quality and functioning of the marsh itself. Therefore, restored marsh habitat in alternatives without ecotone habitat (i.e. alternatives 2, 4, and 5). should have been given lower scores than restored marsh habitat in alternatives with ecotone habitat (i.e. preferred alternative 3). Appendix A references the 1999 Baylands Ecosystem Habitat Goals Report which "presents recommendations for the kinds, amounts, and distribution of wetlands and related habitats". We note that a technical update to the Baylands Ecosystem Habitat Goals Report is expected March 2015. Recommendations: Expand on the discussion of ecotone habitat value by incorporating habitat restoration recommendations in the Recovery Plan. If the updated Baylands Ecosystem Habitat Goals Report Technical Update is released before the FEIS is completed, the FEIS should reference ecotone habitat recommendations from this report as well. The Baylands Ecosystem Habitat Goals Report Technical Update is expected March 2015. http://www.sfbayjv.org/aboutstrategy. php The FEIS should discuss how the restored marsh habitat was valued for each alternative. The restored marsh habitat in Alternatives 2, 4, and 5 should be scored lower than that of Alternative 3 due to the lack of suitable ecotone habitat. This comparison should also identify whether the bench and or ecotone habitat will meet high tide refugia and buffer recommendations identified the Recovery Plan. Update Appendix J to include all action alternatives.	The CHAP report has been revised. However, the model could not be revised at this point due to resource limitations. Your discussion regarding high tide refugia and the ecotone is valid, and is discussed in relation to the findings of the CHAP analysis in Sections 3.6.11 and 3.6.12. However, USACE ecosystem restoration policy regarding analysis of ecosystem restoration benefits still determines the selected NER option.
031_EPA_2-21	Compensatory Mitigation The DEIS indicates that the Corps is not proposing compensatory mitigation for wetland impacts because the project will result in the eventual restoration of many hundreds of acres. However, it can take many decades for tidal marsh habitat to develop and the DEIS identifies a time lag between anticipated project impacts and successful habitat restoration. While this impact is identified as less than significant because the project will result in a net increase in wetlands in the long term, the discussion in the DEIS is not adequate to demonstrate that mitigation is not needed for the loss of wetlands in the near-term. Recommendations: The FEIS should include additional discussion of likely short-term wetland impacts and further justification for the conclusion that compensatory mitigation is not required. Specifically, the FEIS should identify the acres of wetlands likely to develop within 3-5 years after predicted construction-related impacts. This can be done by estimating the acreage that will fall within the tidal range known to support marsh vegetation. If this acreage of expected short-term wetland development is less than the acreage of wetlands fill, then the FEIS should estimate how long it will take to achieve no net loss of wetlands.	The ecotone will assist in temporal impact mitigation by establishing rapidly with tidal marshes much of the non-tidal wetland lost due to initial levee construction, and both ponds A12 and A18 will now be restored in the first phase after completion of the FRM. Approximately 54.7 acres of new vegetated marsh will be created on the ecotone and in the first phase of pond restoration (3-5 years) by using existing A12 and A18 levees as borrow sites (see the response to 027_RWQCB_2-9). This will offset the 8.8 acres of wetlands lost during levee construction.
031_EPA_2-22	Methylmercury Page 4-162 of the DEIS states that, as part of the South Bay Salt Pond Restoration Project (SBSPRP), "studies are currently underway to evaluate the long-term effects, recent data suggest that methymercury (MeHg) concentration would decrease after restoration of tidal habitat". These studies also indicate MeHg increases following levee breaches to restore tidal action to salt ponds are temporary. In addition, the South San Francisco Bay is located in a mercury (Hg)-rich environment due to historic and continuing run off from the New Almaden Quicksilver Mine. Given these conditions, management actions associated with the salt pond restoration (e.g. levee breaches) may remobilize mercury laden sediments. This remobilization of mercury could create environmental conditions that increase or decrease MeHg production and bioaccumulation. In order to continue to restore tidal wetlands, the SBSPRP monitors changes in the distribution, speciation and bioaccumulation of Hg that could be caused by project actions. Recommendations: Use the most current information from the SBSPRP to evaluate the South Bay Shoreline levee's design and construction to minimize Hg mobilization and bioaccumulation.	We agree with the commenter that construction should minimize mercury mobilization as much as possible. The Shoreline Study team's expectation is that while steps can be taken to minimize construction-related mobilization, tidal restoration will cause some scour and deposition of mercury-laden sediments through natural processes. However, the most current mercury data from the SBSP Restoration Project indicated that, in the long-run, tidal restoration is likely to minimize the biochemical process that convert mercury into methylmercury thus decreasing mercury up take into the food web.

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031_EPA_2-23	The discussion in the DEIS of the potential for increased exposure to methylmercury (MeHg) resulting from the project was focused primarily on construction-related mobilization of MeHg. The document did not discuss whether fish, birds, and invertebrates using the restored marshes would likely be exposed to higher levels of MeHg than under current conditions. Recommendations: Clarify, in the FEIS, whether fish, birds, and invertebrates using the restored marshes would likely be exposed to higher levels of MeHg than under pre-construction conditions. We recommend that the FEIS demonstrate whether restored marshes would have lower rates of MeHg production than under pre-construction conditions.	For this Integrated Document, including the FEIS, the Shoreline Study relies on the best available information on mercury dynamics in the south bay. This data is largely focused on bird eggs and fish. As discussed in "Food Web Dynamics" in the Water Quality Section 4.5 (pp. 4-132-134 of the Integrated Document), based on the currently available data, the Shoreline Study expects that in the longer-term tidal restoration will not increase mercury methylation above rates that already exist in wetlands in the south bay and opening the ponds to the tides may very likely reduce methylation rates. The SBSP Restoration Project continues to study mercury dynamics and the Shoreline Study Monitoring and Adaptive Management Plan outlines a process that integrates the Shoreline project with the science and data available from the SBSP Restoration Project to bring as much clarity as possible to the understanding of south bay mercury dynamics.
031_EPA_2-24	Aquatic Biological Resources/State Permitting The Aquatic Biological Resources (ABR) Section identifies consistency with the Recovery Plan as a significance criterion; however, the impact discussion simply states that, since the Recovery Plan does not cover aquatic species, the project will not conflict with its provisions (pag: 4-234). In addition, consistency with the Recovery Plan is not sufficiently discussed in the Terrestrial Biological Resources (TBR) Section. The Recovery Plan clearly addresses habitats covered under the proposed project, and one of the primary objectives of the project is to restore habitat for special status species addressed in the Recovery Plan (i.e. salt marsh harvest mouse and California clapper rail). The impact significance thresholds for the Aquatic and Terrestrial Biological Resources sections should also identify any conflicts with Regional Board and BCDC policies or regulations since the project would require permitting by both of these state agencies. Recommendations: Discuss project consistency with the Recovery Plan either in the Aquatic and Terrestrial Biological Resources Sections of the FEIS. This analysis should include discussion of whether the ecotone and bench habitats are consistent with the recommendations for high tide refugia and buffer habitats. Incorporate Regional Board and BCDC policy and regulation considerations in the impact analysis.	The approach of the draft and final Feasibility Study is to indicate inconsistencies with other plans as impacts in Chapter 4, and to summarize consistency with laws, regulations, and plans in Chapter 8. Text has been added in both chapters in response to this comment. Regulatory and plan information in subchapter 4.6 is noted to apply to subchapter 4.7 and is not repeated there. In some cases the reader is referred to other analyses (CZMA Consistency Determination and responses to RWQCB comments) for a discussion of consistency.

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From: Emily Renzel <marshmama2@att.net>
Sent: Monday, February 23, 2015 5:56 PM
To: BurtonEvans, Jessica L SPN; Brenda.Buxton@scc.ca.gov; Shoreline Environment SPN; MichaelMartin@valleywater.org; DeJager, William R SPN
Subject: [EXTERNAL] Comments on the Shoreline Study

Dear Ms. BurtonEvans, Mr. Martin, Ms. Buxton, and Mr. DeJager:

Thank you for the time extension and the opportunity to comment on the Shoreline Feasibility Study EIS/EIR. I certainly concur with more detailed comments provided by Eileen McLaughlin as well as the Citizens Committee to Complete the Refuge and would like to add the following comments.

The Shoreline Feasibility Study/EIS/EIR is most unwieldy. The information is provided in a manner that hinders the public's ability to provide substantive comments. Information regarding the project description, project impacts, and proposed mitigation measures are interspersed with economic analyses and rationale pertinent to the USACE, but not pertinent to the NEPA and CEQA process. As an example, plan and cross-section views of the proposed alternatives are located in different portions of the report, cross sections appearing in Chapter 3, while plan views are located later in the document. 1

The document fails to consider an alternative that would provide for future widening of the Coyote Creek floodplain, thus foreclosing future opportunities to address fluvial flood issues within the City of San Jose. 2

The project proposal is to phase mitigation for the proposed levee, with construction of bench or ecotone habitat occurring after levee construction has been completed. No mitigation measures are proposed to provide refugia for species in the period between levee construction/and habitat loss due to "restoration" activities. As an example the EIS states (page 4-295):
" Loss of SMHM and salt marsh wandering shrew habitat due to construction of the FRM levees would be significant absent the provision for the expansion of restored tidal marsh 3
the FRM levees promotes in adjacent ponds. The project would provide high-quality habitat, which would benefit not only these species but other wetland species.

Tidal marsh habitat created through Pond A18 ecosystem restoration would provide more habitat for these species than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of habitat. Although the tidal marsh habitat would not be established immediately,

this impact is not considered significant since the project would not result in a net loss of habitat over time." [emphasis added]

The mitigation measure provided do not adequately reduce the significant adverse impacts of the proposed project on federally listed species to a "less than significant" level because the mitigation measures do not adequately provide for mitigation of impacts in the interim between construction impacts and habitat establishment.

The document should also clarify in a concise statement exactly what mitigation components the Corps assumes full responsibility for. Right now cost-shares are mentioned and the Corps has also stated that those cost shares do not extend beyond 10 years after mitigation elements are initiated. What if there are problems? Is USFWS left holding the bag??? 4

Sincerely,
Emily M. Renzel, Coordinator
Baylands Conservation Committee
1056 Forest Avenue
Palo Alto, CA 94301
<marshmama2@att.net>

ID	Issue Text	Response Text
032_BCC_2-1	The Shoreline Feasibility Study/EIS/EIR is most unwieldy. The information is provided in a manner that hinders the public's ability to provide substantive comments. Information regarding the project description, project impacts, and proposed mitigation measures are interspersed with economic analyses and rationale pertinent to the USACE, but not pertinent to the NEPA and CEQA process. As an example, plan and cross-section views of the proposed alternatives are located in different portions of the report, cross sections appearing in Chapter 3, while plan views are located later in the document.	The USACE's Planning Modernization initiative under its Civil Works Transformation program requires the USACE to develop integrated feasibility reports and NEPA documents. Integrated documents have also been required by USACE South Pacific Division policy since 2010. In order to improve the readability and navigability of the integrated document, the Final Feasibility Study includes an annotated table of contents that provides an overview of the information included in each chapter, and indicates where to find information pertaining to the USACE planning process and NEPA/CEQA process.
032_BCC_2-2	The document fails to consider an alternative that would provide for future widening of the Coyote Creek floodplain, thus foreclosing future opportunities to address fluvial flood issues within the City of San Jose.	See Master Response regarding Coyote Creek Levee Alignment
032_BCC_2-3	The project proposal is to phase mitigation for the proposed levee, with construction of bench or ecotone habitat occurring after levee construction has been completed. No mitigation measures are proposed to provide refugia for species in the period between levee construction/and habitat loss due to "restoration" activities. As an example the EIS states (page 4-295): " Loss of SMHM and salt marsh wandering shrew habitat due to construction of the FRM levees would be significant absent the provision for the expansion of restored tidal marsh the FRM levees promotes in adjacent ponds. The project would provide high-quality habitat, which would benefit not only these species but other wetland species. Tidal marsh habitat created through Pond A18 ecosystem restoration would provide more habitat for these species than what would be lost as a result of the levee construction activity habitat impacts. The project, then, would "self-mitigate" for impacts related to the loss of habitat. Although the tidal marsh habitat would not be established immediately, this impact is not considered significant since the project would not result in a net loss of habitat over time." [emphasis added] The mitigation measure provided do not adequately reduce the significant adverse impacts of the proposed project on federally listed species to a "less than significant" level because the mitigation measures do not adequately provide for mitigation of impacts in the interim between construction impacts and habitat establishment.	To jumpstart the restoration of tidal marsh, the Project will now open both Ponds A12 and A18 to tides in the first phase of restoration immediately after the construction of the FRM. The ecotone in these ponds will quickly develop tidal marsh on its own in the tidal zone. The portion of the ecotone at the elevation of upper marsh and marsh-upland transition will be planted to accelerate refugia habitat formation. This is expected to create approximately 46 acres of marsh habitat within a year of breaching. The outboard levees of these ponds will be lowered to approximately MHHW as the ponds are breached. This lowered levee surface would be quickly colonized by pickleweed as is expected to provide another 18 acres of habitat. These 64 acres of tidal marsh will provide important habitat and connectivity while the ponds accumulate sediment necessary to transform to a full tidal marsh.
032_BCC_2-4	The document should also clarify in a concise statement exactly what mitigation components the Corps assumes full responsibility for. Right now cost-shares are mentioned and the Corps has also stated that those cost shares do not extend beyond 10 years after mitigation elements are initiated. What if there are problems? Is USFWS left holding the bag???	The USACE signed implementation guidance for WRRDA 2014, Section 1025 on 26 February 2015, which allows it to recommend a USACE project that includes the implementation of ecosystem restoration on USFWS lands. The Final EIS will be revised to reflect this guidance, and explain the implementation responsibilities of the Federal and non-Federal entities, including schedule, cost/funding, construction, monitoring and adaptive management, and operation and maintenance. This information will be provided in Chapter 9 and summarized in the Executive Summary. The report will recommend USACE cost sharing of the tidal restoration of Ponds A9-15 and A18, but not the ecotone.

From: Patin, Reanna@Wildlife <Reanna.Patin@wildlife.ca.gov>
Sent: Monday, February 02, 2015 4:33 PM
To: michael.martin@valleywater.org
Cc: joseph_terry@fws.gov; mil; Shoreline Environment SPN; Glendening, Susan@Waterboards; Schane, Tami@Wildlife; Blinn, Brenda@Wildlife

Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase I Study SCH#2006012020
Attachments: South San Francisco Bay Shoreline Phase I Study SCH#2006012020-Martin-SCHANE020215.pdf

Mr. Martin,

Please see the attached letter. Original to follow.

Thank you,

Reanna Patin
Habitat Conservation Secretary
Bay Delta Region
California Department of Fish and Wildlife
7329 Silverado Trail
Napa, CA 94558
Phone: (707) 944-5566

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

February 2, 2015

Mr. Michael Martin
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118
Michael.Martin@valleywater.org

Dear Mr. Martin:

Subject: South San Francisco Bay Shoreline Phase I Study, Draft Interim Feasibility Report and Environmental Impact Statement/Report, SCH #2006012020, Santa Clara County

The California Department of Fish and Wildlife (CDFW) has reviewed the draft Interim Feasibility Report and Environmental Impact Statement/Report (EIS/EIR) for the South San Francisco Bay Shoreline Phase I Study (Project), for which the U.S. Army Corps of Engineers (USACE) and U.S. Fish and Wildlife Service (USFWS) are acting as co-Lead Agencies under the National Environmental Policy Act (NEPA), and for which the Santa Clara Valley Water District (SCVWD) is acting as the Lead Agency under the California Environmental Quality Act (CEQA). The document was received in our office on December 22, 2014.

CDFW is a Trustee Agency pursuant to CEQA Section 15386 with responsibility under CEQA for commenting on projects that could affect biological resources. As trustee for the State's fish and wildlife resources, CDFW has jurisdiction over the conservation, protection, and management of the fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species for the benefit and use by the people of California. CDFW also acts as a Responsible Agency pursuant to CEQA Section 15381 if a project requires discretionary approval, such as issuance of a California Endangered Species Act (CESA) Permit (Fish and Game Code Section 2080 et seq.), or Lake and Streambed Alteration Agreement (LSAA) (Fish and Game Code Section 1600 et seq.). CDFW is submitting comments on the draft EIS/EIR as a means to inform SCVWD of our concerns regarding sensitive resources which could potentially be affected by the Project.

Project Description

The proposed Project study area is located between Alviso Slough/Guadalupe River and Coyote Creek, in Santa Clara County. The proposed Project area includes the Water Pollution Control Plant (WPCP), now called the San Jose-Santa Clara Regional Wastewater Facility, and the Community of Alviso, as well as the portions of the Alviso Pond Complex containing Ponds A9-A15 and A18. Portions of the Project are located on the Don Edwards San Francisco Bay National Wildlife Refuge managed by USFWS.

The purpose of the proposed Project is to address the risk to urbanized infrastructure, including transportation corridors, wastewater treatment plants, and the Community of Alviso and surrounding areas along the shoreline that are subject to flooding caused by having large areas of low-lying terrain bordered by severely degraded non-engineered dikes that were originally

Mr. Michael Martin
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designed and constructed for commercial salt ponds. Components of the proposed Project include an Alviso North levee alignment, a WPCP South levee alignment, a 30:1 ecotone adjacent to Ponds A12, A13, and A18, and a tidal flood gate at Artesian Slough.

The draft EIS/EIR describes the roles and responsibilities of the federal and non-federal agencies involved in the Project, in terms of NEPA, CEQA, and compliance with other environmental laws. However, due to uncertainties associated with the pending approval of the Water Resources Reform and Development Act (WRRDA) of 2014 and language in Section 1025 Implementation Guidance regarding restoration activities on federal lands, it is unclear (as of the release of this draft EIS/EIR in December 2014), as to which of the federal and non-federal agencies will fund and implement the planning, design, and construction of various elements of the Project.

Biological Resources

The draft EIS/EIR has identified a variety of biotic habitats located both within and in the vicinity of the Project, including tidal open water, mudflat, ponds [including legacy ponds (former sewage ponds that are no longer used and have reverted to wetlands), sewage treatment ponds, circulation ponds and high-salinity batch ponds], tidal and non-tidal salt marsh, brackish marsh, muted tidal/diked marsh, freshwater marsh, seasonal wetland, riparian/creek corridor, upland and levee, as well as developed and landfill areas.

The proposed Project area is known to support a variety of fish and wildlife species, including the state fully protected (pursuant to Fish and Game Code Section 3511) salt marsh harvest mouse (*Reithrodontomys raviventris raviventris*), American peregrine falcon (*Falco peregrinus anatum*), California black rail (*Laterallus jamaicensis coturniculus*), California brown pelican (*Pelecanus occidentalis californicus*), California Ridgway's rail (*R. obsoletus obsoletus*), California least tern (*Sterna antillarum browni*), golden eagle (*Aquila chrysaetos*), and white-tailed kite (*Elanus caeruleus*); the state candidate (currently under emergency listing as an endangered species) tricolored blackbird (*Agelaius tricolor*); the state threatened longfin smelt (*Spirinchus thaleichthys*); the federally threatened Central California Coast steelhead (*Oncorhynchus mykiss*) and green sturgeon (*Acipenser medirostris*); the federally threatened and state species of special concern western snowy plover (*Charadrius alexandrinus nivosus*); and the state species of special concern Central Valley fall-run/late fall-run Chinook salmon (*O. tshawytscha*), Alameda song sparrow (*Melospiza melodia* pusillula), American white pelican (*P. erythrorhnchos*), ashy storm petrel (*Oceanodroma homochroa*), black tern (*Chlidonias niger*), Bryant's savannah sparrow (*Passerculus sandwichensis alaudinus*), California yellow warbler (*Dendroica petechia brewsteri*), common loon (*Gavia immer*), grasshopper sparrow (*Ammodramus savannarum*), Least bittern (*Ixobrychus exilis*), loggerhead shrike (*Lanius ludovicianus*), northern harrier (*Circus cyaneus*), purple martin (*Progne subis*), redhead (*Aythya Americana*), San Francisco common yellowthroat (*Geothlypis trichas sinuosa*), Vaux's swift (*Chaetura vauxi*), western burrowing owl (*Athene cunicularia hypugea*), and yellow rail (*Coturnicops noveboracensis*).

The proposed Project area has the potential to support the state species of special concern salt marsh wandering shrew (*Sorex vagrans halicoetes*), Barrow's goldeneye (*Bucephala islandica*), black skimmer (*Rynchops niger*), and short-eared owl (*Asio flammeus*); and the state fully protected bald eagle (*Haliaeetus leucocephalus*). The proposed Project area is known to

Mr. Michael Martin
February 2, 2015
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support a few plant species listed under the California Native Plant Society's California Rare Plant Rank (CRPR) system, including Congdon's tarplant (*Centromadia parryi* ssp. *congdoni*), small spikerush (*Eleocharis parvula*), and Hall's bush-mallow (*Malacothamnus halli*).

Longfin Smelt: The draft EIS/EIR states that in-water construction activities, including outboard levee breaches and pilot channel excavation, would be conducted between June 1 and November 30, and that there is a potential for out-drifting longfin smelt larvae to be present in aquatic portions of the Project area during the early portion of that instream work window. The document also states that excavation of the pilot channel could potentially entrain longfin smelt larvae, juveniles, and adults, resulting in mortality. The draft EIS/EIR also discusses other types of impacts that could result from the Project, including possible temporary displacement of aquatic species from occupied habitats, modification of water temperatures and dissolved oxygen levels resulting from the temporary increased sedimentation and turbidity levels that may occur during Project construction, as well as the temporary reduction of prey resources and increases in post-breach salinities. Please be advised that any activities that may result in take of a state-listed species are subject to Section 2081 of the Fish and Game Code. Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill". Therefore, CDFW recommends that the document be revised to state that the Project proponent will consult with CDFW and submit an application for a 2081(b) Incidental Take Permit if needed for activities that may result in take of longfin smelt and any other CESA-listed species. 1

Salt Marsh Harvest Mouse: The draft EIS/EIR states that activities such as the removal of vegetation that salt marsh harvest mouse uses for cover, the direct mortality from construction equipment, and earth movement activities could all result in impacts to salt marsh harvest mouse individuals. The document states that on federal lands (in this case, the USFWS Refuge), salt marsh harvest mouse may be captured and relocated, based on provisions of the USFWS' (not yet finalized) Biological Opinion and coordination with the USFWS Ecological Services office. The document also acknowledges the state fully protected status of this species and states that capture and relocation of this species would not be allowed in areas not under federal ownership. CDFW recommends that the document be revised to ensure that take of the salt marsh harvest mouse, as a fully protected species, is avoided pursuant to Section 4700 of the Fish and Game Code throughout the Project area. 2

For example, a portion of mitigation measure M-TBR-2a describes a method which would be implemented in areas not under federal ownership, to address the manual removal of vegetation on a gradual and progressive basis, such that the advancing front of vegetation removal would move toward vegetation that would not be disturbed. This method, if implemented correctly, would allow individual salt marsh harvest mice to relocate themselves to adjacent vegetation as they seek shelter, and avoid take as defined under Section 86 of the Fish and Game Code. CDFW recommends use of this measure in all areas (both federal land and non-federal land) of the Project containing habitat suitable for salt marsh harvest mouse to avoid the potential for take of this fully protected species.

Burrowing Owl: To address potential impacts to burrowing owl, the draft EIS/EIR states that mitigation measure M-TBR-2d would be implemented. M-TBR-2d refers to survey protocols described in the California Burrowing Owl Consortium's Burrowing Owl Survey and Mitigation Guidelines (1993) and passive relocation. CDFW recommends that effective burrowing owl 3

Mr. Michael Martin
February 2, 2015
Page 4

avoidance, minimization, and mitigation measures consistent with the Santa Clara Valley Habitat Plan/Natural Communities Conservation Plan (Habitat Plan) be included in the EIR/EIS. The EIR/EIS should specify that take of burrowing owl will be avoided, and include appropriate and effective minimization measures based on the best available science that are consistent with Appendix M of the Habitat Plan. Please be advised that CDFW cannot authorize owl relocation, including passive eviction, and that this activity is not permissible under the Burrowing Owl Conservation Strategy (except under a specific exception pertaining to a positive growth trend in the burrowing owl population, as described in Chapter 6 of the Habitat Plan). CDFW recommends that the section in the draft EIS/EIR addressing burrowing owl be revised to be consistent with Appendix M of the Habitat Plan.

CDFW appreciates the opportunity to comment on the USACE/USFWS/SCVWD's Draft Interim Feasibility Report and Environmental Impact Statement/Report (EIS/EIR) for the South San Francisco Bay Shoreline Phase I Study Project. CDFW staff is available to meet with you to further clarify our comments and provide technical assistance on any changes necessary to protect resources. If you have any questions, please contact Ms. Tami Schane, Environmental Scientist, at (415) 831-4640 or tami.schane@wildlife.ca.gov; or Ms. Brenda Blinn, Senior Environmental Scientist (Supervisory), at (707) 944-5541, or brenda.blinn@wildlife.ca.gov.

Sincerely,

Scott Wilson
Regional Manager
Bay Delta Region

cc: State Clearinghouse

Mr. Joseph Terry
U.S. Fish and Wildlife Service
Joseph_terry@fws.gov

Mr. William DeJager
U.S. Army Corps of Engineers
William.R.DeJaer@usace.army.mil
ShorelineEnvironment@usace.army.mil

Ms. Susan Glendening
San Francisco Regional Water Quality Control Board
SGlendening@waterboards.ca.gov

ID	Issue Text	Response Text
033_CDFW-1	Longfin Smelt: The draft EIS/EIR states that in-water construction activities, including outboard levee breaches and pilot channel excavation, would be conducted between June 1 and November 30, and that there is a potential for out-drifting longfin smelt larvae to be present in aquatic portions of the Project area during the early portion of that instream work window. The document also states that excavation of the pilot channel could potentially entrain longfin smelt larvae, juveniles, and adults, resulting in mortality. The draft EIS/EIR also discusses other types of impacts that could result from the Project, including possible temporary displacement of aquatic species from occupied habitats, modification of water temperatures and dissolved oxygen levels resulting from the temporary increased sedimentation and turbidity levels that may occur during Project construction, as well as the temporary reduction of prey resources and increases in post-breach salinities. Please be advised that any activities that may result in take of a state-listed species are subject to Section 2081 of the Fish and Game Code. Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill". Therefore, CDFW recommends that the document be revised to state that the Project proponent will consult with CDFW and submit an application for a 2081(b) Incidental Take Permit if needed for activities that may result in take of longfin smelt and any other CESA-listed species.	The project proponents recognize that the project may result in 'take' of the state listed longfin smelt. A number of Avoidance and Minimization Measures are incorporated into the project to avoid impacts to longfin smelt, including seasonal restrictions, working at low tide, and sediment control. The project proponents will consult with the Department of Fish and Wildlife and submit an application for an Incidental Take Permit prior to construction if necessary.
033_CDFW-2	Salt Marsh Harvest Mouse: The draft EIS/EIR states that activities such as the removal of vegetation that salt marsh harvest mouse uses for cover, the direct mortality from construction equipment, and earth movement activities could all result in impacts to salt marsh harvest mouse individuals. The document states that on federal lands (in this case, the USFWS Refuge), salt marsh harvest mouse may be captured and relocated, based on provisions of the USFWS' (not yet finalized) Biological Opinion and coordination with the USFWS Ecological Services office. The document also acknowledges the state fully protected status of this species and states that capture and relocation of this species would not be allowed in areas not under federal ownership. CDFW recommends that the document be revised to ensure that take of the salt marsh harvest mouse, as a fully protected species, is avoided pursuant to Section 4700 of the Fish and Game Code throughout the Project area. For example, a portion of mitigation measure M-TBR-2a describes a method which would be implemented in areas not under federal ownership, to address the manual removal of vegetation on a gradual and progressive basis, such that the advancing front of vegetation removal would move toward vegetation that would not be disturbed. This method, if implemented correctly, would allow individual salt marsh harvest mice to relocate themselves to adjacent vegetation as they seek shelter, and avoid take as defined under Section 86 of the Fish and Game Code. CDFW recommends use of this measure in all areas (both federal land and non-federal land) of the Project containing habitat suitable for salt marsh harvest mouse to avoid the potential for take of this fully protected species.	The method of vegetation removal described in M-TBR-2a is required for both federal and non-federal lands to avoid impacts to SMHM. The document has been updated to separate this requirement from the provision that mice be moved on Federal lands based on provisions of the USFWS' Biological Opinion and in coordination with the USFWS Ecological Services office, should mice be found within the impact footprint on Refuge land, and do not move on their own to vegetated areas outside the impact footprint
033_CDFW-3	Burrowing Owl: To address potential impacts to burrowing owl, the draft EIS/EIR states that mitigation measure M-TBR-2d would be implemented. M-TBR-2d refers to survey protocols described in the California Burrowing Owl Consortium's Burrowing Owl Survey and Mitigation Guidelines (1993) and passive relocation. CDFW recommends that effective burrowing owl avoidance, minimization, and mitigation measures consistent with the Santa Clara Valley Habitat Plan/Natural Communities Conservation Plan (Habitat Plan) be included in the EIR/EIS. The EIR/EIS should specify that take of burrowing owl will be avoided, and include appropriate and effective minimization measures based on the best available science that are consistent with Appendix M of the Habitat Plan. Please be advised that CDFW cannot authorize owl relocation, including passive eviction, and that this activity is not permissible under the Burrowing Owl Conservation Strategy (except under a specific exception pertaining to a positive growth trend in the burrowing owl population, as described in Chapter 6 of the Habitat Plan). CDFW recommends that the section in the draft EIS/EIR addressing burrowing owl be revised to be consistent with Appendix M of the Habitat Plan.	The measure has been re-written so that if active burrows are discovered, a buffer will be established around the burrow until the young have fledged. Provisions for relocation and passive eviction have been eliminated. Rodent abatement is envisioned to be limited to the footprint of the levee prism and not exceed significantly (> 35 feet) onto the ecotone. A final decision has not been developed for rodent abatement. The leading strategy discussed has been buried stone (or other obstruction) in the face of the levee slope to prevent substantial burrowing. This type of strategy will be further developed and optimized during the design period. Trap and relocation, as well as, poison bait stations are not considered viable alternatives consistent with the Valley Plan's Burrowing Owl Conservation Strategy.

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DAVE CORTESE
PRESIDENT, BOARD OF SUPERVISORS
COUNTY OF SANTA CLARA SUPERVISOR, THIRD DISTRICT
COUNTY GOVERNMENT CENTER, EAST WING
70 WEST HEDDING STREET, 10TH FLOOR
SAN JOSE, CALIFORNIA 95110
TEL: (408) 299-5030 FAX: (408) 298-6637
dave.cortese@bos.sccgov.org • www.supervisorcortese.org

February 19, 2015

Bill DeJager
San Francisco District
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103-1398

Dear Bill,

It has been a great reassurance that the USACE committed to assessing San Francisco Bay's first Shoreline levee in Santa Clara County. A number of our communities and commercial areas near the Bay already suffer repeated, substantial impacts from fluvial flooding and face future flood threat from rising seas.

The County's history of fluvial flooding makes the Draft EIR/EIS document worthy of scrutiny. It seems that the document does not discuss nor include any alternative that considers plans of the City of San Jose for the biosolids ponds/drying beds under its Regional Wastewater Facility Master Plan. One viable option of those plans would improve drainage for the watersheds of both Coyote and Lower Penitencia Creeks by converting the ponds/beds into a floodplain, possibly 1/3 of a mile wide, draining both creeks. That flow would drain to the Bay through Pond A18 which the Draft EIR/EIS proposes for habitat restoration and breaching. 1

It is relevant that the EIR/EIS include discussion of the Regional Wastewater Facility Master Plan and that there be an alternative provided that depicts a levee alignment that would provide the needed floodplain.

The EIR/EIS also proposes a tidal gate on Artesian Slough, which is also the outflow for the wastewater facility at some 100 M gal/day. Please provide more information on how the gate operates and will permit outflow during extreme tide events (and not backup into Alviso) and how it will alter the hydraulic and habitat conditions of the slough which also borders the Don Edwards National Wildlife Refuge. 2

I request that the USACE address the concerns raised here in the EIR/EIS.

Sincerely,

Dave Cortese
President, Board of Supervisors

ID	Issue Text	Response Text
034_Cortese-1	The County's history of fluvial flooding makes the Draft EIR/EIS document worthy of scrutiny. It seems that the document does not discuss nor include any alternative that considers plans of the City of San Jose for the biosolids ponds/drying beds under its Regional Wastewater Facility Master Plan. One viable option of those plans would improve drainage for the watersheds of both Coyote and Lower Penitencia Creeks by converting the ponds/beds into a floodplain, possibly 1/3 of a mile wide, draining both creeks. The flow would drain to the Bay through Pond A18 which the Draft EIR/EIS proposes for habitat restoration and breaching. It is relevant that the EIR/EIS include discussion of the Regional Wastewater Facility Master Plan and that there be an alternative provided that depicts a levee alignment that would provide the needed floodplain.	The Shoreline Study addresses coastal flooding in the Alviso area between Coyote Creek and Guadalupe River/Alviso Slough. Fluvial flooding has already been addressed by the Santa Clara Valley Water District's flood protection projects on Coyote Creek and Guadalupe River and for this reason is not a project objective of this study. The Shoreline planning team worked closely with the City of San Jose staff to consider the Regional Wastewater Facility's current and future needs, in particular the facility's use of the biosolids or sludge lagoons for its plant operations. One levee alignment considered earlier in the planning process cut across the drying beds and would have tied into the existing Coyote Creek flood protection levee further upstream – an alignment similar to one described in the comment. However, as described in the Master Response to the Coyote Creek Levee Alignment, this eastern terminus alignment was not carried forward as a feasible alternative for consideration in the Draft EIS/R because based on the Master Plan for the San Jose-Santa Clara Regional Wastewater Facility the City's current plan is to retain the existing sludge lagoons for their drying operations.
034_Cortese-2	The EIR/EIS also proposes a tidal gate on Artesian Slough, which is also the outflow for the wastewater facility at some 100M gal/day. Please provide more information on how the gate operates and will permit outflow during extreme tide events (and not backup into Alviso) and how it will alter the hydraulic and habitat conditions of the slough which also borders the Don Edwards National Wildlife Refuge.	The project team is continuing to analyze the configuration and operations of the proposed closure on Artesian Slough to avoid negatively impacting plant operations. Backwater effects occurring during a higher water event (approximately 4 hours) are very unlikely to exhaust the Regional Wastewater Facility's existing storage in the wet weather retention basin (approximately 8 million gallons) and lead to substantial flooding in the project area. Additional information about the tide gate can be found in the Master Response for Artesian Slough.

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San Francisco Bay Wildlife Society

http://www.sfbws.com/

February 20, 2015

Bill DeJager, USACE,
1455 Market St.,
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

RE: *South San Francisco Bay Shoreline Study draft feasibility study and environmental impact statement/report*

Dear Mr. DeJager,

The *San Francisco Bay Wildlife Society* (SFBWS) is a long-term Cooperating Association (soon to be a Friends group) in partnership with and support of the San Francisco Bay National Wildlife Refuge Complex. SFBWS is a 501 (c)(3) organization incorporated July 30, 1987, over 25 years ago.

In this letter, the SFBWS wishes to assert its support of the Locally Preferred Plan as stated on page S-50 of the Main Report, as captured below:

> **Locally Preferred Plan (LPP) Details**: The LPP (Figure S-10) differs from the Tentative NED/NER Plan with respect to two features: 1) the levee is higher (15.2 feet for LPP versus the Tentative 13.5 feet for the NED/NER Plan) and 2) the LPP includes an ecotone for Ponds A12/A13 and A18 while the NED/NER Plan includes a bench. Under current policy (pending WRRDA 2014, Section 1025 Implementation Guidance regarding restoration activities on USFWS lands), USACE is limited to implementing restoration within Pond A18 with ecotone adjacent to Pond A18. Ponds A9-15 are recommended for USFWS implementation at this time.

In particular, the ecotone addition for the Ponds A12/13 and A18 would be a boon to wildlife overall and in particular protected species, helping the south bay wetlands move back to where they need to be. As seen in other large flood events throughout the world, this ecotone area can provide additional benefits for Problem 3 (REF: S.8.3 on page S-11): 1

> …Adding this feature beyond the proposed bench in the Tentative NED/NER Plan would benefit the recovery of protected wetland species and help to restore ecological functions. In addition, a large ecotone will buffer maintenance actions that are necessary on the adjacent flood risk management levee. (Main Report, S-51).

Also the ecotone can mitigate Problems 1 and 2 (REF: S.8.1, pages S-8&-9; S.8.2, pages S-10 &-11):

> …Over the short term, the ecotone would dissipate the energy encountered by the proposed levee from large storms by increasing the run-up distance for waves. Native grasses and other non-woody vegetation on the ecotone along the bay side of the levee slopes would add to the wave attenuation effect of the transition zones. (Main Report, S-52).

Thank you for consideration of these comments during the public comment period. Let me know if you have questions.

Respectfully submitted,

(electronic signature on file)

Cecilia (Ceal) D. Craig, PhD

San Francisco Bay Wildlife Society, BOD President
Ceal.Craig@SFBWS.com
(408) 828 2643

cc. City of San Jose: Emy Mendoza
FWS: Anne Morkill, Melisa Amato, Jennifer Heroux
SFBWS BOD

ID	Issue Text	Response Text
035_SFBWS-1	In this letter, the SFBWS wishes to assert its support of the Locally Preferred Plan as stated on page S-50 of the Main Report, as captured below:Locally Preferred Plan (LPP) Details: The LPP (Figure S-10) differs from the Tentative NED/NER Plan with respect to two features: 1) the levee is higher (15.2 feet for LPP versus the Tentative 13.5 feet for the NED/NER Plan) and 2) the LPP includes an ecotone for Ponds A12/A13 and A18 while the NED/NER Plan includes a bench. Under current policy (pending WRRDA 2014, Section 1025 Implementation Guidance regarding restoration activities on USFWS lands), USACE is limited to implementing restoration within Pond A18 with ecotoneadjacent to Pond A18. Ponds A9-15 are recommended for USFWS implementation at this time.In particular, the ecotone addition for the Ponds A12/13 and A18 would be a boon to wildlife overall and in particular protected species, helping the south bay wetlands move back to where they need to be. As seen in other large flood events throughout the world, this ecotone area can provide additional benefits for Problem 3 (REF: S.8.3 on page S-11):…Adding this feature beyond the proposed bench in the Tentative NED/NER Plan would benefit the recovery of protected wetland species and help to restore ecological functions. In addition, a large ecotone will buffer maintenance actions that are necessary on the adjacent flood risk management levee. (Main Report, S-51).Also the ecotone can mitigate Problems 1 and 2 (REF: S.8.1, pages S-8&-9; S.8.2, pages S-10 &-11):…Over the short term, the ecotone would dissipate the energy encountered by the proposed levee from large storms by increasing the run-up distance for waves. Native grasses and other non-woody vegetation on the ecotone along the bay side of the levee slopes would add to the wave attenuation effect of the transition zones. (Main Report, S-52).	Your support of the Locally Preferred Plan (in particular, the ecotone addition) is acknowledged and we thank you for your input.

1580

From: Matt Leddy <mtleddy@sbcglobal.net>
Sent: Friday, February 20, 2015 11:55 AM
To: Shoreline Environment SPN

Cc: Anne Morkill; Brenda.Buxton@scc.ca.gov; MichaelMartin@valleywater.org; Florence LaRiviere
Subject: [EXTERNAL] Comments on Shoreline Phase 1 Project
Attachments: Shoreline Phase 1 draft EIR_EIS comments_M Leddy.docx

Dear Mr. DeJager:

Attached please find comments I am submitting on the Shoreline Phase 1 Project Draft Feasibility Report and Draft EIS/EIR.
A confirmation that my letter has been received would be appreciated.

Thank you,
Matthew Leddy

February 20, 2015

Bill DeJager
USACE
1455 Market Street
San Francisco, CA 94103
ShorelineEnvironment@usace.army.mil

RE: Comments on the San Francisco Bay Shoreline Phase 1 Project Draft Integrated Feasibility Report and Draft Environmental Impact Statement/Environmental Impact Report

Dear Mr. DeJager:

Thank you for the opportunity to provide comments on the Shoreline Phase 1 Project Draft Feasibility Report (FR), and Draft Environmental Impact Statement/Report (EIS/EIR). I appreciate the recent action taken by your agency to extend the period for public review and comment on these important documents.

The South San Francisco Bay Shoreline Phase 1 Project would provide flood protection for Alviso and the San Jose Water Pollution Control Plant, ecosystem restoration on approximately 3,000 acres of former salt ponds and create public trails. My comments will focus on the proposed ecosystem restoration component of the project, and more specifically, on the elements of the FR and EIS/EIR that pertain to provision of high-tide shorebird roosting habitat.

The EIS/EIR findings of the project's potential effects on large and small shorebirds are unclear. On the one hand, the project is not expected to affect large shorebirds (Pg. 4-18) nor limit small shorebird populations (pg. 4-371). On the other hand, the report states that cumulative impacts could affect "some species of shorebirds" as well as pond specialists (pg. 5-12), and that, " ...the potential reduction of areas where shorebirds can congregate at high tide could result in increased predation, possibly increased susceptibility to disease, and increased disturbance by predators and humans (and associated increases in energy expenditure)." (pg. 4-371). 1

It seems prudent at this time when salt pond restoration in the South Bay is between project phases (SBSPRP Phase I and Shoreline Phase I) to include additional measures in the Draft EIR/EIS that could minimize the impacts the Shoreline Phase I project may have on shorebird high-tide roosting habitat and population numbers in the South Bay. Evaluation now could "head off undesirable results before they reach the level of significance." (pg. 4-367). This would allow for modification of the restoration plans to mitigate adverse impacts to shorebirds prior to the implementation of the Shoreline Phase I Project. 2

The Shoreline Phase 1 Tentatively Selected Plan calls for the restoration of all eight ponds in the project area (A9-15 and A18) to tidal habitat. Two of these ponds, A9 and A14, are major shorebird roosts (SBSPRP 2007 EIR). Prior to conversion of these managed ponds to tidal habitats, the four issues listed below should be evaluated to ensure the Project will be providing adequate high-quality roosting habitat for the diversity of shorebird species utilizing the extensive mudflats nearby. 3

1)Adequacy of Pond A16 as a shorebird high-tide roost

The Phase I Report (pg. 4-367) states:

> "The SBSPRP reconfigured Pond A16, which is adjacent to the Shoreline Phase I Project, to improve water management, create nesting and roosting islands, and enhance habitat quality for pond specialists. This pond will not be altered by the Shoreline Phase I Project and is anticipated to continue to provide enhanced managed-pond habitat into the future.
>
> In addition, even if all the ponds in the project area are converted to tidal wetlands, pond specialists would have habitat in adjacent areas of the Refuge, such as NCM and Pond A16. When combined with other available habitats, such as mudflats available in the restored ponds and adjacent bay and sloughs at low tide, there still would be extensive habitat available for pond specialists in the project area, even if all the Shoreline Phase I Project ponds are converted to tidal wetlands." 4

"Pond specialists" are defined specifically as the American Avocet, Black-necked Stilt, Wilson's and Red-necked Phalaropes, Greater and Lesser Yellowlegs, and Snowy Plover (Harvey, 2005).

It is unclear if the "roosting islands" will provide critical high-tide roosting sites required by the fourteen other shorebird species found in the project area. This should be clarified in the FR/EIS/EIR. Additionally, if the Shoreline Phase I plan is considering the A16 roosting islands as potential shorebird roosting habitat, then there are two factors that should to be taken into account:

A. Pond A16 is not being reconfigured to specifically provide high-tide roosting habitat for shorebirds. The stated goal is to, "create islands for nesting birds and shallow water habitat for shorebird foraging." (SBSPRP Alternatives Final EIS/EIR, pg. 2-134). Although A16 will have shallow water for foraging which may be used as a roost during high tides, monitoring will only be focusing on foraging shorebirds and not necessarily roosting shorebird diversity and abundance. If the monitoring program is altered to evaluate high-tide roosting shorebird abundance and diversity, it may be determined that this pond would mitigate loss of this habitat in the Shoreline Phase I Project. 5

B. The successful conversion of Pond A16 may result in high-tide roosting habitat, but Pond A16 is still under construction. Implementation of the Shoreline Phase I Project should not precede the demonstrated success of Pond A16 as a high tide shorebird roost for a diversity of shorebird species. 6

C. Pond A16 and New Chicago Marsh might not accommodate the approximately 11,000 shorebirds counted in Pond A9 and the approximately 7,600 shorebirds counted in Pond A14 when those ponds are converted to tidal habitats. 7

D. If Pond A16 does not provide adequate space for shorebirds in the South Bay, the next closest designated managed pond in the SBSPRP is Pond A3W (SBSPRP Alternatives Final EIS/EIR 8

pg. 78), which is about 5 kilometers away from A16. This could add substantially to energy expenditure and exposure to predators by shorebirds in their local movement from foraging grounds to roosting areas.

2)Pond levees as shorebird high-tide roosts

Dependence on "pond dikes, islands, and other alternative habitats" for high-tide roosting shorebirds as mitigation for lost managed pond roosting habitat is mentioned and recommended in several places in the Shoreline EIS/EIR report (pgs. 4-18, 4-254 and 4-371), and justification for depending on these alternative roosting habitats is based on a report by Nils Warnock and others (Warnock et al. 2002). Figure 6 in Warnock et al. shows that only about 30% of the roosting shorebirds utilized man-made structures for roosting (dikes, roads, pilings, boardwalks etc.), with the remainder of roosting birds on pond mud (38%), islands (about 18%), and water (about 15%). In addition, only 10% of the shorebirds roosted on levees during high tide in a study conducted by SFBBO (Appendix Q of this EIR/EIS report). Warnock and Takekawa (1995), using radio-marked Western Sandpipers, found the birds on levees when the ponds were flooded, then moving into the ponds when they were drained with water < 5 cm deep. They also found a large proportion of birds in former salt ponds that were filled by rainwater. 9

Based on the information above, it appears that levees are not the preferred roosting habitat for shorebirds at high tide. Conversion of both A9 and A14 managed ponds to tidal habitats would eliminate all but the pond levee structures as roosting habitats for shorebirds. This may result in a significant loss of preferred shorebird roosting habitat. Prior to conversion of managed ponds to tidal habitats, the following should be determined:

A. What is the abundance and species composition of shorebirds currently roosting on levees compared to ponds throughout the year? Which species may be most impacted by converting managed ponds to tidal habitats?

B. Are levees preferred high tide roosting habitat, or are they being used because of a current deficiency in higher quality roosting habitats in the project area? Shorebirds roosting on levees may be more exposed to predators compared to those in ponds. Studies to determine levels of shorebird vigilance in existing pond microhabitats (mud, water, dry, levees, etc.), at high tide could help to determine if levee roosts are the same quality as other roosts within existing managed ponds. Shorebirds roosting on levees may also be subject to more stress during inclement weather compared to those roosting within pond habitats. Both of these factors should be considered prior to conversion of ponds. 10

C. Are birds on the top of the levees, or on the sides along the water's edge? It may not be the levee per se that the birds are using, but rather the shallow water along the levee edge. This could have implications for how ponds are designed for providing roosting habitat.

D. What is the abundance and species composition of shorebirds roosting on levees at night throughout the year?

3)Provisions for high tide nocturnal roosts for shorebirds

The Draft Interim Feasibility Report and Environmental Impact Statement / Report for the Shoreline Phase I Study does not take into account the nocturnal roosting requirements of shorebirds in the South Bay. The potential loss of nocturnal roosting habitat from conversion of these ponds to tidal habitats should be evaluated prior to the start of the Shoreline project.

Technology which allows researchers to track or observe birds at night has allowed biologists to learn that nocturnal roosting habitat requirements can be quite different from those utilized during the day (Conklin et al. 2007, Rogers 2003, Sanders et al. 2013). The following studies demonstrate how nocturnal roosts differ from diurnal, illustrating why the location of current nocturnal roost habitats should be determined and shorebird abundance and species composition in the various ponds be evaluated prior to converting managed ponds to tidal habitats: 11

A. As a consequence of predation pressure, birds may need to fly farther from mudflat foraging areas to nocturnal roosts than they do to daytime roosts. (Conklin et al. 2007, Rogers 2003, Sanders et al. 2013).

B. Conklin et al. (2007) studying Dunlin at Humboldt Bay found that, "At night Dunlin used fewer roosts, were more faithful to primary roosts, and moved shorter distances between successive roosts than during the day." The conversion of managed ponds to tidal habitats in this proposed project will reduce the number of areas where shorebirds can congregate at high tide (pg. 4-18), and a reduction in the number of roost sites could be more critical at night than during the day.

4)Availability of high tide shorebird roosts may limit shorebird population size

The impact of losing high-tide roost habitat on the carrying capacity of South Bay shorebird populations needs to be better understood before the A9 and A14 managed ponds are converted to tidal habitats. Loss of mudflat foraging habitat from sea level change may limit shorebird populations as mentioned in the report (pg. 4-18), but the availability of roosting sites can also limit populations of wintering shorebirds (Dias et al, 2006). Studies that connect foraging shorebirds to their roosting areas should be done prior to converting ponds to tidal habitats. The work on Western Sandpipers done by Sarah Warnock and John Takekawa (1995, 1996) are good examples. 12

In summary, since pond restoration in the Alviso area is currently between two project phases, the SBSPRP Phase I and Shoreline Phase I Project, now is the time to implement adaptive management strategies aimed at gathering new information while SBSPRP Phase 1 is in the actual process of pond restoration and before the Shoreline Phase I Project begins and pond modifications affecting shorebird high-tide roosting habitats is initiated. As stated in the Draft South San Francisco Bay Shoreline Phase I Study: 13

"Adaptive management program of both projects involves monitoring between project phases, which generates information that allows land managers to find ways to change

management measures or adjust implementation designs in order to head off undesirable results before they reach the level of significance." (pg. 4- 367).

Ensuring adequate acres of high tide diurnal and nocturnal roosting sites for the shorebirds that are using mudflats in and adjacent to the project area should be planned for in advance. Optimal roosting sites are closest to foraging mudflats, and therefore a sufficient amount of this habitat is an essential element that should be identified in initial restoration and project plans. The EIR/EIS must identify concrete measures that will be implemented in the Shoreline Phase I Project to mitigate the significant cumulative impacts to the diverse species of shorebirds foraging in the South Bay.

Thank you again for the opportunity to provide comments.

Sincerely,

Matthew Leddy

Matthew Leddy

275 D Street
Redwood City, CA 94063
mtleddy@sbcglobal.net

cc: Anne Morkill, USFWS
Brenda Buxton, California Coastal Conservancy
Michael Martin, SCVWD
Florence LaRiviere, Citizens Committee to Complete the Refuge

Literature Cited:

Conklin, J.R., Mark A. Colwell and D.B. Lank. 2007. Diurnal and Nocturnal Roost Site Fidelity of Dunlin (*Calidris alpine pacifica*) at Humboldt Bay, California. The Auk 124: 677- 689.

Dias, M. P., J. P. Granadeiro, M. Lecoq, C. D. Santos & J. M. Palmeirim, 2006. Distance to high-tide roosts constrains the use of foraging areas by dunlins: implications for the management of estuarine wetlands. Biological Conservation 131: 446–452.

H. T. Harvey & Associates. 2005. Biology and Habitats Existing Conditions Report. Prepared for California State Coastal Conservancy, US Fish and Wildlife Service, California Fish and Wildlife Service.

Rogers, D.I. 2003. High-tide roost choice by coastal waders. Wader Study Group Bull. 100: 73-79.

Sanders, F., Spinks, M. & Magarian, T. 2013. American oystercatcher winter roosting and foraging ecology at Cape Romain, South Carolina. Wader Study Group Bull. 120(2): 128–133.

Warnock, N., G. W. Page, et al. 2002. Management and conservation of San Francisco Bay salt ponds: effects of pond salinity, area, tide, and season on Pacific Flyway waterbirds. Waterbirds 25: 79-92.

Warnock, S. and J.Y. Takekawa. 1995. Habitat preferences of wintering shorebirds in a temporally changing environment: Western Sandpipers in the San Francisco Bay estuary. The Auk 112: 920 – 930.

Warnock, S. and J.Y. Takekawa. 1996. Wintering site fidelity and movement patterns of Western Sandpipers *Calidris mauri* in the San Francisco Bay estuary. Ibis 138: 160 – 167.

ID	Issue Text	Response Text
036_Leddy_2-1	The EIS/EIR findings of the project's potential effects on large and small shorebirds are unclear. On the one hand, the project is not expected to affect large shorebirds (Pg. 4-18) nor limit small shorebird populations (pg. 4-371). On the other hand, the report states that cumulative impacts could affect "some species of shorebirds" as well as pond specialists (pg. 5-12), and that, " …the potential reduction of areas where shorebirds can congregate at high tide could result in increased predation, possibly increased susceptibility to disease, and increased disturbance by predators and humans (and associated increases in energy expenditure)." (pg. 4-371).	The findings in the EIS/EIR are consistent in regard to the potential effects on shorebirds. The discussion on page 4-18 relates to the existing conditions and 'future without project' scenarios. Even without the Shoreline project, declines in shorebird numbers are anticipated throughout San Francisco Bay due to changes in the management of ponds (or lack thereof) and mudflat loss resulting from sea level change. The discussion on pages 4-371 and 5-12 both related to the cumulative impacts of the Shoreline project together with other projects, specifically the SBSP Restoration Project and potential climate change. These sections conclude that shorebirds are likely to be able to find alternative roosting habitat with the loss of pond habitat. However the reduction of areas where shorebirds can congregate at high tide could potentially result in increased predation, susceptibility to disease, and disturbance by predators and humans. This impact is considered cumulatively significant. This impact is mitigated by the Adaptive Management Plan for the Shoreline Project and adaptive management that is part of the SBSP Restoration Project. Monitoring data on shorebirds (and other pond species) will directly influence the decisions on whether to proceed with further tidal habitat restoration in the remainder of the A9-15 pond cluster. Only Ponds A12 and A18 will be converted to tidal wetlands in the first phase of the Shoreline Study (when the flood protection levee is completed). Ponds A9 through A11 will be converted approximately five years later, and Ponds A13-15 another five years after that. This will give time to monitoring shorebird populations and their usage of the ponds to determine if there is adequate regional habitat for the later pond conversions to move forward.
036_Leddy_2-2	It seems prudent at this time when salt pond restoration in the South Bay is between project phases (SBSPRP Phase I and Shoreline Phase I) to include additional measures in the Draft EIR/EIS that could minimize the impacts the Shoreline Phase I project may have on shorebird high-tide roosting habitat and population numbers in the South Bay. Evaluation now could "head off undesirable results before they reach the level of significance." (pg. 4-367). This would allow for modification of the restoration plans to mitigate adverse impacts to shorebirds prior to the implementation of the Shoreline Phase I Project.	This is the objective of the Adaptive Management Plan for the Shoreline Project; to monitor changes to shorebird populations (and other species in the south bay) and use that data to inform later phases of restoration. This also ties into the adaptive management plan for the SBSP Restoration Project to track the regional population of species. If monitoring shows "undesirable results" from the conversation of Ponds A12 and A18 to tidal marsh, then that data can be used to alter later pond restoration of Ponds A9 through A11 (scheduled for five years later) and Ponds A13 through A15 (scheduled for ten years later).
036_Leddy_2-3	The Shoreline Phase 1 Tentatively Selected Plan calls for the restoration of all eight ponds in the project area (A9-15 and A18) to tidal habitat. Two of these ponds, A9 and A14, are major shorebird roosts (SBSPRP 2007 EIR). Prior to conversion of these managed ponds to tidalhabitats, the four issues listed below should be evaluated to ensure the Project will be providing adequate high-quality roosting habitat for the diversity of shorebird species utilizing the extensive mudflats nearby.	Only Ponds A12 and A18 will be converted to tidal wetlands in the first phase of the Shoreline Study. The conversion of subsequent ponds will be contingent upon the Shoreline Study Monitoring and Adaptive Management Plan, as well as the SBSP Restoration Project Adaptive Management Plan, to ensure adequate regional habitat for shorebirds exists before proceeding with additional breaching. Pond A9 is scheduled five years after the initial phase, and Pond A14 five years after that. These future actions will be guided by the monitoring data collected to limit adverse impacts to shorebird roosting.
036_Leddy_2-4	1) Adequacy of Pond A16 as a shorebird high-tide roost The Phase I Report (pg. 4-367) states: "The SBSPRP reconfigured Pond A16, which is adjacent to the Shoreline Phase I Project, to improve water management, create nesting and roosting islands, and enhance habitat quality for pond specialists. This pond will not be altered by the Shoreline Phase I Project and is anticipated to continue to provide enhanced managed-pond habitat into the future. In addition, even if all the ponds in the project area are converted to tidal wetlands, pond specialists would have habitat in adjacent areas of the Refuge, such as NCM and Pond A16. When combined with other available habitats, such as mudflats available in the restored ponds and adjacent bay and sloughs at low tide, there still would be extensive habitat available for pond specialists in the project area, even if all the Shoreline Phase I Project ponds are converted to tidal wetlands." "Pond specialists" are defined specifically as the American Avocet, Black-necked Stilt, Wilson's and Red-necked Phalaropes, Greater and Lesser Yellowlegs, and Snowy Plover (Harvey, 2005). It is unclear if the "roosting islands" will provide critical high-tide roosting sites required by the fourteen other shorebird species found in the project area. This should be clarified in the FR/EIS/EIR.	The efficiacy of the existing roosting islands are being monitored as part of the SBSP Restoration Project Adaptive Management Program and will also be monitored by the Shoreline Project. Changes to roosting islands could be made in the future, or incorporated into future phases, if monitor indicates that changes are needed.

1588

036_Leddy_2-5	Additionally, if the Shoreline Phase I plan is considering the A16 roosting islands as potential shorebird roosting habitat, then there are two factors that should to be taken into account: A. Pond A16 is not being reconfigured to specifically provide high-tide roosting habitat for shorebirds. The stated goal is to, "create islands for nesting birds and shallow water habitat for shorebird foraging." (SBSPRP Alternatives Final EIS/EIR, pg. 2-134). Although A16 will have shallow water for foraging which may be used as a roost during high tides, monitoring will only be focusing on foraging shorebirds and not necessarily roosting shorebird diversity and abundance. If the monitoring program is altered to evaluate high-tide roosting shorebird abundance and diversity, it may be determined that this pond would mitigate loss of this habitat in the Shoreline Phase I Project.	The SBSPR project, through USGS and San Francisco Bay Bird Observatory monitoring, looks at waterbird behavior, including roosting, in their 250m grid monitoring of the ponds. To date, there is only 1 year of data at Pond A16, but there will be a better handle on bird use at that pond in the coming years. Therefore, these data are already being collected, and it is the intent of the SBSPR Project to continue conducting those studies. This type of data will directly influence the decisions on whether to proceed with further tidal habitat restoration in the remainder of the A9-15 pond cluster, or if specific changes are needed at Pond A16.
036_Leddy_2-6	B. The successful conversion of Pond A16 may result in high-tide roosting habitat, but Pond A16 is still under construction. Implementation of the Shoreline Phase I Project should not precede the demonstrated success of Pond A16 as a high tide shorebird roost for a diversity of shorebird species.	Please see response to comment #5 above.
036_Leddy_2-7	C. Pond A16 and New Chicago Marsh might not accommodate the approximately 11,000 shorebirds counted in Pond A9 and the approximately 7,600 shorebirds counted in Pond A14 when those ponds are converted to tidal habitats.	Please see response to #3 above. The ongoing monitoring includes use of New Chicago Marsh.
036_Leddy_2-8	D. If Pond A16 does not provide adequate space for shorebirds in the South Bay, the next closest designated managed pond in the SBSPRP is Pond A3W (SBSPRP Alternatives Final EIS/EIR pg. 78), which is about 5 kilometers away from A16. This could add substantially to energy expenditure and exposure to predators by shorebirds in their local movement from foraging grounds to roosting areas.	Pond A3W is a very deep pond, and would not be managed for Shorebirds. Shorebirds are also expected to take advantage of other nature habitats in the south bay. Please refer to response #3 above.
036_Leddy_2-9	2) Pond levees as shorebird high-tide roosts Dependence on "pond dikes, islands, and other alternative habitats" for high-tide roosting shorebirds as mitigation for lost managed pond roosting habitat is mentioned and recommended in several places in the Shoreline EIS/EIR report (pgs. 4-18, 4-254 and 4-371), and justification for depending on these alternative roosting habitats is based on a report by Nils Warnock and others (Warnock et al. 2002). Figure 6 in Warnock et al. shows that only about 30% of the roosting shorebirds utilized man-made structures for roosting (dikes, roads, pilings, boardwalks etc.), with the remainder of roosting birds on pond mud (38%), islands (about 18%), and water (about 15%). In addition, only 10% of the shorebirds roosted on levees during high tide in a study conducted by SFBBO (Appendix Q of this EIR/EIS report). Warnock and Takekawa (1995), using radio-marked Western Sandpipers, found the birds on levees when the ponds were flooded, then moving into the ponds when they were drained with water < 5 cm deep. They also found a large proportion of birds in former salt ponds that were filled by rainwater. Based on the information above, it appears that levees are not the preferred roosting habitat for shorebirds at high tide. Conversion of both A9 and A14 managed ponds to tidal habitats would eliminate all but the pond levee structures as roosting habitats for shorebirds. This may result in a significant loss of preferred shorebird roosting habitat.	Levees may not be the preferred habitat for shorebirds, but can still be utilized along with other natural habitats in the south bay. The analysis determined that the Project will not have a significant impact on shorebirds; however, use of roosting habitat will be monitored as discussed in the response to comment #3 above.
036_Leddy_2-10	Prior to conversion of managed ponds to tidal habitats, the following should be determined: A. What is the abundance and species composition of shorebirds currently roosting on levees compared to ponds throughout the year? Which species may be most impacted by converting managed ponds to tidal habitats? B. Are levees preferred high tide roosting habitat, or are they being used because of a current deficiency in higher quality roosting habitats in the project area? Shorebirds roosting on levees may be more exposed to predators compared to those in ponds. Studies to determine levels of shorebird vigilance in existing pond microhabitats (mud, water, dry, levees, etc.), at high tide could help to determine if levee roosts are the same quality as other roosts within existing managed ponds. Shorebirds roosting on levees may also be subject to more stress during inclement weather compared to those roosting within pond habitats. Both of these factors should be considered prior to conversion of ponds. C. Are birds on the top of the levees, or on the sides along the water's edge? It may not be the levee per se that the birds are using, but rather the shallow water along the levee edge. This could have implications for how ponds are designed for providing roosting habitat. D. What is the abundance and species composition of shorebirds roosting on levees at night throughout the year?	Please see responses to #3 and #5 above.

1589

036_Leddy_2-11	3) Provisions for high tide nocturnal roosts for shorebirds The Draft Interim Feasibility Report and Environmental Impact Statement / Report for the Shoreline Phase I Study does not take into account the nocturnal roosting requirements of shorebirds in the South Bay. The potential loss of nocturnal roosting habitat from conversion of these ponds to tidal habitats should be evaluated prior to the start of the Shoreline project. Technology which allows researchers to track or observe birds at night has allowed biologists to learn that nocturnal roosting habitat requirements can be quite different from those utilized during the day (Conklin et al. 2007, Rogers 2003, Sanders et al. 2013). The following studies demonstrate how nocturnal roosts differ from diurnal, illustrating why the location of current nocturnal roost habitats should be determined and shorebird abundance and species composition in the various ponds be evaluated prior to converting managed ponds to tidal habitats: A. As a consequence of predation pressure, birds may need to fly farther from mudflat foraging areas to nocturnal roosts than they do to daytime roosts. (Conklin et al. 2007, Rogers 2003, Sanders et al. 2013). B. Conklin et al. (2007) studying Dunlin at Humboldt Bay found that, "At night Dunlin used fewer roosts, were more faithful to primary roosts, and moved shorter distances between successive roosts than during the day." The conversion of managed ponds to tidal habitats in this proposed project will reduce the number of areas where shorebirds can congregate at high tide (pg. 4-18), and a reduction in the number of roost sites could be more critical at night than during the day.	Little is known about the nocturnal roosting at these sites. In addition, there is also nocturnal foraging depending on the tides. See response to 3 above regarding adaptive management of future phases.
036_Leddy_2-12	4) Availability of high tide shorebird roosts may limit shorebird population size The impact of losing high-tide roost habitat on the carrying capacity of South Bay shorebird populations needs to be better understood before the A9 and A14 managed ponds are converted to tidal habitats. Loss of mudflat foraging habitat from sea level change may limit shorebird populations as mentioned in the report (pg. 4-18), but the availability of roosting sites can also limit populations of wintering shorebirds (Dias et al, 2006). Studies that connect foraging shorebirds to their roosting areas should be done prior to converting ponds to tidal habitats. The work on Western Sandpipers done by Sarah Warnock and John Takekawa (1995, 1996) are good examples.	Agreed. The Adaptive Management Plan is in place to study and address these issues. Please see response to #3 above.
036_Leddy_2-13	In summary, since pond restoration in the Alviso area is currently between two project phases, the SBSPRP Phase I and Shoreline Phase I Project, now is the time to implement adaptive management strategies aimed at gathering new information while SBSPRP Phase 1 is in the actual process of pond restoration and before the Shoreline Phase I Project begins and pond modifications affecting shorebird high-tide roosting habitats is initiated. As stated in the Draft South San Francisco Bay Shoreline Phase I Study: "Adaptive management program of both projects involves monitoring between project phases, which generates information that allows land managers to find ways to change management measures or adjust implementation designs in order to head off undesirable results before they reach the level of significance." (pg. 4- 367). Ensuring adequate acres of high tide diurnal and nocturnal roosting sites for the shorebirds that are using mudflats in and adjacent to the project area should be planned for in advance. Optimal roosting sites are closest to foraging mudflats, and therefore a sufficient amount of this habitat is an essential element that should be identified in initial restoration and project plans. The EIR/EIS must identify concrete measures that will be implemented in the Shoreline Phase I Project to mitigate the significant cumulative impacts to the diverse species of shorebirds foraging in the South Bay.	The SBSPR Project is experimenting with purposefully designed roosting areas for shorebirds at Ponds E12 and E13 in Eden Landing. These results are aimed to address the same concerns expressed by the commenter and will be part of any decision-making on further breaching and/or managed pond adjustments. The Adaptive Management Plan is the measure the project is implementing to address cumulative impacts to shorebirds in the south bay. With the implementation of the adaptive management plan changes can be made to later phases if necessary to avoid significant impacts and the cumulative impact will be reduced to a less than significant level.

1590

From: JLucas1099@aol.com 038_Lucas_5
Sent: Monday, February 23, 2015 1:06 PM
To: Shoreline Environment SPN

Subject: [EXTERNAL] South San Francisco Bay Shoreline Phase 1 Project - cont. comment (5)

Bill DeJager February 23, 2015
US Army Corps of Engineers
1455 Market Street
San Francisco, California 94103

RE: South San Francisco Bay Shoreline Phase 1 Project Draft Integrated Feasibility Report and Draft Environmental Impact Statement/Environmental Impact Report (continued comment no. 5)

Dear Bill DeJager,

To continue my comment from February 22, in regards your COE South San Francisco Bay Shoreline Phase 1 Project, would wish to question lack of survey data in DEIS/EIR on resident and migratory bird populations.

In January 28, 2015 submittal did include 'historic' 1978 San Jose-Santa Clara Water Treatment Plant EIR Figure 4-8 Endangered Species in the Baylands that mapped extent of California Clapper Rail and Least Tern nesting areas in sloughs and marshes of South Bay.

In addition, the Coyote Creek, Reach 1 A Waterbird Pond Monitoring Program Annual Report of June 1999 Through June 2000, Tables 6 and 7 documented presence of rare, endangered and locally unique birds in project area - California Brown Pelican, California Clapper Rail, Double-crested cormorant, Northern Harrier, Sharp Shinned Hawk, Cooper's Hawk, Black Shouldered Kite, Golden Eagle, Western Bluebird, California Gull, Yellow Warbler, Salt Marsh Yellowthroat; and in project area vicinity, White Pelican, Peregrine Falcon, California Black Rail, Snowy Plover, California Least Tern, Burrowing Owl and Short-eared Owl. 1

Table E 2 of this report noted Species, totals and mean number per survey observed through the July 1999 through June 2000 study period, separated by group: Shorebirds, Gulls, Waterfowl, and Other Waterbirds.

Believe updated monitoring data on species, as observed at Reach 1 A Waterbird Pond, needs to be included in DEIS/EIR for resident and migratory waterfowl using marshes, ponds and sloughs between Coyote Creek and Guadalupe River in shoreline levee project area. Is this DEIS/EIR deficiency or did I just not find data?

An accurate review of elements DEIS/EIR needs to assess re proposed project impacts on migratory and resident shorebird roosting and foraging habitat, particularly in high tide conditions, is detailed and referenced in letter from Matthew Leddy. He is long term observer of South Bay shorebirds and do support his concerns. 2

It seems questionable wisdom that proposed super levee is to obliterate South Bay marsh ecotone interface with uplands refugia and find it hard to understand how such an extent of bay fill in wildlife refuge endangered species habitat can be acceptable to San Francisco Bay Basin Plan criteria. Please substantiate regulatory rationale. 3

Do not believe that overriding public health and safety considerations can be determined to take precedence over CEQA and NEPA environmental law and guidelines in that levee design puts Alviso in greater jeopardy from depth and frequency from flood inundation than it is in at present. After 1984's (?) Coyote Creek flood it was mandated that a ring levee be constructed around Alviso but this was never successfully completed. 4

One rather critical natural constraint of shoreline levee alignment as proposed in DEIS/EIR is its siting on top of marshland that has exceptionally high artesian action. As super levee construction places extensive tons of fill on porous wetlands it is bound to cause upwelling of groundwater into Alviso homes and businesses. The extent of this super levee's impact on groundwater pressure needs hydraulic assessment in DEIS/EIR. How much further inland will Artesian Slough be artesian? Can intrusion affect Coyote Creek levee integrity? 5

Bay level rise and a doubling of water runoff in valley due to imported supplies has already affected evolution of marsh vegetation in project area. Seasonal wetlands are now permanent wetlands. Burrowing owls retreat to levees and higher ground. The Coyote Creek/Guadalupe River delta no longer absorbs sheet flow runoff as groundwater levels run high. Conditions are no longer favorable for riding out intense storms attendant to global warming. 6

Understand that there is growing concern over outflow from San Jose Water Treatment Plant in times of flood when perhaps three days volume of treated water should be stored until South Bay tide levels recede. My math is no longer able to compute acreage of storage that is needed for three to four days of plant output but can appreciate that an isolated facility is preferable. Had always thought Pond 18 had been bought by City of San Jose for this purpose and so suggest that it be managed as a freshwater/recycled water marsh.
Coastal Conservancy designed Emily Renzel Marsh in Palo Alto to handle limited treatment plant outflows. Can similar technology be implemented in Pond 18?

Such use of Pond 18 with adequate levee protection would coordinate with my earlier suggestion of mosaic of managed marsh plain and floodplain, inboard of railroad line levee, in mode of Napa River flood retention. Ponds 16 and 17 could be managed like Island Ponds to attract different species of migratory and resident shorebirds with certain levels of salinity and depths of foraging tidal wetlands to suit their particular needs. 7

The marsh plain floodplain, inboard of the railroad line levee, that I propose might have requisite capacity for two to three days fluvial stormflow, sufficient to mute reflux and overbanking between #237 and #101. It would be configured in horseshoe around Pond 18, extending from tide gates on Guadalupe River at Alviso around to tide gates on Coyote Creek main channel and overflow channel, to Coyote Creek mitigation SMHM marsh.

Island Ponds would be inboard of tide gates and subject to same tidal action as at present as would rest of Wildlife Refuge Ponds 16 and 17 and managed wetlands in marsh flood plain. Would envision tide gates only needed to be implemented in extreme storm event when king tides would inhibit fluvial outflow to South Bay. (In 1990's SCVWD placed metal dams on Coyote Creek (Standish Dam) and Guadalupe River at #237 so the technology, if not hardware, should be readily available). 8

Think this must cover all points of concern on proposed super levee of your COE South San Francisco Bay Shoreline Phase 1 Project. Only might reiterate that railroad line levee alignment would offer protection to City of Milpitas and possibly better buffer for Highway #880 and #237 infrastructure. 9

Thank you for continued consideration of these protracted comment letters.

Libby Lucas
174 Yerba Santa Ave.,
Los Altos, CA 94022

ID	Issue Text	Response Text
038_Lucas_5-1	To continue my comment from February 22, in regards your COE South San Francisco Bay Shoreline Phase 1 Project, would wish to question lack of survey data in DEIS/EIR on resident and migratory bird populations. In January 28, 2015 submittal did include 'historic' 1978 San Jose-Santa Clara Water Treatment Plant EIR Figure 4-8 Endangered Species in the Baylands that mapped extent of California Clapper Rail and Least Tern nesting areas in sloughs and marshes of South Bay. In addition, the Coyote Creek, Reach 1 A Waterbird Pond Monitoring Program Annual Report of June 1999 Through June 2000, Tables 6 and 7 documented presence of rare, endangered and locally unique birds in project area - California Brown Pelican, California Clapper Rail, Double-crested cormorant, Northern Harrier, Sharp Shinned Hawk, Cooper's Hawk, Black Shouldered Kite, Golden Eagle, Western Bluebird, California Gull, Yellow Warbler, Salt Marsh Yellowthroat; and in project area vicinity, White Pelican, Peregrine Falcon, California Black Rail, Snowy Plover, California Least Tern, Burrowing Owl and Short-eared Owl. Table E 2 of this report noted Species, totals and mean number per survey observed through the July 1999 through June 2000 study period, separated by group: Shorebirds, Gulls, Waterfowl, and Other Waterbirds. Believe updated monitoring data on species, as observed at Reach 1 A Waterbird Pond, needs to be included in DEIS/EIR for resident and migratory waterfowl using marshes, ponds and sloughs between Coyote Creek and Guadalupe River in shoreline levee project area. Is this DEIS/EIR deficiency or did I just not find data?	Regional monitoring of this type is being included by reference only, as projects such as the South Bay Salt Pond Restoration project are already taking a broader look at waterbird use in the region in response to these large scale ecosystem restoration efforts.
038_Lucas_5-2	An accurate review of elements DEIS/EIR needs to assess re proposed project impacts on migratory and resident shorebird roosting and foraging habitat, particularly in high tide conditions, is detailed and referenced in letter from Matthew Leddy. He is long term observer of South Bay shorebirds and do support his concerns.	Your support of Matthew Leddy's concerns is noted and responses to his comments can be found in responses "036_Leddy-1" through " 036_Leddy-13".
038_Lucas_5-3	It seems questionable wisdom that proposed super levee is to obliterate South Bay marsh ecotone interface with uplands refugia and find it hard to understand how such an extent of bay fill in wildlife refuge endangered species habitat can be acceptable to San Francisco Bay Basin Plan criteria. Please substantiate regulatory rationale.	The Shoreline project shares the commenter's concern over impacts to the SMHM. One of the key species to benefit from the construction of ecotone (the project includes broad upland transition zones adjacent to the engineered levee) is the SMHM. The ecotone will provide sufficient cover and habitat to protect the SMHM during high tides and storms and allow for migration along the shoreline. When completed, the Shoreline project will create nearly 3,000 acres of SMHM habitat and when combined with the already-restored Pond A17, the south bay will have a continuous band of salt marsh habitat from Alviso Slough Ponds A9-15 through A17 to Coyote Creek's fringing marshes and Pond A18. The only disruption would be the existing Union Pacific Railroad line. This ultimate vision will provide much greater habitat connectivity, and the construction of the ecotone and the phased approach to restoration will help to minimize the direct effects of the initial restoration actions. In addition, all large-scale restoration projects around the Bay (e.g., Sonoma Baylands, Napa Salt Marsh, Hamilton, Island Ponds, A6, A17, Eden Landing, etc.) have had to excavate 'starter channels' through the existing fringing marshes in order for the larger habitat targets, which include the recovery of the SMHM, to be realized. These are standard restoration practices to expedite habitat development, and are routinely accepted by the environmental community and regulatory agencies. In terms of specific connections between the New Chicago Marsh and Coyote Creek mitigation area (Reach 1A) populations, the Preferred Alternative should improve SMHM migration opportunities over existing conditions by restoring large tracts of salt marsh habitat, lowering levees, and creating ecotone (transition zones).
038_Lucas_5-4	Do not believe that overriding public health and safety considerations can be determined to take precedence over CEQA and NEPA environmental law and guidelines in that levee design puts Alviso in greater jeopardy from depth and frequency from flood inundation than it is in at present. After 1984's (?) Coyote Creek flood it was mandated that a ring levee be constructed around Alviso but this was never successfully completed.	We concur that under current law, public health and safety considerations do not override NEPA or CEQA. The project sponsors have no authority to override laws. The project would connect with two existing river flood protection projects, the Guadalupe River and the Coyote Creek projects. In doing so, it would complete the fluvial and coastal protection for the community of Alviso, making past proposals for a ring levee obsolete.
038_Lucas_5-5	One rather critical natural constraint of shoreline levee alignment as proposed in DEIS/EIR is its siting on top of marshland that has exceptionally high artesian action. As super levee construction places extensive tons of fill on porous wetlands it is bound to cause upwelling of groundwater into Alviso homes and businesses. The extent of this super levee's impact on groundwater pressure needs hydraulic assessment in DEIS/EIR. How much further inland will Artesian Slough be artesian? Can intrusion affect Coyote Creek levee integrity?	The proposed project will not induce increases in the water table surface, or induce piezometric head (i.e. Artesian pressures), beyond the immediate footprint of construction. Fill areas to construct project levees and habitat fills will induce localized piezometric heads that will dissipate with time. Dissipation time will vary from very short (~weeks to months) in areas of thin fills or where wick drains are implemented to long (years) in areas of thick (>10 ft) habitat fills. Regardless, these localized piezometric changes will not induce measureable variations in the water table/pressure beyond the footprint of new fills.
038_Lucas_5-6	Bay level rise and a doubling of water runoff in valley due to imported supplies has already affected evolution of marsh vegetation in project area. Seasonal wetlands are now permanent wetlands. Burrowing owls retreat to levees and higher ground. The Coyote Creek/Guadalupe River delta no longer absorbs sheet flow runoff as groundwater levels run high. Conditions are no longer favorable for riding out intense storms attendant to global warming.	Thank you for your comment. The Recommended Plan is expected to be more resilient in the face of sea level change.

1593

038_Lucas_5-7	Understand that there is growing concern over outflow from San Jose Water Treatment Plant in times of flood when perhaps three days volume of treated water should be stored until South Bay tide levels recede. My math is no longer able to compute acreage of storage that is needed for three to four days of plant output but can appreciate that an isolated facility is preferable. Had always thought Pond 18 had been bought by City of San Jose for this purpose and so suggest that it be managed as a freshwater/recycled water marsh. Coastal Conservancy designed Emily Renzel Marsh in Palo Alto to handle limited treatment plant outflows. Can similar technology be implemented in Pond 18? Such use of Pond 18 with adequate levee protection would coordinate with my earlier suggestion of mosaic of managed marsh plain and floodplain, inboard of railroad line levee, in mode of Napa River flood retention. Ponds 16 and 17 could be managed like Island Ponds to attract different species of migratory and resident shorebirds with certain levels of salinity and depths of foraging tidal wetlands to suit their particular needs. The marsh plain floodplain, inboard of the railroad line levee, that I propose might have requisite capacity for two to three days fluvial stormflow, sufficient to mute reflux and overbanking between #237 and #101. It would be configured in horseshoe around Pond 18, extending from tide gates on Guadalupe River at Alviso around to tide gates on Coyote Creek main channel and overflow channel, to Coyote Creek mitigation SMHM marsh.	The City of San Jose's Plant Master Plan calls for Pond A18 to be restored to tidal wetlands and is not proposing that the pond be used for effluent storage. The Master Plan also proposes that some of the current biosolid lagoons be converted to freshwater treatment wetlands in the future (p. 51). Once Pond A18 is breached and reconnected to Bay waters, it will receive some flows from the WPCP's outfall in Artesian Slough and parts of the pond will likely evolve into brackish marsh due to these freshwater inputs, creating some of the mosaic the commenter describes. Through the SBSP Restoration Project, Pond A16 was recently converted to a managed pond for shorebirds and other pond specialist species and Pond A17 has been breached and is evolving into a tidal wetland. The U.S. Fish and Wildlife Service currently has no plans to change the existing management of Ponds A16 and A17.
038_Lucas_5-8	Island Ponds would be inboard of tide gates and subject to same tidal action as at present as would rest of Wildlife Refuge Ponds 16 and 17 and managed wetlands in marsh flood plain. Would envision tide gates only needed to be implemented in extreme storm event when king tides would inhibit fluvial outflow to South Bay. (In 1990's SCVWD placed metal dams on Coyote Creek (Standish Dam) and Guadalupe River at #237 so the technology, if not hardware, should be readily available).	The Shoreline Study tried to avoid constraining tidal flows and creating managed wetland systems. There is a tidal gate proposed for Artesian Slough for reasons unique to that setting (see Master Response to Artesian Slough levee alignment). Although technology may exist to manage flows, the cost of creating and managing this technology and the impact to the environment (see response to 038_Lucas_5-9) must be weighed against its advantages. For this reason, the Shoreline Study tried to avoid engineered solutions as much as possible when able to restore less-intensively managed systems that have natural flood protection features.
038_Lucas_5-9	Think this must cover all points of concern on proposed super levee of your COE South San Francisco Bay Shoreline Phase 1 Project. Only might reiterate that railroad line levee alignment would offer protection to City of Milpitas and possibly better buffer for Highway #880 and #237 infrastructure.	Early in the Shoreline Study planning process, options similar to the commenter's suggestion were considered such as hardening outboard levees and installing tide gates strategic locations to hold back tidal flooding. This would convert the former south bay salt ponds to essentially flood detention basins. Such basins can successfully be managed as either tidal and/or riparian flood flows (depending on how they are designed) and create habitat, but they result in highly-altered environments with the need for intensive, long-term management. Consistent with the vision created by the South Bay Salt Pond Restoration Project and consistent with Corps of Engineers ecosystem restoration policy, the Shoreline Study has tried to incorporate more natural, less managed solutions into the project, as much as possible, in order to reduce environmental impacts, costs, and long-term complications from highly-managed systems. Using the railroad line to create tidal basins would also conflict with the Shoreline Study's identified habitat goals of tidal restoration through an adaptive management process. Tidal basins and tide gates usually preclude full tidal restoration. While these muted tidal systems can provide valuable habitat, they do not have all of the geomorphic and ecological functions that existed historically when the South Bay was dominated by unconstrained tidal marshes. Furthermore, the creation of tidal detention basins would conflict with the habitat goals of the South Bay Salt Pond Restoration Project and other regional plans, such as the Baylands Ecosystem Habitat Goals and the USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. A central goal of these plans is to create largely unbroken swaths of salt marsh habitat in the far South Bay and reconnect isolated wildlife populations. For these reasons, these types of flood protection solutions were not carried forward for further analysis.

From: Ruacho, Mariela <mariela_ruacho@ios.doi.gov>
Sent: Monday, February 02, 2015 8:47 AM
To: Shoreline Environment SPN
Cc: Loretta Sutton; Patricia Port

Subject: [EXTERNAL] Review of the DEIS for South San Francisco Bay Shoreline Phase I, CA
Attachments: ER_14_0797_No Comment Letter.docx

Hello,

Please see the attached No Comment Letter for the *(DEIS)* for South San Francisco Bay Shoreline Phase I, CA Project (ER 14/0797).

Thank you,
--
Mariela Ruacho
Regional Environmental Intern
Office of Environmental Policy and Compliance
US Department of the Interior
333 Bush St., Suite 515
San Francisco, CA 94104
ph: (415) 296-3356
mariela_ruacho@ios.doi.gov

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Pacific Southwest Region
333 Bush Street, Suite 515
San Francisco, CA 94104

IN REPLY REFER TO:
(ER 14/0797)

Filed Electronically

2 February 2015

Thomas R. Kendall Chief
Planning Branch Engineering and Technical Services Division
U.S. Army Corps of Engineers
San Francisco District 1455 Market St.
San Francisco, CA 94103
ATTN: William DeJager
Environmental Section A

Subject: Review of the Draft Environmental Impact Statement (DEIS) for South San Francisco Bay Shoreline Phase I, CA

Dear Chief Kendall:

The Department of the Interior has received and reviewed the subject document and has no comments to offer. 1

Thank you for the opportunity to review this project.

Sincerely,

Patricia Sanderson Port
Regional Environmental Officer

cc:
OEPC Staff Contact: Loretta B. Sutton, (202) 208-7565; Loretta_Sutton@ios.doi.gov

ID	Issue Text	Response Text
039_DOI-1	The Department of the Interior has received and reviewed the subject document and has no comments to offer.	Thank you for your review of the DEIS; it is noted that you have no comments to offer at this time.

1597

040_CG

Cargill

February 19, 2015

Mr. Bill DeJager
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103

Subject: South San Francisco Bay Shoreline Study DIFR/DEIS/DEIR
Cargill file: 2000.005:8

Dear Mr. DeJager:

Thank you for providing the public the opportunity to comment on this very extensive, detailed report that will ultimately provide much needed flood protection in this region of the South San Francisco Bay Area. As the former land owner in this area, I am very familiar with the property and the surrounding uses. I find that it is important to know your neighbors when conducting a study of this magnitude that ultimately may have positive and/or negative impacts to their property or uses.

My comments are relatively few consider the size of this document, but it is important that they are corrected for the record.

1. **Figure S-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas**
   This figure needs both a change in nomenclature as well as a line/shading adjustment. The border around the property labeled "Alameda County Cargill Ponds" is inaccurate. It fails to include our operating salt ponds 4 & 5, which are currently shaded blue and shown as a part of the "Alviso Pond Complex and Santa Clara County". The orange shaded area also includes EBRPD's Coyote Hills – this needs to be removed from the map. Lastly, Cargill's Redwood City Plant Site needs to be distinguished from the "Ravenswood Ponds and San Mateo County". All of Cargill's property should be labeled "Cargill Salt Operating System". I have attached an edited map as Exhibit 1 for your reference. 1

7220 Central Avenue
Newark, CA 94560-4205

Tel (510) 790-8610
Fax (510) 790-8180

2. **Chapter 1, page 1-6, 2nd paragraph**
In the middle of this paragraph, the sentence reads, "However, in 2003, the Federal and State governments acquired 15,100 acres of inactive (former) salt ponds in the South Bay from Cargill Salt…" Please note that in 2003, these salt ponds were in fact "active". Please correct the sentence to read, "However, in 2003, the Federal and State governments acquired 15,100 acres of active salt ponds…" I have attached an edited copy of that page as Exhibit 2 for your reference. 2

3. **Figure 1.4-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas**
This is the same figure as Figure S-1. Please see comment #1 for details. I have attached an edited copy of this page as Exhibit 3 for your reference. 3

4. **Figure 4.4-2 Estimated Bathymetry at Year 50 (2067) Based on the Modeling and Analysis by Brown (2010)**
This figure shows an estimated bathymetry at year 50 in Cargill's operating ponds 1, 2, 3, 4, 5 & 6. Since this is outside the study area and within Cargill's continue operating ponds, please remove this from the map. It erroneously shows a bathymetric change in Cargill's operating ponds as if they were being subject to tidal action – which they are not, nor are they planned to be. Please see the attached edited page as Exhibit 4 for your reference. 4

I would again like to thank you for the opportunity to comment on this extensive document and I trust that you will make the appropriate changes in order to properly reflect both the history of the property as well as the current uses by Cargill as a neighbor to this project. Should you have any questions, please feel free to contact me at (510) 790-8610 or alternatively you can email me at pat_mapelli@cargill.com.

Sincerely,

Pat Mapelli

Pat Mapelli
Manager, Real Property

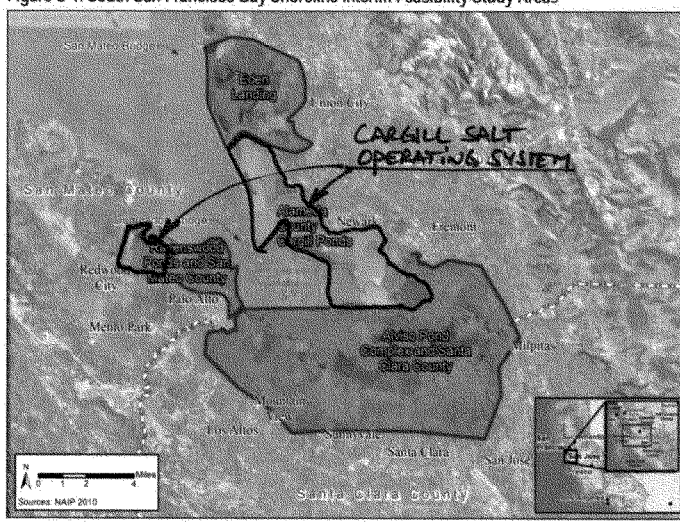
EXHIBIT 1

S.0 Executive Summary

S.1 Stage of Planning Process

The South San Francisco Bay Shoreline Study is an Interim Feasibility study that represents flood risk management and ecosystem restoration in the Alviso Salt Ponds complex and adjacent community of Alviso, Santa Clara County, California (Figure S-1). The reconnaissance phase of the study, which was completed in September 2004, resulted in the finding that there was Federal interest in continuing the study into the feasibility phase.

Figure S-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas



The locally preferred plan (LPP) recommended for implementation and identified as the tentatively selected plan (TSP) would provide a higher level of flood risk resiliency over the Tentative National Economic Development/National Ecosystem Restoration (NED/NER) and would allow for continued Federal Emergency Management Agency (FEMA) accreditation at the end of the study's period of analysis (2017-2067). It would also provide a broad transition zone between upland and tidal marsh areas with the addition of an ecotone adjacent to the Flood Risk Management (FRM) levees. This ecotone would benefit the efficacy of the levee structure as well as provide significantly more acreage for marshes to retreat inland in the face of sea level change. A request for an exception to recommending the NED and NER Plan needs to be approved by the Assistant Secretary of the Army (ASA)'s office at Headquarters United

EXHIBIT 2

In August 1969, the McAteer-Petris Act was amended to make the BCDC a permanent agency and to incorporate the policies of the Bay Plan into State law. The BCDC is the federally designated State coastal management agency for the San Francisco Bay segment of the California coastal zone. This designation empowers the BCDC to use the authority of the Federal Coastal Zone Management Act (CZMA) to ensure that Federal projects and activities are consistent with the policies of the Bay Plan and State law. Among other things, the BCDC is currently responsible for developing rules and regulations prohibiting big bay-fill projects and for permitting any proposed projects that can affect the bay.

Soon after, in 1972, the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) was established on roughly 20,000 acres of active (currently used in solar salt production) and former (inactive; no longer used for salt production) salt ponds. The Refuge, which includes most of the former salt ponds in the Alviso complex, was established ". . . for the preservation and enhancement of highly significant habitat . . . for the protection of migratory waterfowl and other wildlife, including species known to be threatened with extinction, and to provide opportunity for wildlife-oriented recreation and nature study . . ." (86 Statute [Stat] 399, dated June 30, 1972).

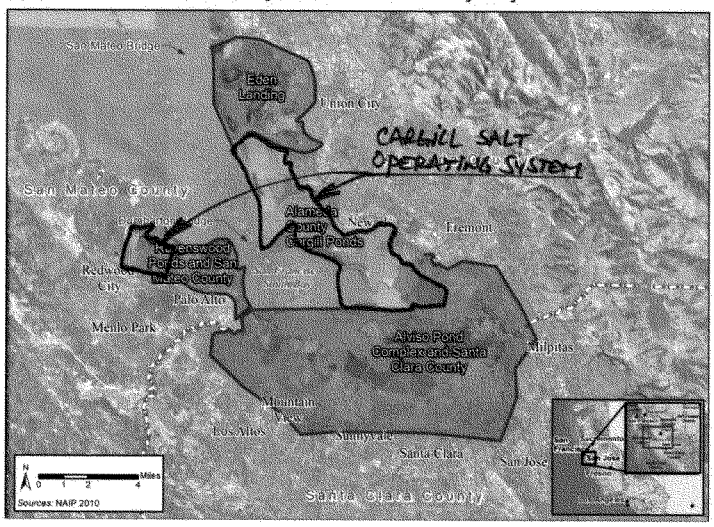
The Shoreline Study was originally authorized by Congress in 1976 to assess the need for flood risk management in the South Bay. In 1992, the USACE found that it could not, within its policy guidelines, economically justify developing a Federal flood risk management project along the South San Francisco Bay shoreline, mainly because it determined that Cargill (previously Leslie) Salt would continue to maintain its existing (and non engineered) salt pond dikes due to economic interests. Although these salt pond dikes were not engineered or built for the purpose of flood risk management, they provided incidental flood risk management for the neighboring communities. However, in 2003, the Federal and State governments acquired 15,100 acres of inactive (former) salt ponds in the South Bay from Cargill Salt (which had purchased the land from Leslie Salt) and began planning a restoration project that would ultimately affect the utility of those former salt pond dikes as flood risk management structures. As a result, the U.S. House of Representatives requested that the USACE review its previous study on flood risk management in San Francisco Bay and expand the study's scope to include environmental restoration and protection as well as tidal and fluvial flood risk management.

IN 2003, THESE SALT PONDS WERE IN FACT "ACTIVE"

The USACE completed an initial reconnaissance analysis in September 2004, which determined that, due to the current and future anticipated conditions in the South Bay, it was likely that a Federal flood risk management and ecosystem restoration project would be justified. The decision was made to phase the planning effort because of the large geographic extent of the South San Francisco Bay area; the complexity of the hydrology, hydraulics, and combined flood risk management and ecosystem restoration components; and in anticipation of Federal and non-Federal funding availability. The geographic area was generally split into four primary study areas: Ravenswood Ponds and San Mateo County, Alviso Ponds and Santa Clara County, Cargill Ponds and Alameda County, and Eden Landing (also Alameda County; Figure 1.4-1). Each of the Interim Feasibility Studies, independent in utility and not reliant on other study areas' proposed actions, would address flood risk management, ecosystem restoration, recreation, and other project purposes specific to each area.

EXHIBIT 3

Figure 1.4-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas



On October 24, 2005, the USACE, the USFWS, the SCVWD, and the CSCC initiated the South San Francisco Bay Shoreline Interim Feasibility Study (2005 Shoreline Study).

At this planning stage, the study area covered the southern portion of the South Bay, including the entire Alviso pond complex and other lands and waters stretching from southwest Fremont to Palo Alto (Figure 1.4-2). A subset of this larger area, the Alviso pond complex, includes approximately 9,000 acres of former salt production ponds and 15 miles of shoreline between Palo Alto and southwest Fremont. It consists of 25 ponds (many of which are owned by the USFWS as part of the Refuge) and resides at the bay's southern extremity in Santa Clara and Alameda Counties. To the south and east, this 2005 Shoreline Study study area extended beyond the former salt ponds to include all lands subject to inundation from a 0.2-percent annual chance of exceedance (ACE) tidal flooding event (also known as the 500-year flood) under predicted future conditions with sea level change.

EXHIBIT 4

To evaluate the effects of uncertainty in the future rate of sea level change, the following rates of sea level change are being considered for the Shoreline Phase I Study:

- USACE Low SLC scenario (total change of +0.51 foot from Year 0 [2017] to Year 50 [2067])
- USACE Intermediate SLC scenario (total change of +0.1.02 feet from Year 0 [2017] to Year 50 [2067])
- USACE High SLC scenario (total change of +2.59 feet from Year 0 [2017] to Year 50 [2067])

These three rates of sea level change were used to estimate the sensitivity of flooding at Year 50 (2067) to the uncertainty about the sea level at the Shoreline Phase I Study Area boundary.

Figure 4.4-2 is the resulting color contour plot of the expected Year 50 bathymetry (Brown 2010). The overall planform elevation has increased by 0.65 meter over the Year 0 planform elevation, to account for the total sea level change over the project life. Pond A6 is filled completely, and Pond A8 is partially filled.

Figure 4.4-2. Estimated Bathymetry at Year 50 (2067) Based on the Modeling and Analysis by Brown (2010)

ID	Issue Text	Response Text
040_CG-1	Figure S-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas. This figure needs both a change in nomenclature as well as a line-shading adjustment. The border around the property labeled "Alameda County Cargill Ponds" is inaccurate. It fails to include our operating salt ponds 4 & 5, which are currently shaded blue and shown as part of the "Alviso Pond Complex and Santa Clara County". The orange shaded area also includes EBRPD's Coyote Hills - this needs to be removed from the map. Lastly, Cargill's Redwood City Plant Site needs to be distinguished from the "Ravenswood Ponds and San Mateo County". All of Cargill's property should be labeled "Cargil Salt Operating System". I have attached an edited map as Exhibit 1 for your reference.	Thank you for clarifying the boundaries of the individual feasibility study areas and the Cargill Salt operating system ponds. The suggested revisions to the Figure (now Figure1.5.1) has been made per the edited map provided as an attachment to your letter. The Executive Summary was shortened and the Figure no longer appears there.
040_CG-2	Chapter 1, page 1-6. 2nd paragraph - In the middle of this paragraph, the sentence reads, "However, in 2003, the Federal and State governments acquired 15,100 acres of inactive (former) salt ponds in the South Bay from Cargill Salt..." Please note that in 2003, these salt ponds were in fact "active". Please correct the sentence to read, "However, in 2003, the Federal and State governments acquired 15,100 acres of active salt ponds..." I have attached an edited copy of that page as Exhibit 2 for your reference.	The suggested revision to Chapter 1 has been made. The sentence has been revised as requested. Additionally, further in the same sentence, the term "former" was removed in reference to the salt pond dikes themselves.
040_CG-3	Figure 1.4-1. South San Francisco Bay Shoreline Interim Feasibility Study Areas. This is the same figure as Figure S-1. Please see comment #1 for details. I have attached an edited copy of this page as Exhibit 3 for your reference.	Thank you for clarifying the boundaries of the individual feasibility study areas and the Cargill Salt operating system ponds. The suggested revision to Figure 1.4-1 (now Figure 1.5-1) has been made per the edited map provided as an attachment to your letter. The Executive Summary was shortened and the Figure no longer appears there.
040_CG-4	Figure 4.4-2 Estimated Bathymetry at Year 50 (2067) Based on the Modeling and Analysis by Brown (2010)This figure shows an estimated bathymetry at year 50 in Cargill's operating ponds 1,2,3,4,5 & 6. Since this is outside the study area and within Cargill's continue operating ponds, please remove this from the map. It erroneously shows a bathymetric change in Cargill's operating ponds as if they were being subject to tidal action - which they are not, nor are they planned to be. Please see the attached edited page as Exhibit 4 for your reference.	Thank you for clarifying the boundaries for the estimated bathymetry at year 50 (Figure 4.4-2). The referenced ponds have been removed from the figure and the bathymetric change has been limited to those areas in the study area that will be subject to tidal action.

1604

CITY OF
SAN JOSE
CAPITAL OF SILICON VALLEY

Sam T. Liccardo
MAYOR

March 19, 2015

Bill DeJager
San Francisco District
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, CA 94103-1398
Via Email to: ShorelineEnvironment@usace.army.mil

Dear Bill,

We would like to request our initial letter dated February 16, 2015, be retracted and no longer be considered as our public comment letter on the Shoreline Study Draft EIS/EIR. We would like to submit this letter dated March 19, 2015 in lieu of the February 16, 2015 letter.

We appreciate the valuable work that the Army Corps of Engineers and non-federal sponsors, the Santa Clara Valley Water District and State Coastal Conservancy, have undertaken to conduct and complete the Shoreline Study Draft EIS/EIR in relation to the San Jose Bay Shoreline. We support the Shoreline Study effort, because protecting our low-lying communities by preparing for the likelihood of sea-level rise and increased threats of extreme storms is important to the City, our residents, the ecosystem, and the economy.

San José's Regional Wastewater Facility's Master Plan adopted by the City Council in November 2013 identified a tentative levee alignment that corresponds to the proposed Shoreline Study levee alignments. Regional Wastewater staff, including our City staff, have been working with the Shoreline Study partners in the development of the Shoreline levee alignment that will allow for the vision of flood protection and restoration to be implemented.

It's the City's intent to continue to work with the Shoreline Study partners to ensure the best levee alignment is realized, a design where restoration may one day connect Bay marshes through a recreated floodplain of Coyote Creek, enriching wetland and riparian habitats all along that reach. It is a vision of an extraordinary opportunity for San José.

200 East Santa Clara Street, San José, CA 95113 *tel* (408) 535-4800 *fax* (408) 292-6422 www.sjmayor.org

We look forward to working with the Shoreline partners on an appropriate levee alignment that reflects this vision.

Sincerely,

Sam T. Liccardo
Mayor, City of San José
District 4

Margie Matthews
Councilmember, City of San José

Cc: Project Manager, Major Adam Czekanski, United States Army Corps of Engineers

ID	Issue Text	Response Text
041_Liccardo Matthews-1	We would like to request our initial letter dated February 16,2015, be retracted and no longer be considered as our public comment letter on the Shoreline Study Draft EIS/EIR. We would like to submit this letter dated March 19, 2015 in lieu of the February 16, 2015 letter.	Your comment is acknowledged and our files have been updated. Your letter dated February 16, 2015 has been removed from the draft Integrated Document review records and replaced with this letter dated March 19, 2015. Therefore, no response to the February 16 letter will be included in the public response to comments.
041_Liccardo Matthews-2	We appreciate the valuable work that the Army Corps of Engineers and non-federal sponsors, the Santa Clara Valley Water District and State Coastal Conservancy, have undertaken to conduct and complete the Shoreline Study Draft EIS/EIR in relation to the San Jose Bay Shoreline. We support the Shoreline Study effort, because protecting our low-lying communities by preparing for the likelihood of sea-level rise and increased threats of extreme storms is important to the City, our residents, the ecosystem, and the economy. San Jose's Regional Wastewater Facility's Master Plan adopted by the City Council in November 2013 identified a tentative levee alignment that corresponds to the proposed Shoreline Study levee alignments. Regional Wastewater staff, including our City staff, have been working with the Shoreline Study partners in the development of the Shoreline levee alignment that will allow for the vision of flood protection and restoration to be implemented. It's the City's intent to continue to work with the Shoreline Study partners to ensure the best levee alignment is realized, a design where restoration may one day connect Bay marshes through a recreated floodplain of Coyote Creek, enriching wetland and riparian habitats all along that reach. It is a vision of an extraordinary opportunity for San Jose.	Thank you for your review of the Shoreline Phase I Project and acknowledgment of our common goals. No revision to the text is required.

1607

Appendix J

Letters of Support

September 2015

(revised December 2015)

San Francisco Bay Conservation and Development Commission
455 Golden Gate Avenue, Suite 10600, San Francisco, California 94102 tel 415 352 3600 fax 415 352 3606

July 10, 2015

Mr. Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
1455 Market Street, 16th Floor
San Francisco, CA 94103

SUBJECT: Request for Determination of Consistency with the Coastal Zone Management Plan: South San Francisco Bay Shoreline Study, Phase 1

Dear Mr. Kendall:

Thank you for your request that BCDC support the flood risk management and ecosystem restoration work proposed by the South San Francisco Bay Shoreline Study, Phase 1. The project is described in the draft Integrated Report released on December 19, 2014, and with additional detail provided in subsequent meetings with the project proponent.

As the proposed project would be constructed entirely by the federal government, albeit with some local and state funding, BCDC will require that the Corps apply for a Consistency Certification under the federal Coastal Zone Management Act. BCDC permits may be required for subsequent management activities by non-federal entities on non-federal lands during operation and maintenance of the project.

BCDC treats consistency matters as much as possible like permits, and permits require that substantial design detail be available for BCDC to determine whether a project is consistent with the Commission's laws and policies. Normally, BCDC permits are granted after environmental documents such as a final Environmental Impact Statement/Environmental Impact Report (EIS/EIR) are completed. Therefore, the Consistency Certification submitted to the Commission will require more detail than is available at the current EIS/EIR level of design. For instance, while information on practical public access options can be provided at present, the consistency certification should propose public access as an integral part of the project and include confirmation of valid title by the applicant for all properties in question. Such information may not be available until after Congressional authorization.

Nevertheless, BCDC staff can provide an initial indication of whether the proposed project appears to generally be consistent with the Bay Plan, or can be made so with additional documentation and minor changes. Therefore, we can comply with your request with the following caveats:

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State of California | Edmund G. Brown, Jr. — Governor

Mr. Kendall
July 10, 2015
Page 2

1. As your request comes at the environmental document stage, and because the staff (rather than the Commission) normally comments on projects at this stage, I believe I can make this determination at this time. However, while my determination is based on the McAteer-Petris Act as amended (California Government Code, Title 7.2), the Bay Plan (BCDC, 2008), and the Commission's Management Program, it is, like staff comments on environmental documents generally, a **staff position only**. A further and final decision on the project and its consistency with the BCDC Management Program will be made by the Commission when adequate design detail is provided to BCDC. Based on discussions with you, this would appear to be during the detailed design phase of your project.

2. Our comments are based upon, and go no further than, the information contained in the draft Integrated Report. While the information in the referenced document permits me to conclude that a project like that proposed can be constructed in a manner consistent with the BCDC Management Program, this does not necessarily mean that the proposed design, as detailed in these documents, is already consistent with the Program.

3. Finally, while the Commission has unanimously approved at least two horizontal levees to create transition zones, upland habitat, and areas where marsh can move inland with rising sea level rise (Sonoma Creek (Consistency Determination No. C2014.004.00) and Max Keech Properties (BCDC Permit No. 2007,005)), the proposed south bay shoreline levee would require significantly larger amounts of fill than either of the two earlier approved projects. The Commission may express concerns about the amount of proposed fill. This concern may be lessened because: (a) the fill is proposed in salt ponds as opposed to the Bay, and the criteria for evaluating fill in salt ponds is somewhat more permissive than fills proposed in the Bay; and, (b) the Commission has expressed great concern about preparing the Bay and its shoreline to be resilient to expected sea level rise and has consistently supported efforts to protect the Bay's existing natural resources.

With these caveats, and based on staff-level coordination and responses to BCDC's comment letter of February 23, 2015, the staff believes that the proposed project is generally consistent with the Bay Plan and the Commission's Management Program. The Bay Plan encourages converting salt ponds to tidal and subtidal habitats, and designing ecosystem restoration and flood risk management features that provide for, and are adaptable to, projected sea level rise. The proposed project incorporates these attributes and its proposed ecotone would provide important habitat and ecosystem resilience. The Bay Plan requires public access to the Bay shoreline, and the project would promote such access by filling a gap in the Bay Trail.

Mr. Kendall
July 10, 2015
Page 3

Discussions among U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and BCDC staff indicate that the federal agencies are willing to work with Commission staff to ensure that the project design will be fully consistent with the Commission's laws and policies as designs are brought to a detailed level. I hope this letter clarifies our position and please be assured that we very much look forward to working with you to complete this very important project.

If you have any further questions, please contact Bob Batha (bob.batha@bcdc.ca.gov; 415/352-3612) of our staff or me directly.

Sincerely,

STEVE GOLDBECK
Deputy Director

SG/gg

cc: Nicholas E. Malasavage, U.S. Army Corps of Engineers
William R. Dejager, U.S. Army Corps of Engineers
Brian M. Mulvey, U.S. Army Corps of Engineers
Keith Lichten, San Francisco Bay Regional Water Quality Control Board
Dale Bowyer, San Francisco Bay Regional Water Quality Control Board

References:

BCDC (1979). Management Program for San Francisco Bay. San Francisco Bay Conservation and Development Commission (prepared with financial assistance from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provisions of the Federal Coastal Zone Management Act of 1972, as amended).

BCDC (2008). San Francisco Bay Plan. San Francisco Bay Conservation and Development Commission.

California Water Boards

San Francisco Bay Regional Water Quality Control Board

Sent via e-mail – no hard copy to follow

July 13, 2015
CIWQS Place ID 813084

U.S. Army Corps of Engineers
San Francisco District
Attn.: Thomas R. Kendall
1455 Market St.
San Francisco, CA 94103

Subject: Letter of support for the South San Francisco Bay Shoreline Project

Dear Mr. Kendall:

This letter is in response to your request for a letter supporting the flood risk management and ecosystem restoration project (Project) proposed in the December 2014 *Draft South San Francisco Bay Shoreline Phase I Study*, Integrated Document, *Draft Integrated Interim Feasibility Report and Environmental Impact Statement / Report* (Shoreline Study). Water quality certification (Certification) pursuant to section 401 of the federal Clean Water Act will be required to authorize construction of the Project. The San Francisco Bay Regional Water Quality Control Board (Water Board) usually reviews applications for Certification during the detailed, final design process that occurs after completion of a final environmental document. Therefore, we plan to consider issuing Certification for the Project following completion of Project review in compliance with the requirements of the California Environmental Quality Act (CEQA) and after review of near-final Project designs. At this time the Water Board has not been requested to take formal action on any requirements related to the Project. However, as is described below, the Project appears to be consistent with the intent of the *San Francisco Bay Basin Water Quality Control Plan* (Basin Plan), the Water Board's primary regulatory document, and, therefore, appears to be eligible for Certification. This letter provides Water Board staff's assessment of the proposed Project.

Project Description

The proposed Project is identified as Alternative 3 in the Shoreline Study. The Project's components include an Alviso North levee alignment, San José–Santa Clara Regional Wastewater Facility (WPCP) South levee alignment, a 30:1 (1 foot of elevation rise for each 30 feet of horizontal distance) ecotone adjacent to ponds A12/13 and A18, restoration of ponds A9-15 and A18, a flood gate across the Union Pacific Railroad tracks near ponds A12/13, and a tidal flood gate at Artesian Slough. The Project includes an engineered levee, approximately 15.2 feet high, along existing salt pond berms, the eastern border of Pond A12, and the southern borders of

Dr. Terry F. Young, chair | Bruce H. Wolfe, executive officer

1515 Clay St., Suite 1400, Oakland, CA 94612 | www.waterboards.ca.gov/sanfranciscobay

ponds A16 and A18. The Project would allow for continued Federal Emergency Management Agency (FEMA) accreditation at the end of the study's period of analysis (2017-2067).

Water Board Comments

Water Board staff supports the Project and recognizes that it is needed both for flood protection and to enable the restoration of salt marsh and related habitats in about 2,800 acres of historically diked salt ponds in South San Francisco Bay, in the former Alviso Salt Pond Complex ponds A9 through A15 and A18. Since the current salt pond levees provide flood protection to the Alviso area, the Project will facilitate salt marsh restoration by allowing the outer salt pond levees to be breached after the Project has replaced flood protection provided by these levees. Project implementation is also part of a long-term adaptive management strategy to address the potential impacts of sea level rise in the Bay.

Reviewed in isolation, the flood control element of the Project, with adjacent ecotone fill, would place fill into about 137 acres of waters of the State, consisting of 16.8 acres of wetlands and 120.8 acres of open water. This impact is large for a single project and would require significant mitigation to be consistent with the Basin Plan, which incorporates the State of California's no net loss policy (Governor's Executive Order W-59-93 and Senate Concurrent Resolution No. 28). However, the Basin Plan also directs the Water Board to use the *Baylands Ecosystem Habitat Goals* (1999) (*Habitat Goals*), and the *Baylands Ecosystem Species and Community Profiles* (2000) (referred to collectively as the "Habitat Goals Reports") as guides for wetland restoration to protect beneficial uses of waters in San Francisco Bay. The *Habitat Goals* contains the following recommendation for the shoreline in the vicinity of Alviso Slough:

> Restore tidal marsh throughout most of the segment, providing a continuous corridor of tidal marsh along the bayshore… . Restoration should emphasize reestablishing a natural transition between tidal marsh and adjacent wetlands and upland habitats, as well as transitions between salt and brackish tidal marsh.

One of the significant beneficial uses that the Basin Plan assigns to waters of the State in South San Francisco Bay is the preservation of rare and endangered species. The proposed habitat enhancement activities in the Alviso Salt Pond Complex ponds will enhance this beneficial use. The Habitat Goals and the *USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan) (USFWS, August 27, 2013), which include recovery actions for the California Ridgway rail (formerly California Clapper Rail) and salt marsh harvest mouse (SMHM), support both the restoration of as many acres of tidal marsh as feasible and the creation of ecotones between marsh habitats and upland high water refuges.

The ecotones will contribute to the value of the marsh and the future success of special status species using the marsh by providing an important transition zone. This type of upland transitional habitat is not well represented in the South San Francisco Bay due to the historic severe loss of habitat and the typically abrupt transitions between remaining middle marsh habitat and steep-sided levees. The ecotones will provide high tide cover and escape habitat for the California Ridgway Rail and SMHM, as well as providing some opportunity for landward migration of wetland habitat in the face of sea level change.

The Project's inclusion of tidal marsh restoration, along with the habitat enhancement provided by the ecotones in the proposed Project, supports the Water Board's ability to issue Certification for the Project.

As is noted in the Shoreline Study, South San Francisco Bay appears to be on the verge of becoming a sediment sink, rather than a sediment source. With increasing sea level and decreasing sediment supply, restoration practitioners and researchers in San Francisco Bay are encouraging all stakeholders to proceed with a sense of urgency to create sustainable marshes. Since the uncertainties related to sediment supply will increase over time, we encourage the U.S. Army Corps of Engineers to commence work on the Project as soon as possible.

Conclusion

In summary, Water Board staff is supportive of the Project, which will provide the integrated flood risk management and tidal habitat restoration that is necessary to support the preservation of rare and endangered species and to enhance habitat resilience to sea level rise. We look forward to continuing to work with the Project sponsors to complete the Certification process as further design details are provided.

If you have questions regarding the Certification process, please contact me at (510) 622-2314 or via email to bwolfe@waterboards.ca.gov.

Sincerely,

Digitally signed by Bruce H. Wolfe
DN: cn=Bruce H. Wolfe, o=SWRCB, ou=Region 2, email=bwolfe@waterboards.ca.gov, c=US
Date: 2015.07.13 12:20:27 -07'00'

Bruce H. Wolfe
Executive Officer

Cc:
John Bourgeois, California Coastal Conservancy – John.Bourgeois@scc.ca.gov
Melanie Richardson, Santa Clara Valley Water District – mrichardson@valleywater.org

San Francisco Bay Conservation and Development Commission
455 Golden Gate Avenue, Suite 10600, San Francisco, California 94102 tel 415 352 3600 fax 415 352 3606

September 4, 2015

Mr. Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
1455 Market Street, 16th Floor
San Francisco, CA 94103

SUBJECT: BCDC Support for the South San Francisco Bay Shoreline Study, Phase 1

Dear Mr. Kendall:

Thank you for the request by the San Francisco District of the U.S. Army Corps of Engineers (USACE) that the San Francisco Bay Conservation and Development Commission (BCDC) support the flood risk management and ecosystem restoration work proposed by USACE's South San Francisco Bay Shoreline Study, Phase 1. The project is described in the draft Integrated Report released on December 19, 2014, and with additional detail provided in subsequent meetings with the project proponent.

As the proposed project would be constructed by the federal government, with some local and state funding, BCDC will require USACE to prepare and submit a Consistency Determination for review by BCDC under the federal Coastal Zone Management Act (CZMA). Based on decades of past practice and experience, we believe that it would be most prudent for USACE to submit its Consistency Determination during the project's Pre-Construction Engineering & Design phase.

In general, the BCDC staff supports the purpose of this project and looks forward to taking it before the Commission for its review and action under the CZMA when enough information is gathered and analyzed to ensure that it will both comply with the enforceable policies of the Coastal Management Program (CMP), as contained in the McAteer-Petris Act and in the San Francisco Bay Plan ("Bay Plan"), and benefit the region. Both the staff and Commissioners can better provide USACE with practical suggestions if USACE is willing to provide the Commission with an initial briefing on the project. As such, we have reserved time for a USACE presentation at our next Commission meeting on September 17, 2015.

It is worthwhile to note that the Commission previously has unanimously approved at least two horizontal levees to create transition zones, upland habitat, and areas where marsh can move inland with rising sea level rise at Sonoma Creek (Consistency Determination No. C2014.004) and Max Keech Properties (BCDC Permit No. 2007.005). That being said, the project's south bay shoreline levee would require much larger amounts of fill than either of the two above-referenced projects, although the fill is proposed to be placed within salt ponds, as opposed to within the Bay. While BCDC's criteria for evaluating fill in salt ponds are different than its criteria used to analyze fill proposed in the Bay, any fill proposed within BCDC's

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State of California | Edmund G. Brown, Jr. — Governor

Mr. Thomas Kendall
United States Army Corps of Engineers
September 4, 2015
Page 2

jurisdiction must be justified. Also, the Commission will analyze this project in light of its efforts to make the Bay's shoreline more resilient to expected rising sea level; it has consistently supported appropriate efforts to do so in the past, and I am sure that USACE will receive many questions from the staff and Commissioners about the project's design and purpose in light of the ramifications of climate change and the need to protect the Bay's existing natural resources.

Based on the draft Integrated Report, BCDC-USACE staff-level coordination, and USACE's responses to BCDC's comment letter of February 23, 2015, the BCDC staff can indicate now that the proposed project is generally consistent with the Bay Plan's policies, or can be amended to be so, with additional documentation and a series of changes. The Bay Plan encourages converting salt ponds to tidal and subtidal habitats and designing ecosystem restoration and flood risk management features that provide for, and are adaptable to, projected rising sea level. The USACE proposal incorporates these attributes and its proposed ecotone would provide important habitat and ecosystem resilience. The Bay Plan requires that the public have access to the Bay shoreline, and the project would promote such access by filling a gap in the Bay Trail. I am happy that discussions among the Corps, BCDC, and other project-related staff indicate that the federal agencies are willing to work with Commission staff to ensure that the project design will be fully consistent with the Commission's policies as it is brought to a more detailed level.

Finally, please note that BCDC is open to the concept of phased consistency review, as authorized by section 930.36(d) of the CZMA regulations, should USACE elect to pursue this approach. Using this approach, BCDC generally requires up to 75 days to conclude our process and provide a federal agency with a phased Consistency Concurrence following the submission of a phased Consistency Determination. As stated above, however, we believe that a better process would be to expedite a Commission briefing on the overall goals of the project now, and review a USACE Consistency Determination later at the Pre-Construction Engineering & Design phase.

I hope this letter clarifies our position and please be assured that we very much look forward to working with you to complete this very important project.

If you have any further questions, please contact Bob Batha of our staff at 415-352-3612, or by email at bob.batha@bcdc.ca.gov; or me directly.

Sincerely,

LAWRENCE J. GOLDZBAND
Executive Director

Mr. Thomas Kendall
United States Army Corps of Engineers
September 4, 2015
Page 3

References:

BCDC (1979). Management Program for San Francisco Bay. San Francisco Bay Conservation and Development Commission (prepared with financial assistance from the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provisions of the Federal Coastal Zone Management Act of 1972, as amended).

BCDC (2008). San Francisco Bay Plan. San Francisco Bay Conservation and Development Commission.

San Francisco Bay Conservation and Development Commission
455 Golden Gate Avenue, Suite 10600, San Francisco, California 94102 tel 415 352 3600 fax 415 352 3606

November 6, 2015

Mr. Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
1455 Market Street, 17th Floor
San Francisco, CA 94103

SUBJECT: BCDC Support for the South San Francisco Bay Shoreline Project

Dear Mr. Kendall:

Thank you for the San Francisco District of the U.S. Army Corps of Engineers' (USACE) request that the San Francisco Bay Conservation and Development Commission (BCDC) support the flood risk management and ecosystem restoration project proposed by the USACE's South San Francisco Bay Shoreline Study. The project is described in the draft Chief's Report and Integrated Report sent to BCDC in September, was the subject of a briefing before our Commission on September 17, 2015, and has been the center of many detailed discussions between the project proponents and BCDC staff.

As the proposed project would be constructed by the federal government, with some local and state funding, BCDC will require the USACE to submit a Consistency Determination for review and approval by the Commission under the federal Coastal Zone Management Act (CZMA) prior to commencing any work on the ground. Based on decades of past practice and experience, the staff and Commission believe that it would be most prudent for the USACE to submit its Consistency Determination during the project's Pre-Construction Engineering & Design (PED) phase.

While that is the case, on November 5, 2015, on a vote of 17-0-0, the Commission requested that I send you this letter to demonstrate its support for the project in principle because its successful completion will greatly benefit the region's shoreline resilience and habitat. The Commission viewed the project purpose, at this phase, as being generally consistent with the enforceable policies of the Coastal Management Program (CMP) as contained in the McAteer-Petris Act and in the San Francisco Bay Plan. The Commissioners look forward to BCDC's formal review and action under the CZMA during the PED phase, during which more information will be available for BCDC to review as the Corps demonstrates complete compliance with the CMP.

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Mr. Thomas Kendall
United States Army Corps of Engineers
November 6, 2015
Page 2

The Bay Plan encourages converting publicly owned and non-operational salt ponds to tidal and subtidal habitats and designing ecosystem restoration and flood risk management features that provide for, and are adaptable to, a projected rise in sea level. The USACE project proposes to incorporate these attributes and its proposed ecotone would provide important habitat and ecosystem resilience. The Bay Plan requires that the public have access to the Bay shoreline, and the project would promote such access by proposing to fill a gap in the Bay Trail.

It is worthwhile to note that the Commission previously has unanimously approved at least two horizontal levees to create transition zones, upland habitat, and areas where marsh can move inland with rising sea level, first at Max Keech Properties (Permit No. 2007.005) and then at Sonoma Creek (Consistency Determination No. C2014.004.00). The Commission plans to analyze this project in light of its efforts to make the Bay's shoreline more resilient to expected rising sea level; it has consistently supported appropriate efforts to do so in the past. I hope this letter clarifies the Commission's position on this important proposal. Please be assured that we very much look forward to working with you to complete this very important project.

If you have any further questions, please contact Bob Batha of our staff at (415) 352-3612, or by email at bob.batha@bcdc.ca.gov. Of course, you can always contact me directly, as well.

Sincerely,

R. ZACHARY WASSERMAN
Chair

References:

BCDC (1979). Management Program for San Francisco Bay. San Francisco Bay Conservation and Development Commission (prepared with financial assistance from the Office of Coastal Zone

Management, National Oceanic and Atmospheric Administration, under the provisions of the

Federal Coastal Zone Management Act of 1972, as amended).

BCDC (2008). San Francisco Bay Plan. San Francisco Bay Conservation and Development Commission.

DAVE CORTESE
PRESIDENT, BOARD OF SUPERVISORS
COUNTY OF SANTA CLARA SUPERVISOR, THIRD DISTRICT
COUNTY GOVERNMENT CENTER, EAST WING
70 WEST HEDDING STREET, 10TH FLOOR
SAN JOSE, CALIFORNIA 95110
TEL: (408) 299-5030 FAX: (408) 298-6637
dave.cortese@bos.sccgov.org - www.supervisorcortese.org

August 19, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Dear Lt. Gen. Bostick:

As President of the Board of Supervisors of Santa Clara County, home to Silicon Valley, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline in our county, including Cisco, Google, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area that I represent houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

The Shoreline project is an innovative, critical investment in our community's future. That is why as the Board President—and proud representative of much of the precious shoreline itself—I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

We are the Shoreline.

Sincerely,

Dave Cortese
President, Santa Clara County Board of Supervisors

SANTA CLARA CALIFORNIA

Santa Clara 2001

Mayor

Jamie L. Matthews

Council Members

Dominic J. Caserta
Debi Davis
Lisa M. Gillmor
Patrick Kolstad
Jerry Marsalli
Teresa O'Neill

August 25, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the City of Santa Clara—home to the San Francisco 49ers and Levi's Stadium—I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along our shoreline, including Citrix, Intel, Google, Yahoo, and Oracle. These companies aren't just integral to our local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline.

Mayor and Council Offices
1500 Warburton Avenue
Santa Clara, CA 95050
(408) 615-2250
FAX (408) 241-6771
www.santaclaraca.gov

Lt. Gen. Thomas P. Bostick
August 25, 2015
Page 2

The Shoreline project is an innovative, critical investment in our community's future. In light of its importance to our city, and the region as a whole, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

We are the Shoreline.

Sincerely,

Jamie L. Matthews
Mayor
City of Santa Clara

cc: City Council
City Manager

CITY OF
SAN JOSE
CAPITAL OF SILICON VALLEY

Manh Nguyen
Councilmember – District 4

August 31, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

As the elected official representing a critical segment of the south bay shoreline, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

This shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline in and adjacent to my district, including Cisco, Brocade, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area that I represent houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including the economically disadvantaged community of Alviso in my district that sits 13 feet below sea level.

The Shoreline project is an innovative, critical investment in our community's future. That is why as the District 4 Councilmember—and proud representative of much of the precious shoreline itself—I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

We are the Shoreline.

Sincerely,

Manh Nguyen
Councilmember

200 East Santa Clara St. Fl. 18, San José, CA 95113 *tel* (408) 535-4904 District4@SanJoseCa.Gov

CITY OF SAN JOSE
CAPITAL OF SILICON VALLEY

Sam T. Liccardo
MAYOR

August 27, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

As Mayor of the 10th largest city in the United States, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our concerns of a rising sea level and a deteriorating bay ecosystem.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline, including Cisco, Google, Intel, Yahoo, and Oracle. Not only are these companies integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with devastating economic and social consequences. The shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. I look forward to continued cooperation with our partners through the design process to ensure flood control benefits to the shoreline area within San Jose. Once constructed, Shoreline will protect valuable public and private assets in San Jose, including the community of Alviso that sits on the shore, 13 feet below sea level.

200 East Santa Clara Street, 18th Floor San José, CA 95113 tel (408) 535-4800 fax (408) 292-6422 www.sjmayor.org

The Shoreline project is an innovative, critical investment in our community's future. That is why as the Mayor of San José, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

Sincerely,

Sam Liccardo
Mayor, City of San Jose

200 East Santa Clara Street, 18th Floor San José, CA 95113 tel (408) 535-4800 fax (408) 292-6422 www.sjmayor.org

San Jose Silicon Valley
CHAMBER OF COMMERCE

Executive Committee

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PRESIDENT & CEO
Matthew R. Mahood
San Jose Silicon Valley Chamber of Commerce

August 17, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. General Bostick:

On behalf of the San Jose Silicon Valley Chamber of Commerce and our 1500 members, we are writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

Our Chamber believes, as one of its guiding principles that "Infrastructure solutions must take a regional approach and will need to integrate partnerships across Silicon Valley". The South San Francisco Bay Shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline in our county, including Cisco, Google, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area in north San Jose houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

The Shoreline project is an innovative, critical investment in our community's future. In light of its importance to our member businesses and their 250,000 employees, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

We are the Shoreline.

Sincerely,

Matthew R. Mahood
President & CEO

101 W. Santa Clara St. | San Jose, Calif. 95113 | P: 408 291 5250 | F: 408 286 5019 | sjchamber.com

Chamber of Commerce
MOUNTAIN VIEW

August 17, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the Mountain View Chamber of Commerce, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline in our county, including Intuit, Google, and LinkedIn. These companies aren't just integral to the local economy by employing tens of thousands of people; they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides and sea level rise, with devastating economic and social consequences. The shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

580 Castro Street Mountain View, California 94041 tel 650.968.8378 fax 650.968.5668 www.chambermv.org

1

The Shoreline project is an innovative, critical investment in our community's future. In light of its importance to our businesses and their employees, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

Sincerely,

Oscar Garcia
President & CEO

2

August 27, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the Sunnyvale Silicon Valley Chamber of Commerce and its 500 member businesses, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study. This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along our shoreline, including NetApp, Google, Intel, Yahoo, Amazon126, Comcast, Lockheed Martin, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to

provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline.

The Shoreline project is an innovative, critical investment in our community's future. In light of its importance to our 500 businesses and their 30,000 employees, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report.

Sincerely,

Don Eagleston

Don Eagleston
President & CEO
Sunnyvale Silicon Valley Chamber of Commerce

2

SANTA CLARA
SILICON VALLEY CENTRAL®
CHAMBER OF COMMERCE & CONVENTION – VISITORS BUREAU

August 27, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the Santa Clara Chamber of Commerce's almost 600 member businesses, I am writing to convey our strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline, including Citrix, Google, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including global business leaders.

The Shoreline project is an innovative, critical investment in our community's future. In light of its importance to our businesses and their 22,000 employees, I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

We are the Shoreline.

Sincerely,

Roy Truitt
Interim President & CEO
Santa Clara Chamber of Commerce

1850 Warburton Avenue, Santa Clara, CA 95050 • www.santaclarachamber.org • www.santaclara.org
Telephone: 408.244.8244 • Chamber of Commerce Fax: 408.244.7830 • Convention-Visitors Fax: 408.244.9202

OPEN SPACE AUTHORITY
SANTA CLARA VALLEY

August 26, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the Santa Clara Valley Open Space Authority, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. In addition, the shoreline area contains precious open space traversed by recreational trails that provide thousands of visitors with sweeping views of the south bay, its tidal wetlands, and the unique flora and fauna that live within them.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets along the shoreline, including sensitive wetlands that provide critical habitat for many plant and animal species, some of which are endangered.

5980 Santa Teresa Blvd
Suite 100
San Jose, CA 95119
408.224.7476 T
408.224.7548 F
openspaceauthority.org

The Shoreline project is an innovative, critical investment in our community's future. That is why I ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

Sincerely,

Andrea Mackenzie

Andrea Mackenzie
General Manager

SAVE THE BAY

August 26, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick,

On behalf of Save The Bay, I wish to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and the project, once built, will provide a resilient solution to some of our region's most serious sea level rise concerns, while also addressing some of our most pressing ecosystem restoration priorities.

The south San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline, including Cisco, Google, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy, employing tens of thousands, but also drive the global economy.

Currently, these important assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with potentially devastating economic and social consequences. To give just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than one million people. Left unprotected from flooding, the facility could be compromised, threatening the health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected, removing their ability to naturally protect the shoreline against flooding from extreme weather events exacerbated by climate change

The Shoreline project directly addresses these issues, by restoring up to twenty-five square miles of Bay habitat and providing crucial protection from tidal flooding, while also providing public access and recreation along restored tidal areas. Importantly, Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets for residents of San Jose, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

The Shoreline project is a critical and innovative investment in our community's future that will benefit our economy and our community for generations to come. Therefore, we ask respectfully that you advance the South San Francisco Bay Shoreline Study to a signed Chief's Report.

Sincerely,

David Lewis

David Lewis
Executive Director

SILICON VALLEY LEADERSHIP GROUP

2001 Gateway Place, Suite 101E
San Jose, California 95110
(408)501-7858 svlg.org
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President & CEO

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UPS
RICK WALLACE
KLA-Tencor
KEN XIE
Fortinet
JED YORK
San Francisco 49ers
Established in 1978 by
DAVID PACKARD

August 28, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

Lt. Gen. Bostick:

On behalf of the Silicon Valley Leadership Group, I am writing to convey my strong support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The South San Francisco Bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline, including Cisco, Google, Intel, Yahoo, and Oracle. These companies aren't just integral to the local economy by employing tens of thousands, they also drive the global economy.

Yet these assets are vulnerable to catastrophic flooding from increasingly volatile storms, king tides, and sea level rise, with devastating economic and social consequences. As just one example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of residents in Silicon Valley. To make matters worse, vast areas of tidal wetlands along the shoreline have been diked off, developed, or neglected outright, removing their ability to naturally protect the shoreline against flooding.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Importantly, the Shoreline Study calls for the use of natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets in San Jose, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

The Shoreline project is an innovative, critical investment in our community's future. That is why we ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. Without question, this project will be to the benefit of our economy, our community, and our future.

The Silicon Valley Leadership Group, founded in 1978 by David Packard of Hewlett-Packard, represents more than 375 of Silicon Valley's most respected employers on issues, programs and campaigns that affect the economic health and quality of life in Silicon Valley, including energy, transportation, education, housing, health care, tax policies, economic vitality and the environment.

Thank you for your leadership on this issue. If you have any questions on our position, please contact Mike Mielke, Vice President of Environmental Programs & Policy at 408-501-7858 or mmielke@svlg.org.

Sincerely,

Mike Mielke
Senior Vice President of Environmental Programs & Policy
Silicon Valley Leadership Group

BAYAREA COUNCIL

August 28, 2015

Lt. Gen. Thomas P. Bostick
Commanding General and Chief of Engineers
U.S. Army Corps of Engineers
441 G St., NW
Washington, DC 20314

RE: Support for the South San Francisco Bay Shoreline Study

Lt. Gen. Bostick:

On behalf of Bay Area Council, I am writing to express support for the South San Francisco Bay Shoreline Study (Shoreline). This study has been decades in the making and once built, the project will provide a resilient solution to our sea level rise concerns and ecosystem restoration priorities.

The South San Francisco bay shoreline area contains homes, schools, businesses and critical infrastructure—including roads, bridges, and power, water, and wastewater pipelines—worth more than $50 billion. Many of the most recognized companies in the world are located along the shoreline, including Cisco, Google, Intel, Yahoo, and Oracle. These companies are integral to the local economy, employing tens of thousands, but also drive economic growth globally.

However, these assets are vulnerable to catastrophic flooding from increasingly volatile storms, sea level rise, and the degradation of tidal wetlands --our natural protectors against flooding and sea level rise-, posing devastating economic and social consequences. For example, the shoreline area houses the largest wastewater facility in the Bay Area, serving more than 1 million people. Left unprotected from flooding, the facility could become compromised, threatening the public health and safety of hundreds of thousands of local residents. The Bay Area Council Economic Institute estimates that a regional mega storm would result in over $10 billion in damages.

The Shoreline project directly addresses these issues, by restoring up to 25 square miles of bay habitat, providing crucial protection from tidal flooding, and providing public access and recreation along restored tidal areas. Shoreline will use natural infrastructure to provide an adaptable flood protection system that can evolve over time. Once constructed, Shoreline will protect valuable public and private assets in San Jose, including the economically disadvantaged community of Alviso that sits 13 feet below sea level.

The Shoreline project is an innovative, critical investment in our community's future. That is why we ask you to allow the South San Francisco Bay Shoreline Study to advance toward a signed Chief's Report. This project will be to the benefit of our economy, our community, and our future.

Sincerely,

Jim Wunderman
President & CEO
Bay Area Council

P 415.946.8777
F 415.981.6408

353 Sacramento Street, 10th Floor
San Francisco, California 94111

1215 K Street, Suite 2220
Sacramento, California 95814

DIANNE FEINSTEIN
CALIFORNIA

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COMMITTEE ON THE JUDICIARY
COMMITTEE ON RULES AND ADMINISTRATION

United States Senate
WASHINGTON, DC 20510-0504
http://feinstein.senate.gov

Chair Stockton and members of the review board,

I write to repeat my strong support for the South San Francisco Bay Shoreline Study. I would also like to express my appreciation for the diligent efforts of all to complete this study on time: the Army Corps of Engineers, Fish and Wildlife Service, Santa Clara Valley Water District, and California Coastal Conservancy.

Decades in the making, this project is an innovative and cost-effective solution to flooding and sea level rise brought on by our changing climate. Coupled with ecosystem restoration, this project will provide both refuge to protected species in the region and protection for the vulnerable communities that lie beyond the patchwork of existing levees.

With nearly 200 square miles of communities in low-lying areas along the shoreline, some that are more than 13 feet below sea level, it is now well-established that this area faces a significant threat of major tidal flooding. Climate change and the inevitable sea level rise will only exacerbate this dire situation.

Much has changed since the surrounding dikes and levees were first constructed in the 1920s. Originally constructed for commercial salt ponds, these same dikes now surround vast urban tracts, home to Silicon Valley and critical infrastructure, like the largest advanced wastewater treatment facility in the western United States. This patchwork of dikes and levees—never designed for flood risk management—is now all that stands between these vulnerable communities and major flood events.

The effects of a major flood could be devastating. The Shoreline houses public and private infrastructure valued at more than $50 billion. Drivers of economic growth—Google, Cisco, and Oracle, among them—are located here. And many communities, like that of Alviso, call this home. Yet the only infrastructure protecting these communities from widespread economic and environmental devastation is an outdated and ill-suited system of dikes, levees, and ponds. Increasing this region's resilience to flooding and climate change is therefore money well spent.

The area's tidal marsh habitat has also been subject to severe environmental degradation, with more than 90 percent of the original tidal wetlands diked, drained, or filled over the past century. This decline in habitat quality and quantity has undermined the wetlands' dual benefits: providing refuge to impacted protected species, like steelhead trout and the salt marsh harvest mouse, while mitigating flood risks.

Once completed, this multi-purpose project will restore up to 25 square miles of lost tidal wetland habitat, provide protection from tidal flooding to urban areas adjacent to the South San Francisco Bay, and provide important opportunities for public access and recreation. Allowing the levees and ecosystem restoration to work in tandem also means this project satisfies two of the Corps' primary missions: flood risk management and habitat restoration. Beyond that, by relying on natural infrastructure, this project will develop and construct a flood protection system that can evolve over time.

I have had a long involvement in this project, from its initial concept to implementation, and strongly urge you to support this effort today.

Sincerely,

Dianne Feinstein
United States Senator

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