# TABLE OF CONTENTS

## Elkhorn Slough Tidal Marsh Restoration Project, Phase 1
## Request for Incidental Harassment Authorization

## List of Figures



## List of Tables

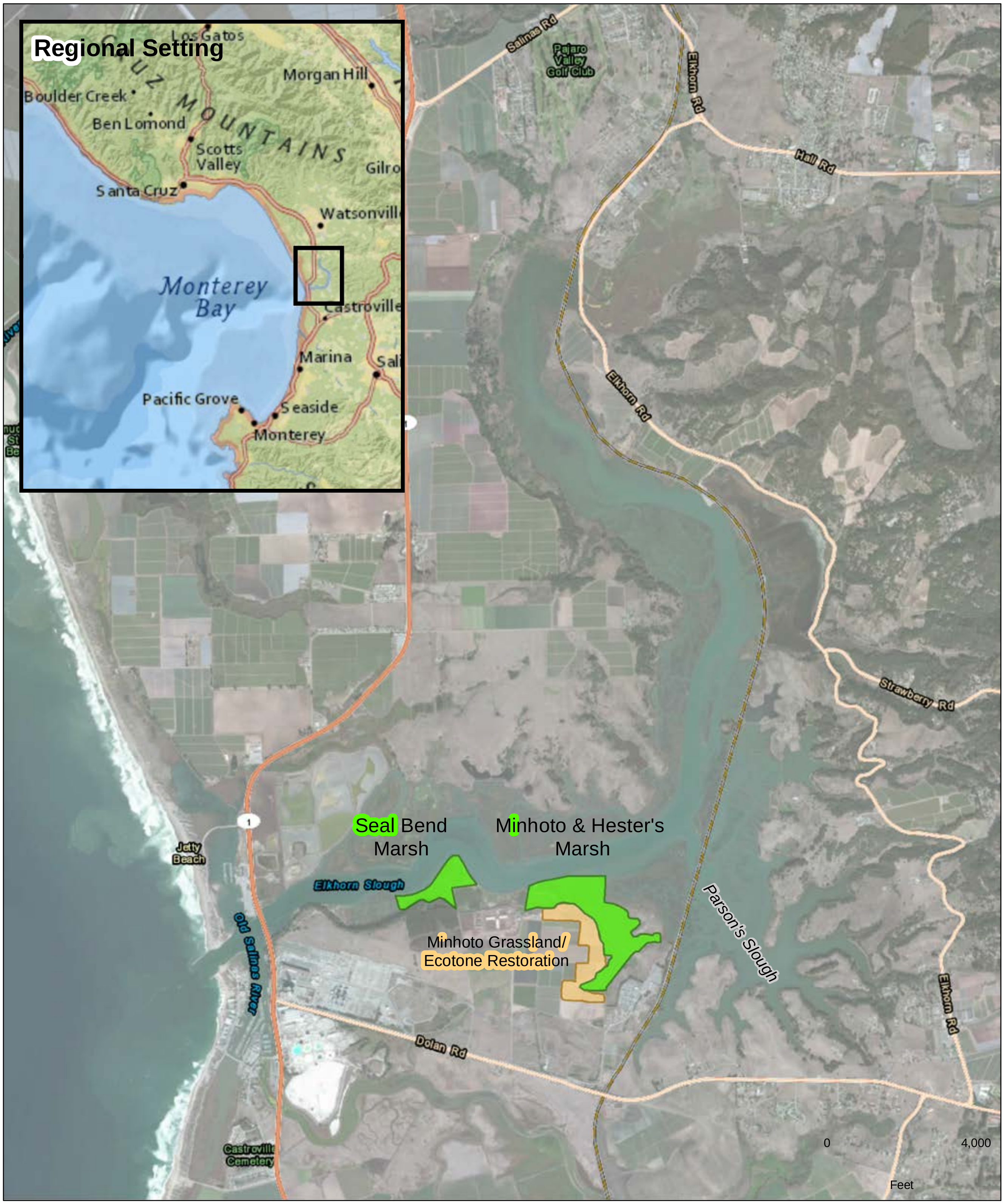
# SECTION 1
# Description of Specified Activity

## 1.1 Background

The Elkhorn Slough Tidal Marsh Restoration Project (project or proposed project) would restore 147 acres of vegetated tidal salt marsh, upland ecotone, and native grasslands in Monterey County (**Figure 1-1**). This request for Incidental Harassment Authorization (IHA) coverage covers only Phase 1 of the proposed project. The project would restore approximately 47 acres of tidal marsh within the Minhoto-Hester Marsh area of Elkhorn Slough and additional tidal marsh, upland ecotone and native grassland within the buffer area (**Figure 1-2**). Future phases (which are not part of this application and would be permitted separately from the proposed project) would begin at the completion of the proposed project (Phase 1) and may be implemented over several construction seasons. Some work associated with future phases (e.g., delivery and stockpile of sediment from off-site sources) could begin prior to completion of the proposed project; however, any work below MHHW would likely not occur for several years. Future phases are unfunded and present some additional technical challenges since the tides cannot be easily blocked for sediment addition work. Another IHA request will be made prior to implementation of future phases.

The Elkhorn Slough estuary is one of the largest estuaries in California and contains the State's largest salt marshes south of San Francisco Bay. The slough provides important habitat for an exceptionally broad range of resident and migratory birds, fish, and other wildlife, and plays a crucial role in the local estuarine and nearshore food web. The Elkhorn Slough watershed encompasses approximately 45,000 acres. The Elkhorn Slough Ecological Reserve is owned and managed by the California Department of Fish and Wildlife (CDFW). Those lands are also designated as Elkhorn Slough National Estuarine Research Reserve (ESNERR) with administrative and research funding provided by the National Oceanic and Atmospheric Administration (NOAA) to CDFW through the Elkhorn Slough Foundation (ESF). The ESF is an accredited land trust and partner to CDFW. ESF owns nearly 3,300 acres and manages easements on an additional 300 acres of private land in the Elkhorn Slough watershed (Elkhorn Slough Foundation, 2014). A large portion of Elkhorn Slough is designated by CDFW as the Elkhorn Slough Marine Protected Area. The boundary of this designation extends to the mean high tide level. Therefore, some of this proposed project occurs within the Marine Protected Area.

The slough system has historically faced substantial tidal wetland loss related to prior diking and marsh draining, and is presently facing unprecedented rates of marsh degradation. Over the past 150 years, human activities have altered the tidal, freshwater, and sediment processes which are




Elkhorn Slough Tidal Marsh Restoration Project . D120505.00

**Figure 1-1**
Regional Setting

essential to support and sustain Elkhorn Slough's estuarine habitats. Fifty percent of the tidal salt marsh in Elkhorn Slough has been lost in the past 150 years. This habitat loss is primarily a result of two historic land use changes, 1) construction of a harbor at the mouth of the slough and the related diversion of the Salinas River, which lead to increased tidal flooding (and subsequent drowning of vegetation) and 2) past diking and draining of the marsh for use as pasture land. The act of draining wetlands led to sediment compaction and land subsidence, from 1 to 6 feet. Decades later, the dikes began to fail, reintroducing tidal waters to the reclaimed wetlands. Rather than converting back to salt marsh, the areas converted to poor quality, high elevation intertidal mudflat, as the lowered landscape was inundated too frequently to support tidal marsh, and insufficient sediment supply was available in the tidal waters to rebuild elevation. The loss of riverine sediment inputs, continued subsidence of marsh areas, sea level rise, increased salinity, and increased nutrient inputs may also contribute to marsh loss (Watson et al., 2011). Bank and channel erosion in Elkhorn Slough are leading to deepening and widening tidal creeks, causing salt marshes to collapse into the channel, and eroding sediments that provide important habitat and support estuarine food webs.

In 2004, ESNERR initiated a planning effort (Tidal Wetland Project) to evaluate marsh dieback and tidal erosion at Elkhorn Slough and to develop restoration and management strategies. Experts from multiple disciplines agreed that without intervention, excessive erosion would continue widening the tidal channels and that salt marsh would continue to convert to mudflat. If left unabated, continued erosion at present rates could result in a significant loss of habitat function and decrease estuarine biodiversity. Habitat loss is expected to become more severe with accelerating sea level rise. As described more fully in the following subsections, the project proposes restoration and experimental designs to address these issues across a range of impacted tidal marshlands, including subsided marsh areas that now support substantially less emergent marsh and more mudflat than was historically present.

## 1.2 Goals and Objectives

The proposed project's goals and objectives were developed by ESNERR staff and are listed below:

**Goal 1: Increase the extent of tidal marsh in Elkhorn Slough**

***Objective 1.1*****:** Restore salt marsh ecosystem in 47 acres of historically diked and drained areas through adding sediment.

**Goal 2: Reduce tidal scour in Elkhorn Slough**

***Objective 2.1*****:** Add sediment to 47 acres of historically diked and drained areas, thereby decreasing the tidal prism.

**Goal 3: Protect and improve surface water quality in Elkhorn Slough**

***Objective 3.1*****:** Establish a permanent vegetated buffer to absorb upland sediment and contaminants.

**Goal 4: Provide resilience to climate change to estuarine ecosystems in Elkhorn Slough**

***Objective 4.1*****:** Increase the extent of tidal marsh from one to two feet to be resilient to moderate sea level rise.

**Goal 5: Increase understanding of how best to restore salt marsh**

***Objective 5.1*****:** Conduct a well-designed and monitored project so that lessons learned can inform future salt marsh restoration projects in the estuary.

## 1.3 Location and Setting

The proposed project is located in the Elkhorn Slough estuary, situated 90 miles south of San Francisco and 20 miles north of Monterey (Figure 1-1). The site is located on land owned and managed by CDFW as part of ESNERR. The project site is shown in **Figure 1-2**. One Marine Protected Area (MPA), a State Marine Reserve (SMR), is located within the project site. Two additional MPAs are located within approximately one mile of the project site: Elkhorn Slough State Marine Conservation Area (SMCA) and Moro Cojo Slough SMR. Regional access to the site is provided by U.S. Highway 101 (U.S. 101), State Route 1 (SR 1), State Route 156 (SR 156), and State Route 183 (SR 183). Local access is provided by Dolan Road and Via Tanques Road in the unincorporated area of Monterey County known as Elkhorn, between Moss Landing and Prunedale.

## 1.4 Overview of Existing Land Use

The Elkhorn Slough system is a network of intertidal marshes, mudflats, and subtidal channels located at the center of the Monterey Bay shoreline. Elkhorn Slough has an average depth of 4.6 feet, and is deepest at the SR 1 bridge overcrossing where it measures 25 feet deep at mean lower low water (MLLW). The main channel in Elkhorn Slough becomes narrower and shallower as it winds inland. Tidal marshes in the slough are dominated by perennial pickleweed (*Salicornia pacifica*) and occur at higher intertidal elevations than the mudflats that lie below the tidal marshes. Pickleweed provides important habitat for a variety of aquatic and terrestrial species and pickleweed-dominated marshes are generally recognized as having significant ecological value (Woolfolk and Labadie, 2012).

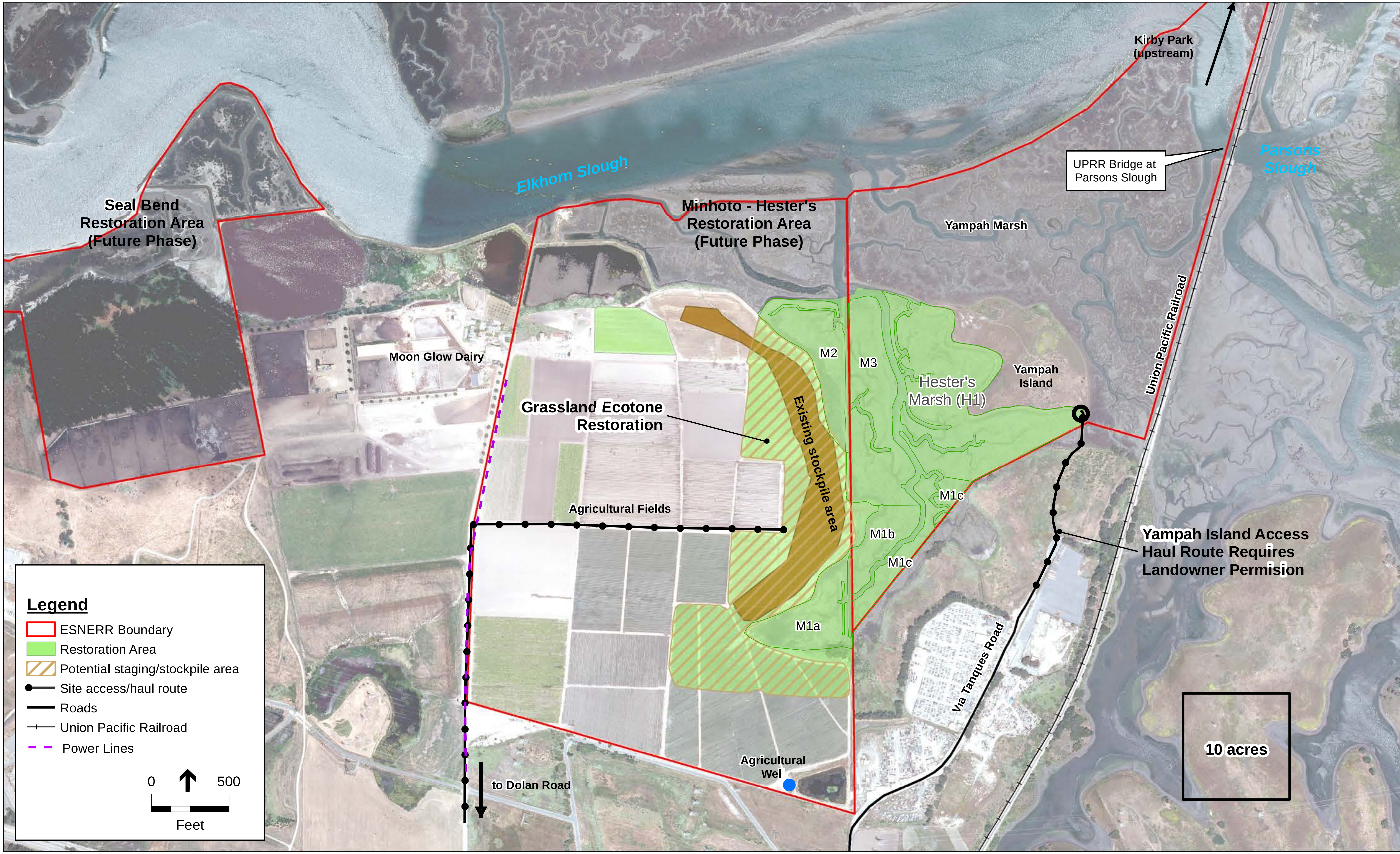
Surrounding Elkhorn Slough are the hilly uplands and marine terraces that lie between the Pajaro and Salinas valleys. Upland areas drain into Elkhorn Slough through numerous small ephemeral creeks. The largest of these is Carneros Creek at the head of the estuary. Land use in these uplands consists of agriculture (primarily strawberries and other row crops), cattle grazing, rural residences, and the small town of Las Lomas. Wetlands, mudflats, and marsh areas on both sides of Elkhorn Slough characterize the immediate project setting. Uplands surrounding Elkhorn Slough are primarily undeveloped.

## 1.5 Restoration Areas

The proposed project would restore one portion of the ESNERR, the Minhoto-Hester restoration area (consisting of sub-areas M1a-c, M2, M3, and H1) and the buffer area between the remnant marsh and agricultural fields, containing the existing stockpile area (Figure 1-2).

The Minhoto-Hester restoration area is, like the Seal Bend area, a low-lying area consisting of subsided pickleweed marsh, intertidal mudflats, tidal channels and remnant levees. Similar to Seal Bend, the area has multiple cross-levees and both natural and dredged channels. A major dredged channel (over 100 feet wide in some locations) runs north-south through the remnant marsh. The perimeter levee at the Minhoto-Hester area shows signs of erosion.

The buffer area upslope of the Minhoto-Hester restoration area is located on gently sloping uplands adjacent to the tidal marsh and mudflats. Historically, both the buffer area and the adjacent agricultural fields were used to grow crops such as strawberries and artichokes as well as bulb/flower production, but are not currently in active production (Andrea Woolfolk, pers. comm. in ESA, 2015a). Since 2012, the buffer area has been planted in sterile barley. In July of 2013, approximately 50,000 cy of sediment was delivered from the Pajaro River Bench Excavation Project and stockpiled within the buffer area for use in the Elkhorn Slough Tidal Marsh Restoration Project. The stockpile presently covers an area of approximately 11 acres and has been re-planted in triticale, a sterile hybrid of wheat and rye, to prevent erosion. Portions of the agricultural fields, including the stockpile area, may be tiled for drainage. However, the buffer area was probably not historically tiled for drainage (Monique Fountain, pers. comm., 2015).




Elkhorn Slough Tidal Marsh Restoration Project . D120505.00

**Figure 1-2**

Restoration Plan Overview

This page intentionally left blank

## 1.6 Project Characteristics

The proposed project would restore approximately 47 acres of tidal marsh within the Minhoto-Hester Marsh area and additional tidal marsh, upland ecotone and native grassland within the buffer area (**Figure 1-3**). This work would require between approximately 170,000 cy of fill to raise the marsh plain an average height of 2.4 feet, or 1.9 feet after one year of soil consolidation. The entire remnant marsh plain would be raised to an elevation that would allow emergent wetland vegetation to naturally reestablish and persist.

A 35-acre portion of the buffer area would be revegetated with native dominated perennial grassland. The native grassland area would be re-vegetated by reducing the weed seed bank and planting native grasses/forbs. A weed-resistant border of rhizomatous perennial plants that readily spread (e.g., creeping wild rye [*Elymus triticoides*] or Santa Barbara sedge [*Carex barbarae*]) would be planted between the grassland and ecotone. The remaining 6-acre portion of the buffer (proposed grassland/ecotone restoration) area would be used as a stockpile location for future restoration phases and be revegetated with annual barley. Upon completion of future phases this area would be restored as well. The revegetation process would similarly include reducing the weed seed bank, decompacting the soil, and potentially adding an organic matter amendment.

The project would improve marsh sustainability with sea level rise, as the restored marsh would be higher in the tidal frame, further from the drowning threshold, and marsh vegetation in the restored areas would accrete organic material that would help the restored marsh plain rise with sea level. The project would also reduce tidal prism in Elkhorn Slough, reducing the potential for ongoing tidal scour and associated marsh loss.

## 1.7 Design Elements and Grading

Design elements to restore hydrologic function to the project area would include raising the subsided marsh plain, maintaining or re-excavating the existing tidal channels, and excavating within the upland buffer area to restore marsh plain, ecotone, and native grassland habitat.

### 1.7.1 Restored Marsh Plain

The subsided former marsh plain (currently mostly too low to sustain vegetation) would be raised over an area of approximately 47 acres to mid-high marsh plain elevations. Based on vegetation-elevation data collected for the project (ESA, 2013), this target elevation would support a healthy growth of perennial pickleweed as well as a diverse high marsh community. Sediment would be placed to a fill elevation slightly higher than the target marsh plain elevation to allow for settlement and consolidation of the underlying soils. The average fill depth would be 2.1 feet, including 25 percent overfill. **Table 1** below presents the acreages of the restoration sites and extents of proposed fill within each marsh sub-area, as well as the volume of fill required for each marsh sub-area. The stockpiled Pajaro Bench soils and onsite borrow would be used as fill sources. The project would rely primarily on natural vegetation recruitment in the restored marsh areas.

**TABLE 1**
**VOLUME OF FILL REQUIRED IN EACH SUB-AREA**

| Project Component / Staging Area | Area (acres) | Fill Area (acres) | Fill volume (range in cubic yards) |
|---|---|---|---|
| Phase 1 | | | |
| Sub-area M1 | 12.1 | 9.5 | 28,000 to 43,700 |
| Sub-area M2 | 5.6 | 4.5 | 10,700 to 17,700 |
| Sub-area M3 | 11.1 | 8.3 | 27,000 to 41,000 |
| Sub-area H1 | 17.8 | 14.1 | 42,100 to 65,300 |
| *Subtotal Phase 1* | *47* | *36* | *107,900 to 167,800* |
| **Total Phase 1** | **47** | **36** | **107,900 to 167,800** |

NOTE: Volumes in presented in this table are mid-range estimates; actual volumes may be higher or lower.

SOURCE: ESA, 2014b, Final Elkhorn Slough Tidal Marsh Restoration Project Restoration Plan, July 1, 2014

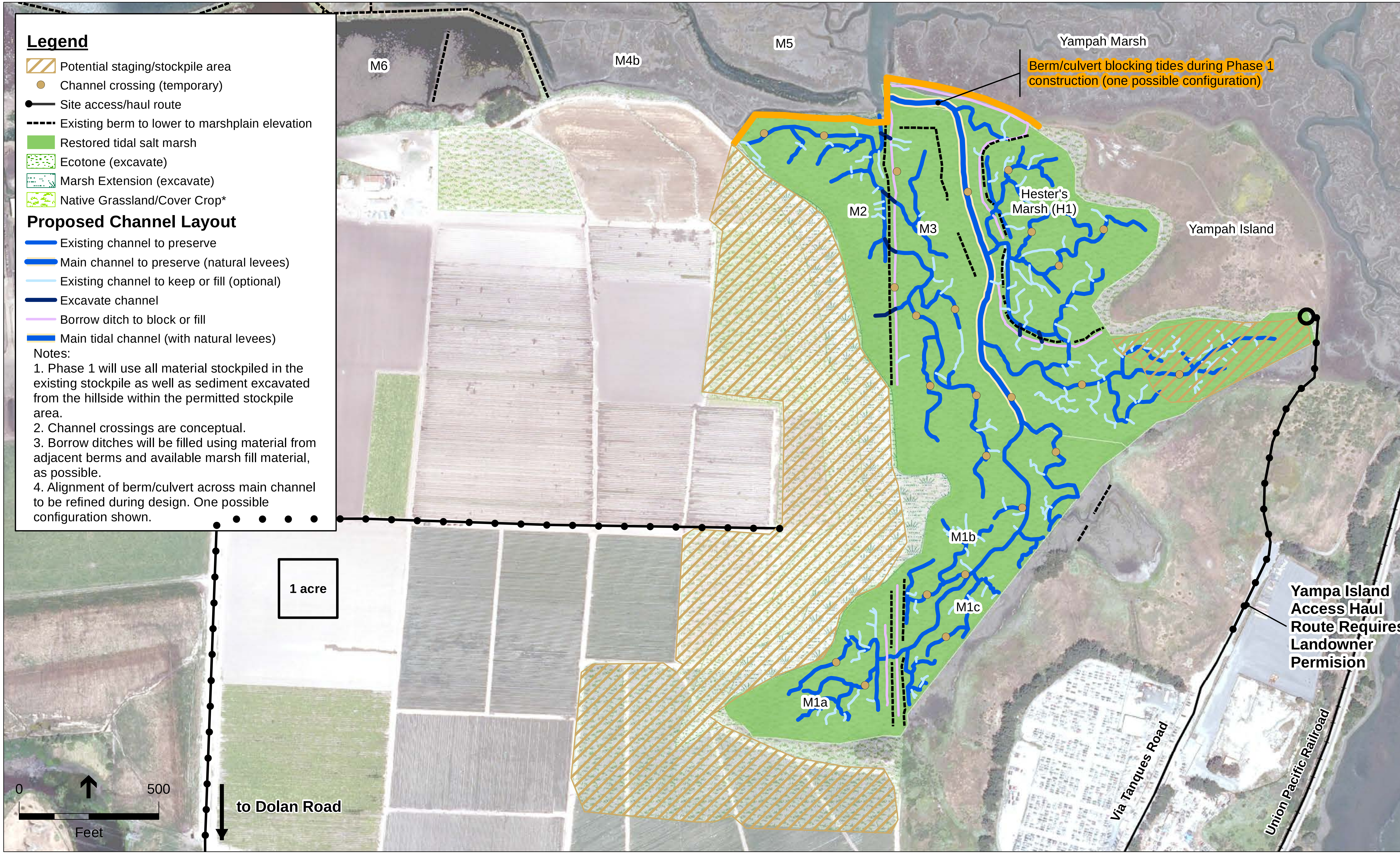
A natural marsh plain is very gently sloped, more gently than can be graded during construction. Where permeable soils are used for marsh fill, the marsh plain would be approximately flat to simplify design and construction. Where less permeable soils are used, the design may include a slightly sloped marsh plain to improve drainage. The stockpiled Pajaro Bench soils are relatively permeable, while onsite upland borrow sediments are expected to be less permeable.

### 1.7.2 Tidal Channels

Remnant historic channels onsite would generally be left in place or filled and re-excavated in the same place. As needed for marsh access, smaller channels would be filled. Avoidance of channel fill, temporary and permanent, is preferred. As much of the existing tidal channel network would be maintained as is feasible, and the post-project channel alignments would be similar to those under existing conditions. The density of channels (length of channel per acre of marsh) after restoration would be comparable to the density in natural reference marshes.

Low levees (less than 0.5 feet above the marsh plain) composed of fill material would be constructed along the larger channels to simulate natural channel levees. The project would recreate natural levee features along the sides of the main channel into the Minhoto-Hester area. Fill would be placed as close to the edge of the channel as possible to simulate the form and function of a natural channel bank.

Borrow ditches that date from the times of historical wetland reclamation in these areas would be blocked or filled completely if fill is available after raising the marsh plain. Blocking borrow ditches would route more flow through the natural channels and slightly increase hydraulic resistance, which may achieve benefits from reducing tidal prism and associated scour in the Elkhorn Slough system.




Path: J:\GIS\Projects\12xxxx\D120505 - Elkhorn Cultural Wetland Del\BA\Fig2-4_Phase1Area.mxd
9/10/2015

Source: Air photo from NAIP 2010.

Elkhorn Slough Tidal Marsh Restoration Project . D120505.00

**Figure 1-3**
Restoration Areas

This page intentionally left blank

### 1.7.3 Marsh, Ecotone and Grasslands in the Buffer Area

The buffer area would be graded to increase marsh area and create a gently sloping ecotone band along the edge of the restored marsh. Specifically, excavation would widen the existing marsh (by up to 150 feet) and create a band of gentle slope (e.g., 1:30) on the hillside, fostering creation of a wider ecotone habitat. The remaining buffer area would be restored to native grassland habitat. The north end of the buffer area (adjacent to M4 and M6) would be restored in a later phase so this area could be used to stockpile material for future placement on subareas M4, M5, and M6.

### 1.7.4 Experimental Design

Field experiments would be built into the design, with the results of these experiments helping to refine the design for subsequent phases. Experiments would utilize different approaches to marsh plain fill elevation, tidal creek construction, sediment texture and organic matter amendment, marsh plain slopes, ecotone/grassland revegetation and weed control, followed by monitoring.

### 1.7.5 Sediment Source

In 2013, approximately 50,000 cy of clean sediment, suitable for marsh fill, was delivered to the existing stockpile area from Santa Cruz County's Pajaro Bench Excavation Project. Approximately 167,000 cy of sediment is required for implementation of the proposed project. CDFW plans to utilize the 50,000 cy of imported sediment, along with approximately 117,000 cy of sediment excavated from existing upland areas of the project site, to achieve the requisite 167,000 cy necessary for project implementation. However, should an additional source of offsite sediment become available prior to project implementation, CDFW would consider importing that sediment and using it in lieu of or in combination with the sediment excavated from the project site. Any imported sediment considered for use in the restoration would be evaluated for quality, timing, feasibility and affordability.

## 1.8 Construction Timing and Sequencing

Construction is scheduled to start as soon as permitting is complete (current start window - October 2016 – February 2017) and is anticipated to take 11 months. Construction sequencing would begin with water management and/or turbidity control measures constructed around the work areas prior to placing material on the marsh (discussed more fully in the sections below). After fill placement on the marsh, any temporary features, such as water management berms, sheet pile and culverts, would be removed. The following sections describe each of these steps.

# 1.9 Construction

## 1.9.1 Access Routes

The access routes are shown on Figure 1-2. Construction crews and equipment would access the existing stockpile area and Minhoto Marsh from Dolan Road via existing roadways that were used for delivery of the existing sediment stockpile, located alongside the existing agricultural fields. The Hester Marsh staging area may be accessed from Via Tanques Road shown in Figure 1-2. This access route would require permission and collaboration with the land owners.

All material needed for this phase of the project is onsite. Additional material may be delivered to the restoration areas by trucks if it becomes available. If available, delivered material could be stockpiled in the vicinity of the restoration site in locations shown on Figure 1-2, or placed directly on the marsh for spreading. Material would be hauled onsite using the access route described above.

## 1.9.2 Construction Equipment

Construction equipment would include haul trucks, heavy earthmoving equipment, such as dozers, backhoes, loaders, and excavators to transport dry material out onto the marsh. A conveyor system could also be used to transport material from a stockpile out to the marsh, in lieu of dozers. In such cases, timber matting could be temporarily placed on the marsh to provide a stable footing for the conveyors. A mobile radial stacker at the end of the conveyor belt would be rotated to spread the material.

## 1.9.3 Working and Staging Areas

The approximately 30-acre working/staging area would be located as shown on Figure 1-2. If additional material becomes available it may also be stockpiled in this area. The existing stockpile area, which is positioned near the restoration area, is shown in Figure 1-2. Crews would work from the existing stockpile and transport excavated and stockpiled sediment out into the marsh. The stockpile area encompasses the shoreline along the proposed marsh restoration areas to enable progressive placement as needed within the wetlands.

## 1.9.4 Material Placement

Once water control and/or turbidity measures are in place, sediment would be transported from the stockpile to the marsh by means of earthmoving equipment, possibly supplemented with a conveyor system. All heavy equipment used to transport dry material out onto the marsh would be of low ground pressure to prevent sinking in the mud. Mats would be temporarily placed on the marsh, as needed, to spread the weight of the equipment. A conveyor system could also be used to transport dry material from the stockpile out to the marsh, in lieu of dozers pushing the material the full distance. In the latter case, a loader would continuously load the conveyor system with material near the stockpile, and a dozer at the marsh drop off location would spread the material. A conveyor system may increase construction time because it would need to be assembled and taken apart to move it to new areas. A conveyor system is also likely cost prohibitive. At the end of construction in each cell/stage, any elevated haul roads and/or berms constructed to aid in material placement would be excavated to design grades, with the resulting earth used to fill adjacent restoration areas.

### 1.9.5 Water Control and Turbidity Management

Work areas on the remnant marsh plain would for the most part be isolated from the tides and dewatered to allow construction in non-tidal conditions. Water control structures such as temporary berms would be utilized to isolate the fill placement area during the construction period. Existing berms would be used, where possible. There are a number of potential configurations and these will depend on the workflow of the contractor chosen. For this document we have identified the water control option with the greatest potential impacts and this is a sheet pile wall at the mouth of the restoration area (Figure 1-3). It is likely that the mouth of the restoration area can be closed with an earthen dam or an inflatable dam and the sheet pile (vibratory hammering) would not occur. Tidal channels into such areas would be blocked. The isolated work areas would be drained using a combination of gravity and pumps. Water levels within the blocked areas would be managed to keep them mostly free of water (with some ponded areas remaining) and to allow fill placement at all stages of the tides. To reduce the potential for fish to become entrained in isolated ponded areas blocking of tidal channels would occur at low tide. When sediment placement is completed, the berms would be lowered to the target marsh elevation, reintroducing tidal inundation. Additionally, any blocked tidal channels will be re-excavated.

### 1.9.6 Tidal Channels

Tidal channels are an important design feature of the restoration plan. For earthmoving equipment, however, tidal channels present a challenge to navigating the marsh. The most efficient method of earthmoving would be to fill the marsh plain to the target elevation, with straight paths throughout the fill footprint to push the material. Working around the channels and extending the trip paths from the stockpile to the fill locations would increase the time, and therefore cost, of restoring the marsh.

To limit trip distances onto the marsh, the project would employ one or more of the following placement approaches. Temporary channel crossings may be constructed, or tidal channels may be temporarily filled and then re-dug with an excavator or backhoe. If re-excavation of the smaller channels proves infeasible, these channels may be permanently filled, the resulting channel extent consisting of the larger channels only. The resulting channel extent would be sufficient to provide drainage and tidal exchange to support natural marsh functions.

The number and locations of channel crossings would depend on the tradeoff between haul distances and the ease of installing and removing the crossings. Where tidal channels were maintained in place, turbidity control measures (i.e., BMPs, such as hay bales or weed free straw wattles) could be staked down in or adjacent to the channels to be preserved. Bulldozers would push fill up to the hay bales and wattles, but not into the channels. Channel crossings and BMPs would be removed at project completion.

### 1.9.7 Construction Workforce

The construction workforce would require approximately 6 full-time workers and approximately 3 part-time workers plus occasional engineer visits and supplies delivery.

## 1.10 Operations and Maintenance

Following construction, it is expected that the restored marsh plain would be self-maintaining; no active management would be anticipated. CDFW would maintain the upland ecotone and grasslands revegetation area in a manner consistent with its other properties in the area. Maintenance activities would generally include periodic visits to the site for removing trash, pulling weeds, and reseeding, as necessary. As a primary purpose of the restoration project is to garner scientific information about the effectiveness of various restoration techniques, all areas of the restoration project would be monitored for several years following project construction.

# SECTION 2
# Dates, Duration, and Specified Geographic Region

## 2.1 Dates and Duration

It is anticipated that construction would begin in February 2017 and last approximately 11 months (if continuous) and may be implemented over two construction seasons. If there is a break in construction activities the construction window would be extended by the length of the break. The timing and duration of each project component is likely weather dependent. The eleven month window is a conservative estimate and includes ecotone and grassland restoration work as well. Most of the work on the marsh plane should be completed with six to eight months. The construction period assumes that the construction contractors would work between the hours of 5:00 a.m. to 6:00 p.m., Monday through Friday. However, some construction activity may also be required during these times on Saturdays.

## 2.2 Environmental Setting

The information contained in this section is from the *Final Elkhorn Slough Tidal Marsh Restoration Project Existing Conditions Report* (ESA, 2014b). The biotic conditions were assessed by H.T. Harvey & Associates via a review of existing information, supplemented with a reconnaissance-level survey of the project site conducted on 18 January, 2013.

## 2.3 Geographic Setting and Land Use History

The geographic setting and land use history within Elkhorn Slough and the larger Pajaro-Elkhorn-Salinas basin are primary drivers of both physical conditions and biological communities within and adjacent to the project site. This section describes both regional and site-scale geography and land use history.

### 2.3.1 Elkhorn Slough

The Elkhorn Slough system is a network of intertidal marshes, mudflats, and subtidal channels located at the center of the Monterey Bay shoreline. Like many estuarine systems along the Central Coast, tidal marshes in the slough only contain high marsh pickleweed (*Salicornia*) vegetation communities, not the low marsh cordgrass (*Spartina*) communities found in other tidal marsh systems such as those in San Francisco Bay. The Slough has a complex geologic and human history that is explained in detail by a number of documents published by ESNERR scientists and others (Van Dyke and Wasson, 2005; PWA, 2008; Watson et al., 2011; and many more). Prior to European colonization, the system contained broad expanses of tidal marsh, fresh-brackish marsh, and related habitats throughout Elkhorn, Parsons, Moro Cojo, Bennett, and Tembladero Sloughs. Major anthropogenic modifications to the Slough commenced in the late 1800s with the diking and draining of marshes in Moro Cojo and Tembladero Sloughs. Around the same time, the Union Pacific Railroad was constructed along the Slough's eastern edge. In the early 1900s, large portions of tidal wetlands within Elkhorn and Parsons Slough were reclaimed for agriculture, duck hunting, and other uses, and the Salinas and Pajaro Rivers were diverted from the slough. These activities significantly decreased both fluvial flows and tidal prisms within the Elkhorn Slough system, leading to increased shoaling and periodic closure of the slough mouth near Moss Landing (A. Woolfolk, pers. comm. in ESA, 2014a). The diversion of the Salinas and Pajaro Rivers also eliminated a likely significant source of sediment from the Slough (Watson et al. 2011). The construction of Moss Landing Harbor in 1946-1947, and associated channel deepening, dramatically altered the hydrodynamics in Elkhorn Slough by permanently opening the system to the full range of the tides. The increased tidal range resulted in the increased inundation of the Slough's remaining salt marsh habitats, which has been compounded by shallow subsidence, a sediment deficit, and sea level rise within the Slough (Callaway et al., 2012). Overall, human activities have led to the loss and/or degradation of over 2/3 of the former marsh habitats in Elkhorn Slough, severely impacting the Slough's ecosystem (Van Dyke and Wasson, 2005).

Existing habitats within the estuarine portion of the Slough include areas of open water, mudflats, salt flats, diked marsh, and tidal marsh. Many of the tidal marshes in lower Elkhorn Slough and Parsons Slough are in various stages of degradation from the recent history of human activities described above.

## 2.3.2 Tidal Restoration Site

The low lying areas of the site were historically dominated by mature tidal salt marsh plains drained by dendritic channel networks. Diking and draining of these areas occurred at various times after 1872 in order to convert the tidal marshes into areas for agricultural use. Portions of the Minhoto-Hester area were purchased by the Empire Gun Club in 1902 and were actively managed to encourage use by waterfowl. The gun club constructed an extensive network of levees and ponds, managed water levels, and attracted ducks by placing grain in the ponds (King, 1982; Silberstein et al., 2002). Portions of the Minhoto-Hester restoration area were later converted to pasture for dairy cattle during the early 20th century (Silberstein et al., 2002). The draining of the tidal marsh caused the marsh sediments to desiccate, compact, decompose, and subside. Over time, as the parcels were acquired by various resource agencies and non-profits (the Minhoto-Hester parcel is owned by CDFW[1]). By 1983, levee failures had resulted in tidal action being returned to nearly all of the Seal Bend and Minhoto-Hester parcels, with levees still intact only at the westernmost impoundment in Minhoto-Hester marsh. Remnant levees persist around the outboard edge of these areas, but in some places are eroded. Overall, tidal marsh within the

1 The State of California is listed on the property deeds.

Minhoto-Hester restoration area community is not very robust. Certain subareas within Minhoto-Hester (e.g., M4b) are relatively higher, and have some poor quality pickleweed scattered throughout the marsh plain, while others (e.g., M5) are lower, and only have pickleweed along wetland-upland transitional areas. The Minhoto-Hester area contains multiple cross-levees and dredged channels, and the borrow channel for one of the levees has turned into a major (over 100 feet wide in some locations) north-south trending tidal connection between the site and Elkhorn Slough. The perimeter levee at the Minhoto-Hester area appears to be slightly less eroded than that at Seal Bend, which could potentially be due to the extensive (up to 350 feet wide in some locations) mudflat within Elkhorn Slough that is outboard of the levee. Mudflats within the Minhoto-Hester restoration area often develop extensive beds of the macroalga sea lettuce (*Ulva* sp.) and others during the summer.

### 2.3.3 Minhoto Stockpile Area and Adjacent Uplands

The stockpile area upslope of the Minhoto-Hester restoration area is located on gently sloping uplands adjacent to the historic tidal marsh. Historically, both the stockpile area and the adjacent agricultural fields were used to grow crops such as strawberries and artichokes as well as bulb/flower production (Andrea Woolfolk, pers. comm. in ESA, 2015a). Since 2012, the stockpile area has been kept fallow; it has been mowed and disked annually and at times been planted with sterile annual barley or triticale to prevent erosion of sediment into the Slough. As recently as 2014, the fields outside of the stockpile area were still in production and were primarily used for bulb production. Portions of the agricultural fields may be tiled for drainage. However, the buffer area was probably not historically tiled for drainage (Monique Fountain, pers. comm. in ESA, 2015a).

## 2.4 Habitats in the Project Area

The following discussion provides a description of the habitat types that occur in the project area. Habitat types were developed using a combination of described habitats and vegetation alliances as per Holland (1986), Sawyer et al. (2009), and (Kutcher 2008). The habitat types are based upon hydrology, land use, and vegetation, and are consistent with those previously described for Elkhorn Slough (Zimmerman and Caffrey, 2002; ESTWPT, 2007). The four habitat types found within the project area are subtidal, intertidal mudflat, intertidal salt marsh, and formerly cultivated field/ ruderal grassland. These are described in detail below.

### 2.4.1 Subtidal/Aquatic

Subtidal channels connect to the main channel of Elkhorn Slough and provide tidal exchange to intertidal mudflats and intertidal salt marsh at the site. Subtidal channel habitats occur below the elevation of the low tidemark or Mean Lower Low Water (MLLW) where the substrate is continuously submerged. Tidal creeks form networks that serve an important function of water conveyance and drainage onto and off of mudflat and marsh surfaces as well as the transfer of sediment and nutrients between marshes and the main estuarine channel (ESTWPT, 2007). The corresponding National Estuarine Research Reserve System (NERRS) classification for the Subtidal habitat type is Estuarine Subtidal Haline Unconsolidated Bottom Mud.

Elkhorn Slough channel habitats have substrates largely composed of material such as organic matter, mud, sand, and gravel. The fine-grained materials are often cohesive, as a result of unconsolidated material eroding away over several decades. Channel depth averages about 9.8 feet (ESTWPT, 2007). Water temperatures range from 10 to 22 °C, with an average temperature of approximately 13.5 °C (MBARI LOBO data).

Recent water quality assessments indicate that channels in the estuary overall are moderately eutrophic, indicating excessive nutrient enrichment (Johnson, 2010; Hughes et al., 2011). Elkhorn Slough is surrounded by intensely cultivated/chemically fertilized farmlands and the estuary receives substantial agricultural run-off. Nitrate concentrations in the estuary often exceed values found in the nutrient-rich waters of Monterey Bay by nearly 20-fold (Johnson, 2010). Dissolved oxygen concentrations fluctuate much more widely in Elkhorn Slough than in most other estuaries, likely attributable to the high rates of primary productivity induced by external inputs of nitrogen, the physical configuration of the slough, and the general lack of non-tidal water input. Degraded water quality is strongly affecting environmental conditions for organisms dwelling in subtidal habitats in Elkhorn Slough (Wasson et al., 2012).

Many of the slough channels onsite have a natural, sinuous form, however there are also numerous linear human-constructed channels as well (e.g., borrow ditches). The constructed channels reduce slough channel topographic complexity relative to the natural marsh condition and thereby likely reduce plant and animal community diversity.

Subtidal macroalgal species in Elkhorn Slough include *Ulva lactuca*, *U. expansa*, and *U. lobata*. Floating macroalgal mats occur in the water column, dominated primarily by *U. intestinalis*, but also include *Rhizoclonium riparium* and *Chaetomorpha* sp.

## 2.4.2 Intertidal Mudflat/Aquatic

Intertidal mudflats occur between channel and marsh habitats, typically between the elevations of MLLW and Mean High Water (MHW). Mudflats are generally inundated during high tide and exposed during low tide. Mudflats serve an important function in estuarine chemical cycles (ESTWPT, 2007). However, it is not clear that these mudflats, caused by historic diking and draining of salt marsh, serve those same functions. The corresponding NERRS classification for the Intertidal Mudflat habitat type is Estuarine Intertidal Haline Unconsolidated Shore Mud.

The mudflats in the project area are devoid of salt marsh vegetation but do support diatoms and macroalgae. Peak months of macroalgal productivity are in the summer, when blooms can completely cover intertidal mudflats in Elkhorn Slough. Dense macroalgal blooms are an indicator of high nutrient loading and eutrophication, which can facilitate microbial decomposition causing hypoxic and anoxic conditions and lead to an overall loss in biodiversity. Macroalgal species documented on intertidal mudflats in Elkhorn Slough include *U. lactuca, U. intestinalis, R. riparium, Chaetomorpha* sp., and *Gracilariopsis andersonii* (Hughes et al., 2010).

Because the mudflats within the project area are much higher than natural mudflats they are devoid of large benthic invertebrates such as large clams and worms that typical characterize healthy mudflats in Elkhorn Slough.

### 2.4.3 Intertidal Salt Marsh

Intertidal salt marsh occurs from approximately +4 ft NAVD88 (~1 ft below MHW) to approximately +7 ft NAVD 88 (~1.3 ft above Mean Higher High Water [MHHW]). Intertidal salt marshes in Elkhorn Slough are highly saline. The corresponding NERRS classification for the Intertidal Salt Marsh habitat type is Estuarine Intertidal Haline Emergent Wetland Persistent.

The vegetation is dominated by a single native species, perennial pickleweed (*Salicornia pacifica*), as is characteristic of high elevation intertidal salt marshes in the region. Both the percent cover and the height of pickleweed are generally lower at lower elevations of the project area where the marsh transitions to mudflat. The diversity of the native plant community increases at slightly higher elevations, as on remnant interior berms, and at the upper marsh edge where a few other native species are found occurring with pickleweed; these include saltgrass (*Distichlis spicata*), marsh jaumea (*Jaumea carnosa*), alkali heath (*Frankenia salina*), and coast gumplant (*Grindelia stricta*).

### 2.4.4 Formerly Cultivated Field/Ruderal Grassland

Nearly the entire Minhoto stockpile/ecotone restoration area is comprised of a formerly cultivated field (fallowed since 2009), with a narrow margin of ruderal grassland occurring intermittently between the field and adjacent marshlands. Soils are described as fine sandy loam; moderately deep soils that formed in material weathered from soft sandstone (NCSS-NRCS, 2013). In addition to the stockpile site, the levee surrounding the diked salt marsh is vegetated by ruderal grassland interspersed with occasional coyote brush. The corresponding NERRS classification for the Cultivated Field/Ruderal Grassland habitat type is Upland Inland Herbaceous Upland Grassland.

The site has been seeded annually with sterile annual barley (*Hordeum vulgare*) as an erosion protection measure, and weeds have been controlled as needed by disking (Woolfolk personal communication, 2013 in ESA, 2014a).

In a few areas there is a narrow fringe of ruderal grassland species including poison hemlock (*Conium maculatum*), annual grasses, and mallow (*Malva* sp.), as commonly occurs adjacent to agricultural lands in the Elkhorn Slough watershed (Wasson and Woolfolk, 2011; A. Woolfolk, personal communication 2013 in ESA, 2014a). Within this ruderal grassland margin, the native shrub coyote brush (*Baccharis pilularis*) occurs at the north end of the stockpile site and a single small coast live oak tree (*Quercus agrifolia*) occurs at the south end.

Because the field has been tilled regularly, small mammals are likely present in low numbers; however, California ground squirrel (*Otospermophilus beecheyi*) burrows are present in the field.

## 2.5 Ambient Noise Conditions

Ambient noise monitoring has not been conducted for the proposed project. However, noise levels were monitored at the adjacent Parson's Slough Project site during construction of that project in 2010 and 2011. Background noise at that site was approximately 57dBC $L_{max.}$ as measured at 20 and 40 meters northeast of the pile installation site and approximately 1.5 meters above the ground (ESNERR, 2011). Ambient noise levels in the project area are likely similar to those at the Parson's Slough Project site. Approximately 15 to 20 trains pass along the Union Pacific Railroad (UPRR), which is located within 400 feet of the eastern-most portion of the project site, each day (Vinnedge Environmental Consulting, 2010c). Noise levels from trains were monitored during construction of the Parson's Slough Project and estimated at 108 dBC $L_{max.}$ Pick-n-Pull, a vehicle dismantling yard and recycling yard, is located approximately 300 feet from the project site. In addition, agricultural equipment is occasionally operated within the existing uplands and haul trucks regularly travel across adjacent agricultural lands and along nearby levees.

# SECTION 3
# Species and Numbers of Marine Mammals

Two species of marine mammals occupy the project area or the area adjacent to the project: southern sea otter (*Enhydra lutris nereis*) and harbor seal (*Phoca vitulina richardsi*). The southern sea otter, federally listed as threatened, is included in this application for consultation with US Fish and Wildlife Service (Service) under the MMPA. A Biological Assessment, to support Section 7 consultation between the Corps and the Service, has been prepared for the proposed project and includes southern sea otter (ESA, 2015b). The harbor seal, a non-listed species, is included in this application for consultation with National Marine Fisheries Service (NMFS) under the MMPA.

## 3.1 Southern Sea Otter

The sea otter population was extirpated from the mouth of Elkhorn Slough and Moss Landing Harbor by the early 1900s. In the 1980s, a small group returned to this historic habitat. Although the Moss Landing Harbor provides shelter and the entrance provides accessibility to the Slough, there was another decline in populations in the central California coast in the late 1900's, although the cause remains unknown. Research indicates that increased mortality rates, and not decreased reproductive rates, occurred during this period (Estes et al., 2003). More recent counts of California sea otters, conducted semi-annually as a collaborative effort led by the U.S. Geological Survey (USGS), indicate no distinct trends (Hatfield and Tinker, 2014).

Currently, sea otters frequently use Elkhorn Slough and up to 149 otters (mostly male) raft together in the harbor and over 50 females and pups utilize a protected tidal creek and adjacent waters further up the slough (Scoles et al., 2012). In Elkhorn Slough, sea otters mostly occur in the harbor, tidal channels, and where eelgrass (*Zostera marina*) is present. When not disturbed, otters frequently come ashore to rest, interact, and groom (Scoles et al., 2012). Sea otters forage mainly on Washington clams, followed in decreasing order of occurrence by gaper clams, innkeeper worms, and crabs (Kieckhefer et al., 2004). The peak pupping season in Elkhorn Slough occurs in March and April (USFWS, 2003; Maldini et al., 2010).

## 3.2 Harbor Seal

Harbor seals use Elkhorn Slough for hauling out, resting, socializing, foraging, molting and reproduction. Counts of harbor seals in the greater Elkhorn Slough began in 1975 and at that time averaged about 30 seals (Harvey et al., 1995; Oxman, 1995). Counts conducted by Osborn (1985) in 1984 averaged 35, and during 1991, maximum counts reported by Oxman (1995) were five times greater. Oxman also reported a 20 percent increase between 1990 and 1991, from 150 to 180 seals. Average counts remained comparable from 1994 through 1997, with peaks coinciding with pupping and molting seasons. A count of 339 seals was reported in 1997 (Jones et al., 2002; Richman 1997). The population in the Slough is estimated at 300 to 500, but numbers can vary seasonally based on prey availability, molting and reproduction (McCarthy, 2010a). Harbor seal count data as reported are collected from a variety of sources using various methodology. Data sources include former graduate student research, occasional counts by Jim Harvey et al. at Moss Landing Marine Labs, and ESNERR staff observations.

Harbor seals have utilized the Elkhorn Slough as a resting site since the 1970s, but the first births were not recorded until 1991 (Maldini, et al., 2010). From 1995 through 1997, there was a significant annual increase in pups, from 14 in 1995 to 29 in 1997 (Richman, 1997). Marine mammal research scientists speculate that this increase was due to removal of public restrooms from the Seal Bend area in the early 1990s (Maldini pers. comm. in Vinnedge Environmental Consulting, 2010b). Some seals may depart during pupping/breeding season, which peaks in May on the central California coast. Seals in Elkhorn Slough likely head 25 kilometers south to Cypress Point, Carmel, or 60 kilometers north to Año Nuevo to pup and breed (Osborn 1992, Oxman 1995). No births have been noted in the project area.

# SECTION 4
# Affected Species Status and Distribution

## 4.1 Southern Sea Otter

Sea otters are the smallest marine mammal in North American found in both hard- and soft-sediment nearshore marine environments and are considered a key species in coastal ecosystems they inhabit as a result of their ecological role. The California sea otter predominantly occupies subtidal rocky habitats and kelp forests, soft-bottom habitats, or some combination of the two, within approximately 1.5 miles (~2.5 km) of shore (McCarthy, 2010b). Range delineation for the southern sea otter, or California sea otter, is somewhat arbitrary because individuals frequently wander well beyond the distributional limits of most of the rest of the population; however, the California geographic range can be generally characterized as occurring from Half Moon Bay in the north to south of Point Conception in depths of less than 330 feet (100 meters) within protected bays and exposed outer coasts (USFWS, 2003).

In California, most births occur from late February to early April but births may occur throughout the year, and the birth peak may extend over several months (USFWS, 2003). The age of sexual maturity in males varies, but probably averages to be about 5 years, depending on population status and social context. Females typically attain sexual maturity after 3 years. Pups wean between 5.5 and 6 months of age.

### 4.1.1 Status in Elkhorn Slough

There are two main areas of sea otter concentration in the Slough: one in the North Harbor used by non-territorial males and one in Seal Bend with territorial males, females, and pups (Maldini et al., 2010). North Harbor, which is approximately 2 river miles west of the project area, is an important area for young non-territorial males because it serves as shelter from storms and predation. Approximately 40 otters occupy North Harbor during the day and twice that number has been observed using North Harbor at night (Maldini et al., 2010). Seal Bend, which is located approximately 0.8 river miles west of the project area, has been an important area for sea otter activity due to the large patch of eelgrass present there. Seal Bend was once occupied by a large raft of (mostly) young males, but more recently the area has been occupied by reproductive females and territorial males. Between 2005 and 2006, the primary pupping area in Elkhorn Slough was in Seal Bend. Up to 14 pups have been born there in one year (Maldini et al., 2010).

The bulk of the population, mainly males that occupy the Harbor, tends to feed in Monterey Bay or in the lower Slough (McCarthy, 2010). The females that predominantly occupy areas in the

Slough tend to feed in the lower portion of the main Slough channel. **Figure 4-1** shows the areas that are primarily occupied by sea otters.

### 4.1.2 Project Area Distribution

Monitoring was completed in 2013 to document the abundance and distribution of sea otters in the Minhoto Marsh complex to determine potential impacts from the proposed project (Beck, 2014). Monitoring occurred in weekly shifts from June 19, 2013 to July 30, 2013, with one additional date in August 2013. Shifts ranged from 3 to 12 hours, and counts were done at 30 minute intervals on the hour and half hour. The marshes and berms were viewed and counted in the same order during each interval. Times were chosen in order to observe use at both ebb (declining) and flood (rising) tides (see **Table 2**). Data collected included observation time, the number and species of marine mammals sited, and the berm or marsh within Minhoto where they were located. **Figure 4-2** shows the monitoring observation site and the monitoring areas.

**TABLE 2**
**DATES AND TIMES THAT MARINE MAMMAL MONITORING OCCURRED FOR THE MINHOTO MARSH COMPLEX[1]**

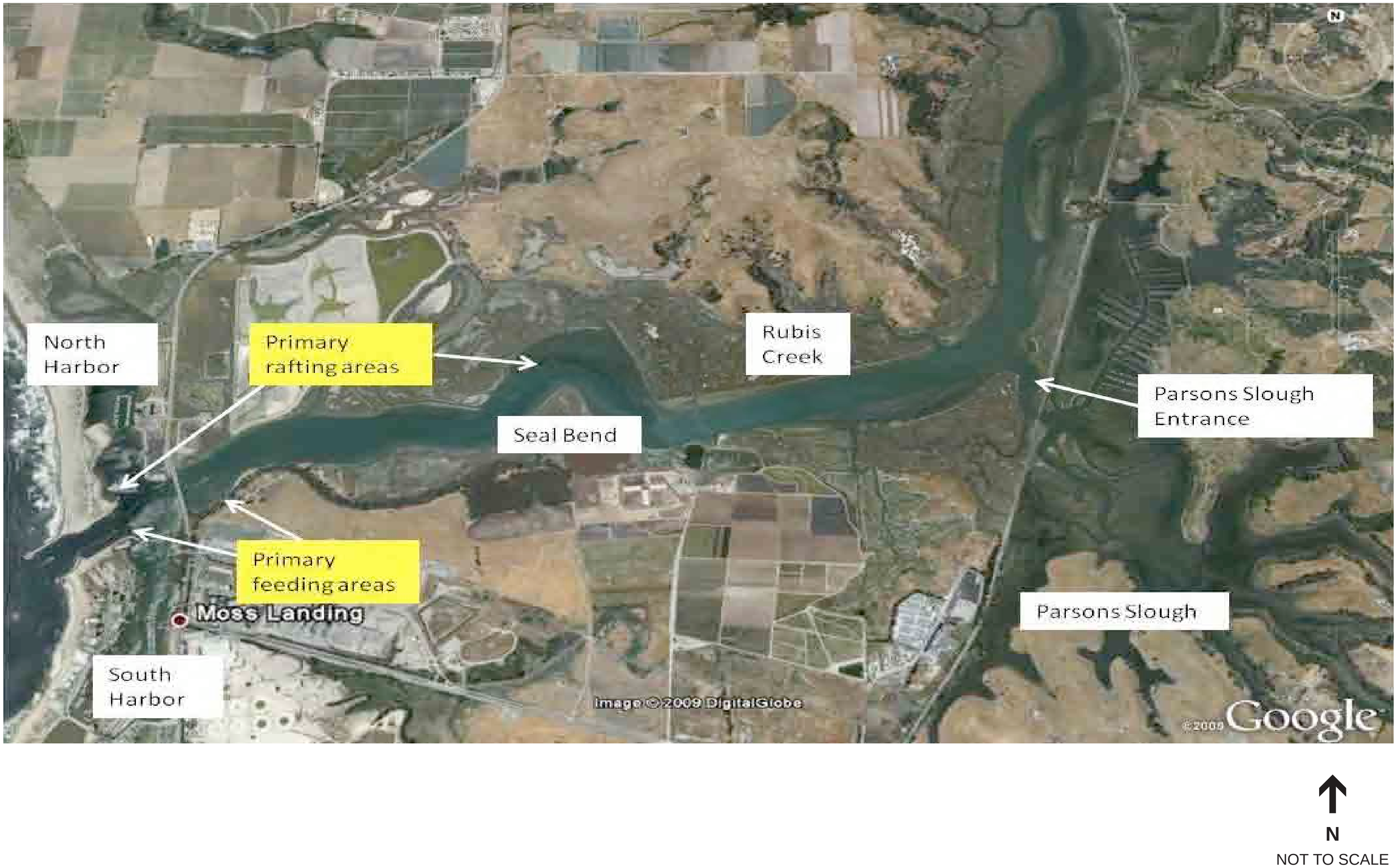
| Date | Monitoring Time | Total Hours | Tide |
|---|---|---|---|
| 6/19/2013 | 13:30-16:30 | 3 | F |
| 6/20/2013 | 10:00-13:30 | 3.5 | E |
| 6/25/2013 | 7:00-19:00 | 12 | EF |
| 7/2/2013 | 7:30-18:00 | 11.5 | EF |
| 7/9/2013 | 9:30-18:30 | 9 | EF |
| 7/16/2013 | 9:00-18:00 | 9 | EF |
| 7/21/2013 | 9:30-17:30 | 8 | EF |
| 7/30/2013 | 9:30-17:30 | 8 | EF |
| 8/20/2013 | 10:00-15:30 | 6.5 | EF |

NOTE:
[1] Counts were made on both ebb (declining) and flood (rising) tides

SOURCE: Beck, 2014

During the surveys conducted in 2013, a maximum of two otters at a time were observed in Minhoto (Beck, E. 2014). These sea otters were observed resting in M3 during the survey. On four out of the nine sampling days, one otter was observed resting in M3 when tide heights were near or above four feet. On two of the nine sampling days, two otters were observed resting in M3, again when tide heights were near or above four feet. The maximum length of time an otter was observed in M3 during the monitoring was 1.5 hours. Otters were not observed foraging or hauling out in Minhoto during the monitoring shifts.

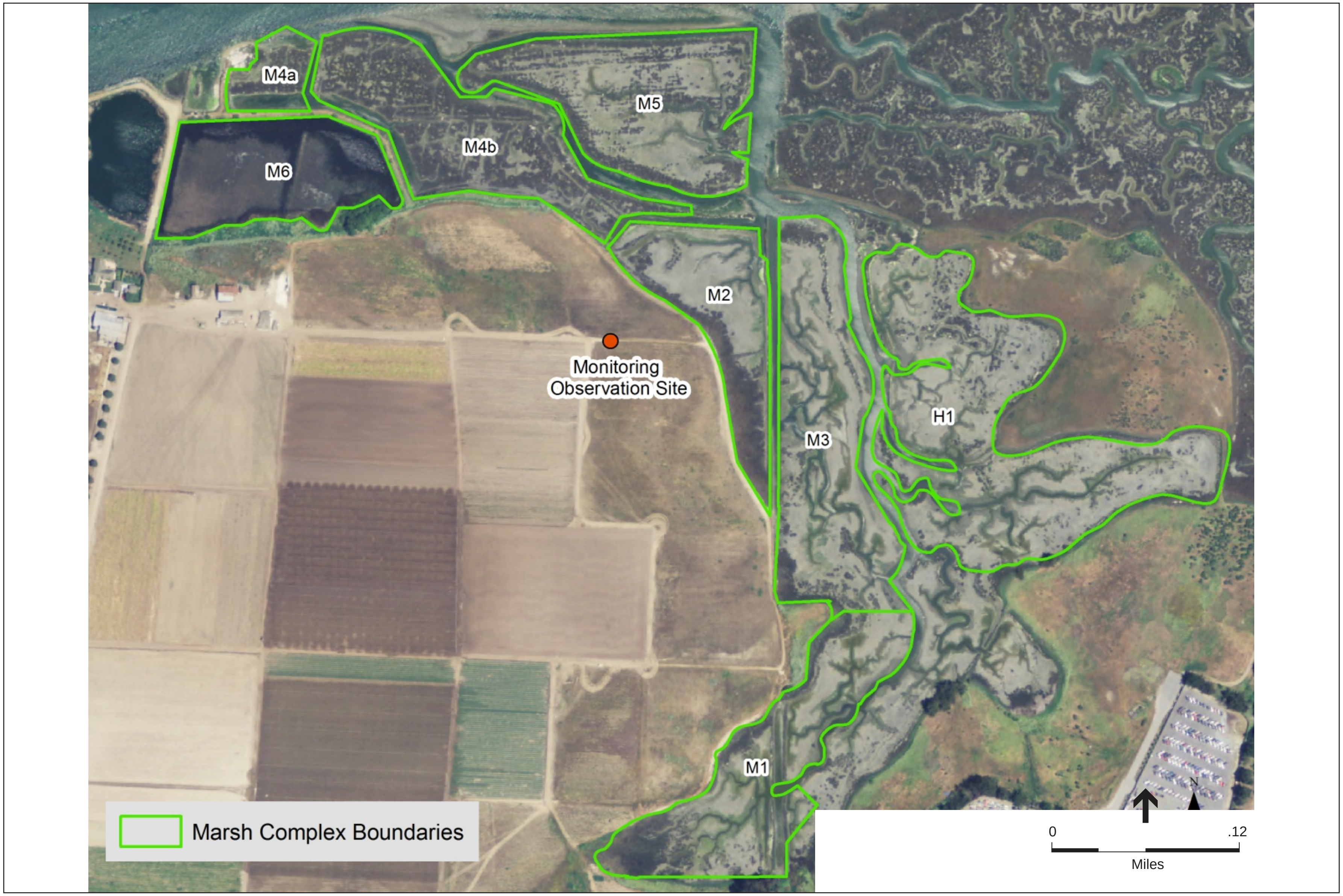
Otters have also been observed over subtidal mudflats and tidal channels adjacent to the project site in Parsons Slough. They have been observed hauled out in pickleweed vegetation in the Parsons Slough area (Vinnedge Environmental Consulting, 2010a). Sea otters are also known to occur in Yampah Marsh adjacent to the Minhoto-Hester marsh restoration area (Eby and Scoles, 2010).




SOURCE: Maldini et al, 2009



**Figure 4-1**
Areas Primarily Used by Sea Otters in Elkhorn Slough




SOURCE: Beck, in press

Elkhorn Slough Tidal Marsh Restoration Project Request for Incidental Harassment Authorization . 120505.00

**Figure 4-2**
Minhoto Marsh Restoration Area: Sea Otter and Harbor Seal Monitoring Areas

Approximately 17 to 28 sea otters use the Parsons Slough Complex and adjacent Yampah Marsh Island (Maldini et al., 2009). The sea otter population at the Parsons Slough complex has been closely monitored as part of the Parsons Slough Project (Vinnedge Environmental Consulting, 2010a). Up to 35 individuals were observed during construction monitoring for this project (ESNERR, 2011). Monitoring showed that three main sea otter resting areas occur in the Parsons Slough complex and adjacent Yampah Marsh. The resting areas identified in Maldini et. al. 2010 are shown in **Figure 4-3**. One territory is located in the Parsons Slough Complex near the Avila Property. Two additional territories, outside of the Parsons Slough complex, are located near Yampah Island, southwest of the UPRR bridge (because these areas are close to each other they are indicated by a single point on Figure 4-3). These otters – referred to as the "Yampah Island Group" – access the Yampah Island marsh via the smaller channel located west of the UPRR bridge and towards the Moonglow Dairy Farm. Each of the three areas consists of a dominant male and associated females and pups. The Yampah Island Group is closest to the project site and is located approximately 800 feet northeast of the project area. Mother sea otters with pups use the Yampah Marsh as a nursery (Scoles et al., 2012).

## 4.2 Harbor Seal

The harbor seal (*Phoca vitulina*) is one of 33 species of phocids found throughout the world. It is one of the most widely distributed pinnipeds, occurring along temperate, sub- Arctic and Arctic coasts of the Pacific and Atlantic in the northern hemisphere (Trumble, 1995). They usually inhabit nearshore waters, and are commonly found in rivers and estuaries (Oxman, 1995). Harbor seals haul out onto beaches, rocks and other substrates to rest, whelp and molt (Hanan, 1996). They haul out more often and for longer periods in summer, when they are molting, than in autumn and winter (Stewart and Yochem, 1994). They are central place foragers, tend to exhibit strong site fidelity within-season and across years, generally forage close to haul-out sites, and may repeatedly visit specific foraging areas (Grigg et al., 2012). In the Eastern Pacific, breeding populations range from San Quintin Bay, Baja California to Nome, Alaska (Gunvalson, 2011).

Historically, management and conservation of pinnipeds was difficult due to heavy exploitation. Harbor seals in California were commercially hunted until 1938, and between 1938 and 1972 sport and commercial fisherman would harass and kill harbor seals that interfered with fishing operations (Trumble, 1995). Since the passage of the Marine Mammal Protection Act in 1972, the U.S. coastal population has been increasing by 5 to 7 percent per year. They are now common in their range with a total population of approximately 400,000-500,000 and California coastal estimates of around 30,968 ( Carretta et. al. 2015).

### 4.2.1 Status in Elkhorn Slough

Harbor seals inhabit Elkhorn Slough year-round and occur individually or in groups. They usually occupy areas just beyond the mouth of the Slough in the Moss Landing harbor and in the Salinas River channel south of the Moss Landing bridge, and the lower portion of the Slough extending up to Parsons Slough and Rubis Creek. As stated in Section 3, the seal population in Elkhorn Slough


SOURCE: Maldini et al, 2009



**Figure 4-3**
Sea Otter Resting Areas and Harbor Seal Haul-out Areas
in Parsons Slough and Yampah Marsh

estimated to be between 300 and 500 individuals, but numbers can vary. **Figure 4-4** depicts haul-out areas used by Elkhorn Slough harbor seals. Excluding the haul-outs in the project area would temporarily remove less than 2% of the potential haul-out areas in the slough (same tidal range).

Harbor seals mainly use the Slough as a staging area for foraging in the Monterey Bay, but there is a limited amount of foraging in the Slough (McCarthy, 2010a). They typically use the corridor from the mouth of Slough through the Moss Landing Harbor entrance for nightly feeding in the Bay. In a harbor seal diet study conducted in Elkhorn Slough between 1995 and 1997, diets included 35 species including topsmelt, white croaker, spotted cusk-eel, night smelt, bocaccio, Pacific herring, a brachyuran crustacean, and 4 genera of mollusks (Harvey et al., 1995 in McCarthy, 2010a).

Harbor seal abundance may change seasonally depending on prey, abundance, molt, and reproduction (McCarthy, 2010a). Pupping can occur throughout the year but generally starts in late March peaking in May (McCarthy, 2010a). During the pupping/breeding season, some seals may depart to other breeding areas outside of Elkhorn Slough. Harbor seals have used Elkhorn Slough for reproduction for the past two decades. Females tend to remove themselves from the group to give birth and return within a week (McCarthy, 2010a). In 2010, 50 pups were observed in Elkhorn Slough (J. Harvey unpublished data in McCarthy, 2010a).

### 4.2.2 Project Area Distribution

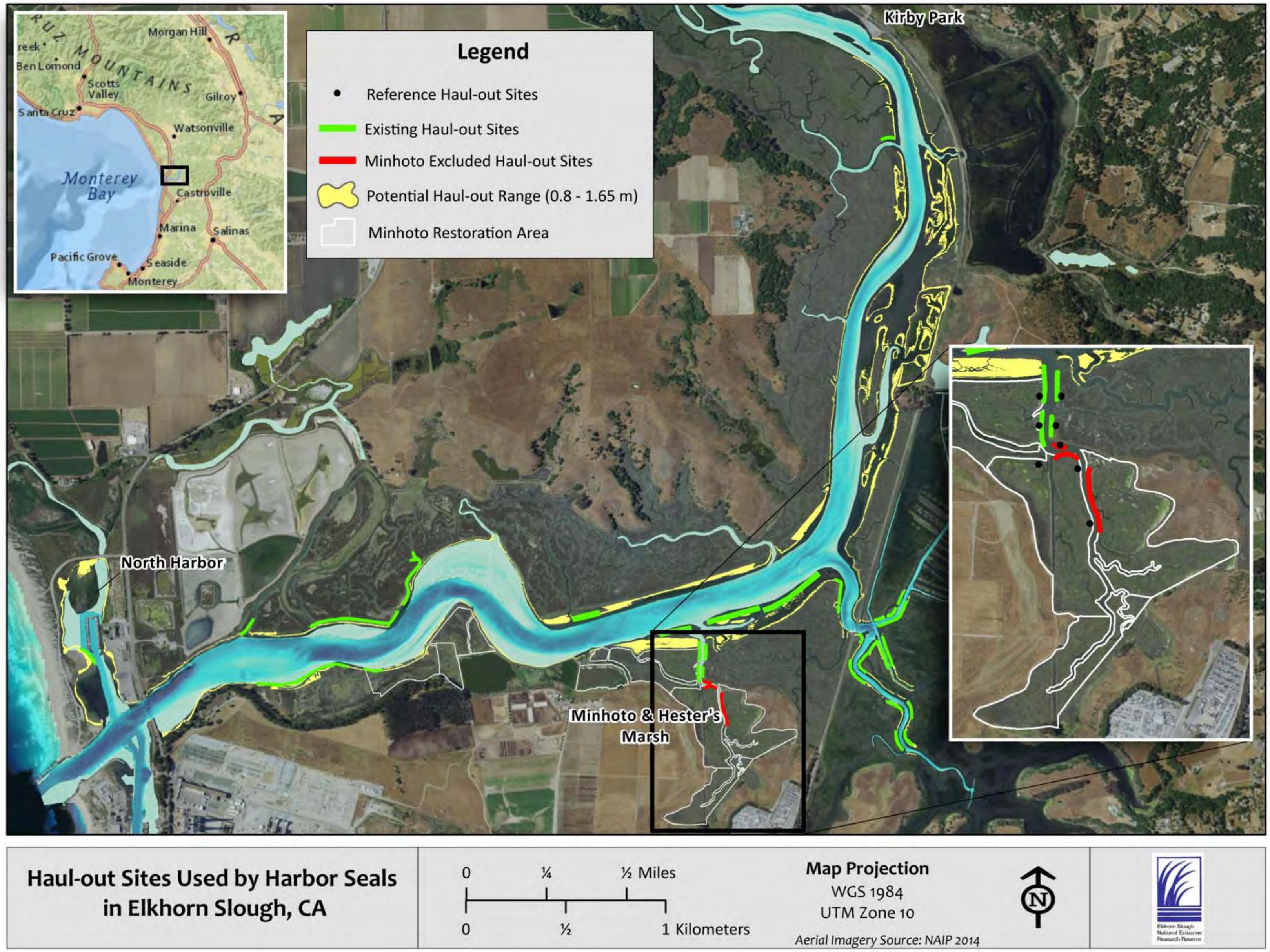
In the eastern part of Elkhorn Slough (east of seal bend), harbor seals primarily use two sub areas to haul out, the Minhoto marsh complex (project area and the area just outside the project) and the area in and around Parson Slough (Figure 4-4). Below is a summary of seal distribution in these two separate areas.

Monitoring was completed in 2013 to document the abundance and distribution of harbor seals utilizing the Minhoto Marsh complex to determine potential impacts from the proposed project (Beck, 2014). The monitoring methods are described in *Section 4.1.2* above for sea otter.

Eight harbor seal haul-out sites were identified in the Minhoto Marsh complex, which included haul-outs in portions of Yampah Marsh adjacent to Minhoto Marsh (see **Figure 4-5**). Four of these are within the current project area and will be inaccessible during construction but available again after construction. To better assess which areas of Minhoto were used by seals, haul out sites were categorized as either inside (inside the project area) or outside (just outside the project area). The four inside sites are remnant berms used as haul out sites on the interior of the marsh, specifically the small island, M2 North, M3 North and M3 East. Outside sites are on the outside edge of the marsh nearest the main channel, M5 Northeast and Southeast, and Yampah Northwest and Southwest. The maximum number of seals counted was 94 between inside and outside.

Adjacent to the Minhoto Marsh complex is an area known as Parsons Slough which is not directly accessible from within the Minhoto marsh complex. Approximately 100 harbor seals use exposed mudflats in Parsons during low tide to haul out. During high tide harbor seals are absent from Parsons Slough (Maldini et al., 2009). In 2009 there were 5 main haul out areas within the

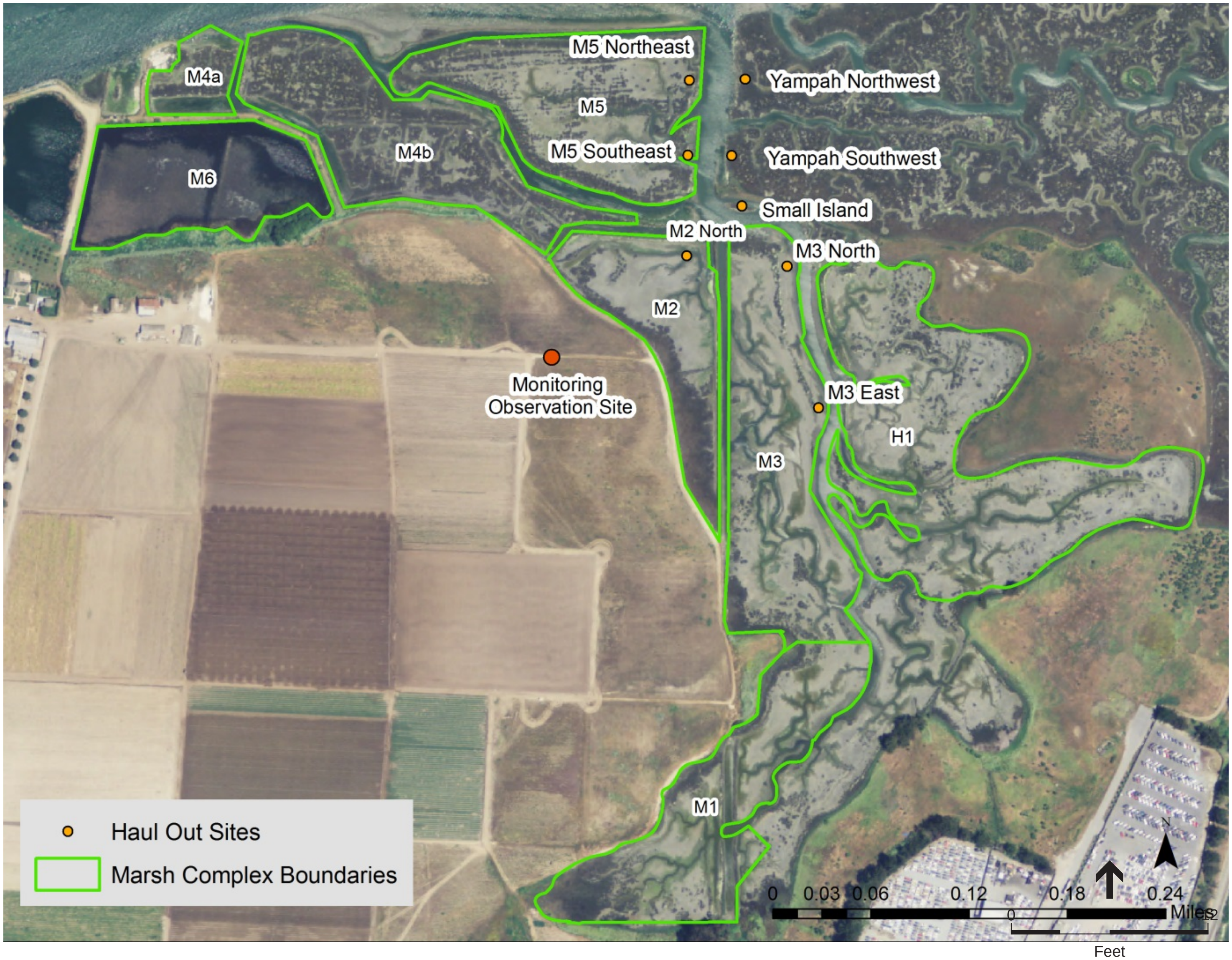
Parsons Slough and one just outside (Maldini et al., 2009) (Figure 4-3). Now even more of the channel banks within Parsons are used by seals (Figure 4-4). The closest haul-out is approximately 1,300 feet northeast of the project area. Consistent with harbor seal behavior, abundance on the mudflats is highest during the day and drops after sunset.




Elkhorn Slough Tidal Marsh Restoration Project Request for Incidental Harassment Authorization . 120505.00

**Figure 4-4**

Map of Areas Used by Harbor Seals for Hauling-out in Elkhorn Slough




SOURCE: Beck, in press



**Figure 4-5**
Haul-out Sites Used by Harbor Seals
in the Minhoto Marsh Complex

This page intentionally left blank

# SECTION 5
# Type of Incidental Taking Authorization Requested

The purpose of this document is to address the requirements of the MMPA as it relates to southern sea otters and harbor seals in the vicinity of the Elkhorn Slough Tidal Marsh Restoration Project, Phase 1. Activities addressed in this request for an Incidental Harassment Authorization (IHA) include actions that may temporarily result in a certain level of incidental take corresponding to non-lethal take described as Level B harassment under the MMPA.

This page intentionally left blank

# SECTION 6
# Take Estimates for Marine Mammals

## 6.1 Southern Sea Otter

### 6.1.1 Local Abundance

During surveys conducted of the Minhoto Marsh complex in 2013, a maximum of two otters at a time were observed in Minhoto (Beck, E. 2014.). These sea otters were observed resting in M3 when tides were near or above four feet. Additionally, up to 35 otters were observed within the adjacent Parsons Slough Complex and Yampah Marsh Island during monitoring for the Parsons Slough Project (ESNERR, 2011). Similar to the Minhoto Marsh, higher tides were correlated with greater otter abundance in the Parsons Slough Complex and Yampah Marsh.

### 6.1.2 Take Estimate

If sheet pile is required to be installed at the tidal entrance to the work area, a vibratory hammer would be used for several days during installation. The behavioral threshold for non-pulse noise (i.e. from vibratory pile driving) is 120 dBrms (NOAA, 2015, **Figure 6-4**). Although the exact distance of disturbance from the vibratory hammer is unknown, the Parsons Slough Project can be used as an example. Vibratory hammers were used to install sheet pile for the Parsons Slough Project. Most sea otter disturbance occurred within 180 meters of the pile driver, but many sea otters traveled away (no startle) at distances greater than 180 meters. Noise modeling was done to outline the extent of the area that could potentially be disruptive to marine mammals. The Level A injury threshold for non-pulse noise such as vibratory pile driving is 190 dBrms and would occur at <1 ft (0.22m) (See Appendix A – Noise Modeling). Regardless, the exclusion zone would be set at 49ft (15m) to avoid physical injury from machinery.

Two sea otters have been observed within the Tidal Marsh Restoration Project. If present at the time of construction, they would likely be disturbed by sheet pile installation. Additionally, the closest resting area in Yampah Marsh is approximately 400 meters from the potential sheet pile installation area. There is some potential the 35 sea otters that have been described to use the Parsons Slough Complex and Yampah Marsh could be located in or around Yampah Marsh and may be behaviorally disturbed during sheet pile installation. Additionally, depending on the distance of pile driving disturbance, if sea otters are located in the main Elkhorn Slough channel during sheet pile installation, they could experience a behavioral disturbance response. The number of otters that could be disturbed in this area is unknown, but expected to be relatively small as most otters in Elkhorn Slough occur either at the harbor or at Seal Bend. The number of otters disturbed could be greatest during higher tides when otters are typically in greater abundance. For purposes of this analysis, an upward estimate of 50 sea otters could be disturbed each day during sheet pile installation. If sheet pile installation requires 4 days to complete, approximately 200 instances of sea otter disturbance occur during pile installation.

After sheet piles are installed, the site would be isolated from aquatic areas and otters would no longer be able to access the work area. At that time, otters outside of the work area would be subject to relatively lesser levels of disturbance. At that time, various types of construction equipment would be utilized for earthmoving such as dozers, loaders, and backhoes that may generate noise above ambient levels or create a visual disturbance for a period of 11 months. Although the exact distance of disturbance is unknown, it is anticipated that the disturbance area would be smaller than the sheet pile installation impact area since construction equipment does not generate as much noise as pile driving. Additionally, only work in the northern and eastern portions of Minhoto Marsh would be anticipated to disturb sea otters. Work in these areas would occur for approximately half (6 months) of the 11 month construction period. The number of otters disturbed could be greatest during higher tides when otters are typically in greater abundance. For the purposes of this analysis, we conservatively assume that an average of 10 sea otters per day could be disturbed during construction of the restoration area following sheet pile installation. If work in the northern and eastern portions of the Minhoto Marsh is implemented in 132 days, up to approximately 1,320 minor instances of sea otter disturbance could occur during construction activities.

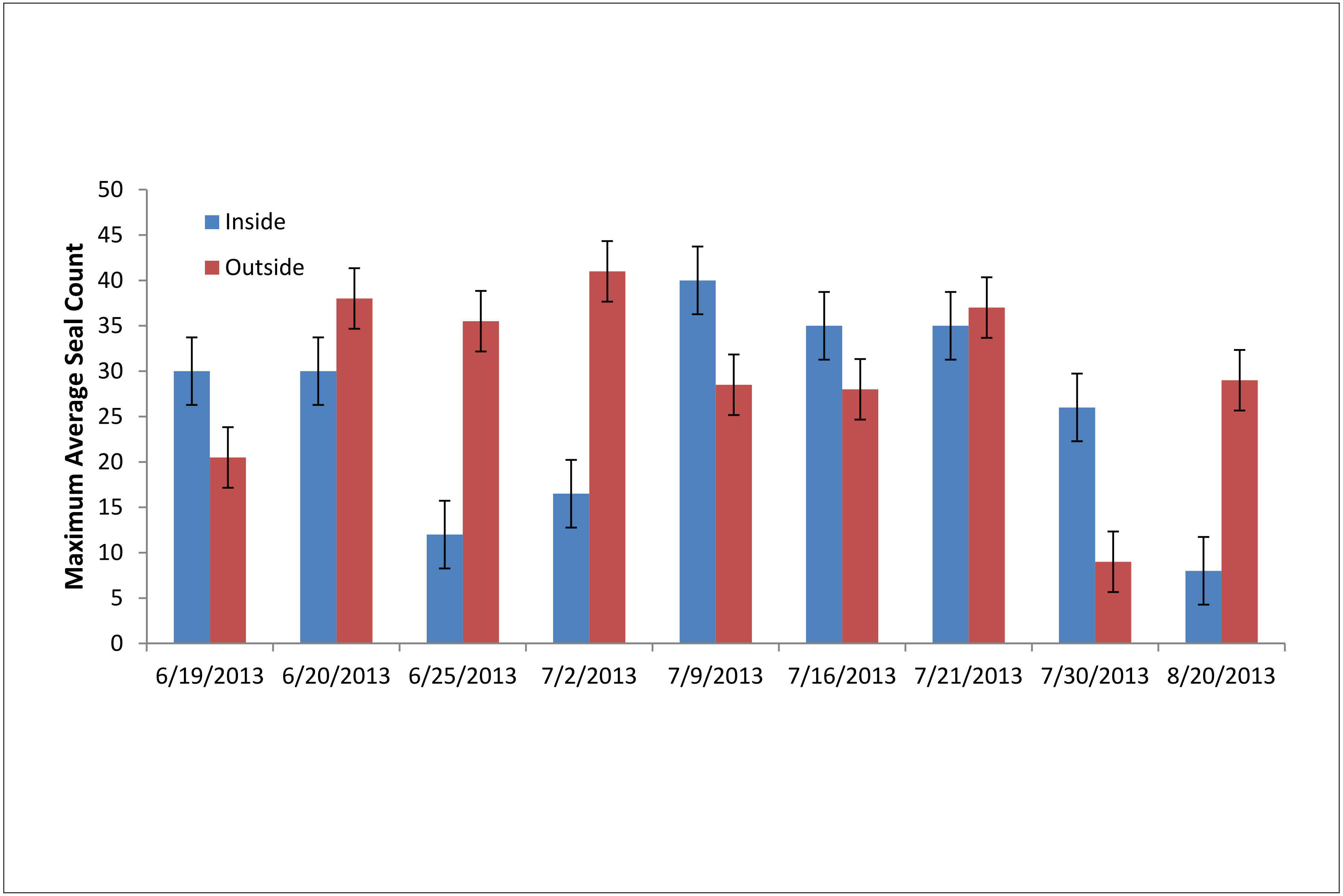
## 6.2 Harbor seal

### 6.2.1 Abundance In and Around Project Area

During surveys conducted of the Minhoto Marsh complex in 2013, a maximum of 94 harbor seals were observed to use the complex (Beck, 2014). As described in Section 4.2, seals were observed to use seven haul-out sites in the Minhoto Marsh complex. These sites were characterized as either inside the marsh (small island, M2 North, M3 North, and M3 East) or just outside of the marsh (M5 Northeast and Southeast, and Yampah Northwest and Southwest) and are shown in Figure 4-5.

**Figure 6-1** shows the average number of seals hauled out, by location (either inside or outside of the marsh), during each of the 2013 survey days. The maximum daily average number of seals observed inside was 40, and the maximum daily average observed outside was 41.

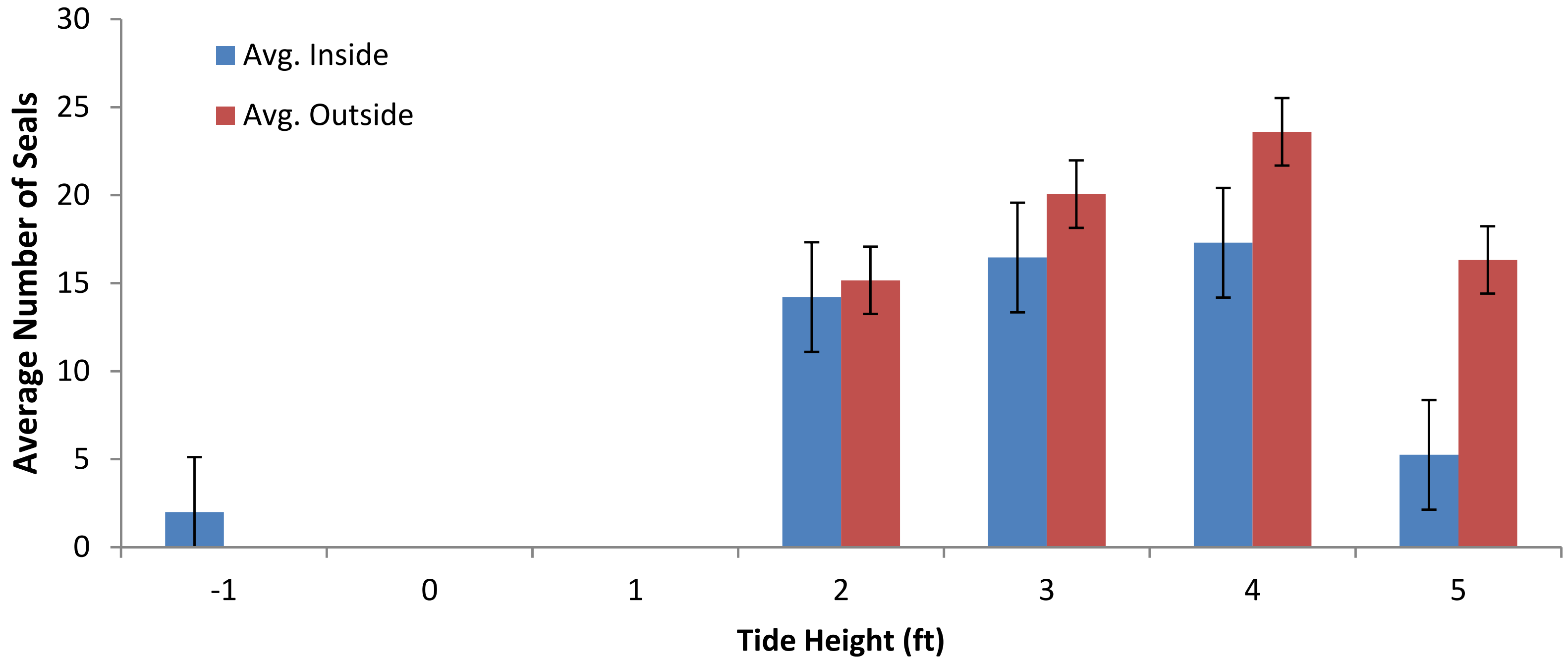
**Figure 6-2** shows the average number of seals hauled out by tide height. The average number of seals hauled out showed an increasing trend starting in the two to four foot range when analyzed by tide height. **Figure 6-3** shows the average number of seals hauled out by time of day. The average count increased progressively throughout the morning and peaked in the afternoon, with counts declining toward sunset. These results are consistent with several previous studies (Ainley et al, 1977, Fancher 1979, Allen et al. 1984), including the published results from marine mammal monitoring competed for the Parsons Slough Complex in 2009-2010 (Maldini et. al. 2010). The decline in numbers toward sunset is in line with findings that harbors leave the Slough in the evening to forage in Monterey Bay (Oxman, 1995).




SOURCE: Beck, in press



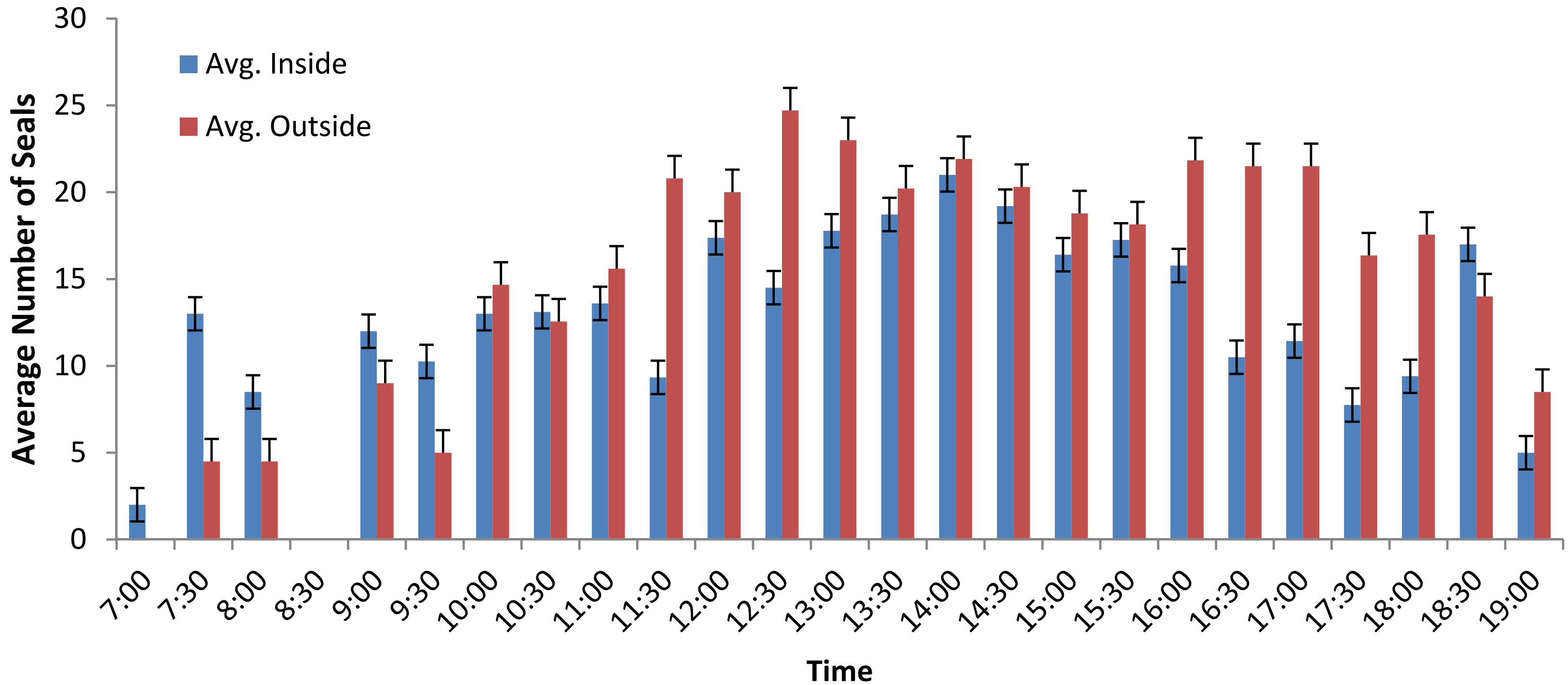
**Figure 6-1**
Maximum Daily Average Number of Seals Hauled-out
at Minhoto Marsh During Each Sampling Day




SOURCE: Beck, in press



**Figure 6-2**
Average Number of Seals Hauled-out by Tide Height




SOURCE: Beck, in press



**Figure 6-3**
Average Number of Seals Hauled-out by Time of Day


SOURCE: Google Earth; ESA



Figure 6-4
Approximated Zone of Influence for Sheet Pile Driving in Elkhorn Slough

This page intentionally left blank

Additionally, approximately 100 harbor seals use the adjacent Parsons Slough Complex and Yampah Marsh. Harbor seal use at the site was monitored during construction of the Parsons Slough project. The number of seals present fluctuated depending on tide height and time of day (ESNERR, 2011). The highest abundance of harbor seals occurred between 9:00 AM and 2:00 PM, with lower numbers present during pre-construction counts in the early morning and during post-construction counts in the evening. More seals tended to haul out outside of the Parsons Slough Complex during higher tides while distribution shifted to inside of the Parsons Slough Complex during lower tides.

### 6.2.2 Take Estimate

If sheet pile is required to be installed at the tidal entrance to the work area (see section 1.9.5), a vibratory hammer would be used for several days during installation. The behavioral threshold for non-pulse noise (i.e. from vibratory pile driving) is 120 dBrms in water (NOAA, 2015, **Figure 6-4**). In-air acoustic thresholds for Level B harassment for harbors seals in 90 dBrms. Although the exact distance of disturbance from the vibratory hammer is unknown, the Parsons Slough Project can be used as an example. Vibratory hammers were used to install sheet pile for the Parsons Slough Project. Most harbor seal disturbance occurred within 180 meters of the pile driver, but many harbor seals were disturbed (raised head or reorient body, or flush into water) at distances greater than 180 meters. Noise modeling was done to outline the extent of the area that could potentially be disruptive to marine mammals. The Level A injury threshold for non-pulse noise such as vibratory pile driving is 190 dBrms and would occur at <1 ft (0.22m) (See Appendix A – Noise Modeling). Regardless, the exclusion zone would be set at 49ft (15m) to avoid physical injury from machinery.

The approximately 100 harbor seals that utilize Minhoto Marsh could be disturbed during sheet pile installation. Depending on tidal conditions and the time of day, up to 40 to 50 harbor seals (of the 100 seals in Minhoto Marsh), could be located inside the project area when construction is initiated. Fewer seals were observed at the site in the morning and evening compared to the afternoon. Additionally, fewer seals were observed during low tide (less than 2 feet) compared to higher tide (2 feet or greater). Depending on tidal conditions and the time of day, up to an additional 40 to 50 seals (of the 100 seals in Minhoto Marsh) could be located outside of the project area when construction is initiated. Seals located outside of the work are could be incidentally harassed by noise from sheet pile installation. Additionally, there is some potential that if all 100 harbor seals that occur in the adjacent Parsons Slough Complex and Yampah Marsh are located in or around Yampah Marsh they may be disturbed during sheet pile installation. Additionally, depending on the distance of pile driving disturbance, if harbor seals are located in the main Elkhorn Slough channel in direct line of the sheet pile installation, they could be disturbed. The number of harbor seals that could be disturbed in this area is unknown, but expected to be relatively small as many seals haul-out west of Seal Bend. For purposes of this analysis, we assume conservatively that an average of 250 seals (100 around Minhoto marsh, 100 that are typically in Parsons but could be near Minhoto marsh, 50 from closer to the harbor mouth that could move up to the project area) could be disturbed each day of sheet pile installation. This is a very conservative estimate, as not all the seals in Elkhorn Slough are likely to be east of Seal Bend at the same time and not all seals would be affected by noise from construction – especially given the terrain of Elkhorn Slough, where noise attenuates quickly due to shallow water, tidal influence and sinewy channels. If sheet pile installation requires 4 days for completion, up to approximately 1,000 instances of harbor seal disturbance may occur during pile installation.

After sheet piles are installed, harbor seals are not likely to access the work area therefore it is most likely that only harbor seals outside of the work area would be disturbed. Various types of construction equipment would be utilized for earthmoving such as dozers, loaders, and backhoes that may generate noise above ambient levels or create a visual disturbance for a period of 11 months. Although the exact distance of disturbance is unknown, it is anticipated that the disturbance area would be smaller than the sheet pile installation impact area since construction equipment does not generate as much noise as pile driving. Additionally, only work in the northern and eastern portions of Minhoto Marsh would be anticipated to disturb harbor seals because seals do not use other areas of the project and will be on the other side of the barrier. There is a wrecking yard nearby and the main line of Union Pacific railroad runs through this area so seals are accustom to load machinery noise. The number of harbor seals disturbed could fluctuate depending on time of day and tidal depth. For the purposes of this analysis, we conservatively assume that a maximum daily average of 50 harbor seals could be disturbed during construction of the restoration area following sheet pile installation. If work in the northern and eastern portions of the Minhoto Marsh is implemented in 132 days, up to approximately 6,600 minor instances of harbor seal disturbance may occur during construction activities.

If seals are in the project area before or during construction of the tidal barrier they would be allowed to leave on their own or coordination with NMFS will occur to ensure a government official be present should an animal require flushing from within the footprint of the construction area. . Once the barrier is complete it would be unlikely for seals to enter the construction area as they would need to traverse a minimum 7ft high berm into an area without water. However, they can scale the berm (pers com Jim Harvey on 6/30/16 site visit) and if they do, sediment addition will not occur within 200 feet. Per Jim Harvey it is not likely that neonates will be in the project area as moms prefer to keep their pups along the main channel. If they are present and flushed there is no concern that they would be separated (Jim Harvey pers. com 6/30/16 site visit).

This page intentionally left blank

# SECTION 7

# Anticipated Impact of the Activity

## 7.1 Parsons Slough Project Marine Mammal Monitoring

In 2010 and 2011, sea otters and harbor seals were monitored during implementation of the Parsons Slough Project (ESNERR, 2011). Results from the Parsons Slough Project monitoring are summarized below and are useful to determine the anticipated impacts from the proposed project on marine mammals.

The Parsons Slough Project site is located approximately 0.5 miles northeast of the proposed project. The Parsons Slough Project included construction of a partially submerged tidal barrier (a sill) at the mouth of Parsons Slough to reduce tidal scouring. The sill was constructed from floating barges. Vibratory hammers were used to set the sheet pile. Both vibratory and impact hammers were used to set end bearing piles (impact hammering is not planned for this project). Sea otters and harbor seals within the Parsons Slough complex and in Yampah Marsh were monitored to determine project impacts. Several best management practices (such as limiting construction to the non-pupping season, conducting an education program, employing soft starts to pile driving, construction monitoring, and implementing marine mammal safety zones) were implemented to avoid and minimize impacts to marine mammals. Similar measures, presented in *Section 11: Mitigation Measures* would be implemented as part of the proposed project to avoid and minimize impacts to marine mammals.

During construction, monitors tracked abundance, distribution, and disturbances in the Parsons Slough area and adjacent Yampah Marsh. Monitors were authorized to shutdown construction activities if a marine mammal approached within a 10-meter range of pile driving. Monitors recorded any disturbance behaviors exhibited by marine mammals and concurrent construction activities and also noted “no disturbance” when animals in zones closest to construction showed no disturbance associated with construction. No marine mammals were recorded entering the 10-meter safety zone during pile driving and no marine mammals were injured during construction of the project.

### 7.1.1 Sea Otter

Sea otter disturbances within 30 meters of construction were usually water-based and included head raises, swimming away without startling, or startle diving. However, most of the time sea otters within 30 meters showed no disturbance. A majority of the observations of a sea otter within 30 meters of construction were of a single adult male sea otter with an established territory that included the construction site. This individual otter was rarely interrupted from his normal activities including foraging, resting, grooming and interacting.

Some of the disturbance behaviors involving sea otters swimming away with startling and swimming away without startling at distances greater than 180 meters, were mother/pup pairs that turned back in the direction of Yampah Marsh or the main channel after approaching the construction area. Most other sea otter disturbances (between 30 and 180 meters) were associated with moving vessels (approximately 23 percent of behavioral responses), followed by vibratory driving of sheet piles (approximately 13 percent of behavioral responses) and “other” construction activities (approximately 13 percent of behavioral responses).

Monitors used a statistical analysis to compare average abundance of sea otters inside and outside of Parsons Slough during the preconstruction baseline and during the construction period. They found a significant increase in abundance outside of Parsons Slough and a decrease inside of Parsons Slough during construction activities. This may reflect that sea otters occupying the Yampah Marsh area outside of Parsons Slough were not deterred from using the area because they were far enough away from construction (well over 200 meters), and/or because they did not have a direct line of sight of construction activities. It is quite possible that the animals in the Yampah Marsh area are accustomed to mechanical sounds, considering that the area abuts a wrecking yard and is bisected by an active railroad track. The decreased abundance inside Parsons Slough likely resulted from mom/pup pairs and other individuals remaining in Yampah Marsh and avoiding passing through the construction zone to get to upstream areas of Parsons Slough.

### 7.1.2 Harbor Seal

Most of the harbor seal disturbances were when seals were haul-out and occurred at distances of 150 meters or greater and involved head raises or body repositioning, but many individuals showed no disturbance at all, even during pile driving. Movement of vessels was the construction activity most frequently associated with disturbances (approximately 38 percent of behavior responses), followed by vibratory driving of sheet piles (approximately 13 percent of behavior responses) and “other” construction activities (approximately 13 percent of behavior responses), a category that included multiple activities, aside from impact or vibratory hammering. Impact hammering is not planned for this project.

Monitors used a statistical analysis to compare average abundance of harbors seals inside and outside of Parsons Slough during the preconstruction baseline and during the construction period. They found no significant change in harbor seal abundance, which probably indicates minimal disturbance to their use of this habitat during the construction period.

### 7.1.3 Monitoring Conclusions

Vibratory driving of sheet piles was associated with more disturbances than any other type of pile driving, but it had a longer duration than the other types of pile driving, so the duration of the construction activities should be taken into account. Both harbor seals and sea otters showed more disturbance by passing vessels associated with construction than by the sounds of machinery. It is quite likely that individuals using these areas are acclimated to sounds of machinery since the main north south line of Union Pacific Railroad runs through Elkhorn Slough between harbor seal and sea otter haul outs and next to the railroad on the south edge of the slough there is a wrecking yard that has larger tractors and crushes cars throughout the day.

Because “no disturbance” was a common occurrence during pile driving and because normal harbor seal and sea otter activities continued with no observed lasting effects, the evidence indicates that pile driving was not particularly disruptive to animals using the Parsons Slough and adjacent areas.

## 7.2 Construction Impacts To Sea Otter

Construction activities have the potential to directly affect sea otters that may be resting, foraging, or engaging in other activities either inside or outside of the project area. These otters may be temporarily disturbed or harassed by construction noise or human presence.

The greatest noise disturbance would occur if sheet pile is used to isolate the construction area from tidal waters, dewater the work area, and allow construction activities in non-tidal conditions. If sheet pile is required, a vibratory hammer may be utilized for installation, which would temporarily increase ambient noise levels at the site for a period of several days. Sheet pile installation could impact up to 50 sea otters per day that occur in or around the Minhoto Marsh, Parsons Slough, and Yampah Marsh. During the 11 month construction period following sheet pile installation, various types of construction equipment would be utilized for earthmoving such as dozers, loaders, and backhoes that may generate noise above ambient levels. These construction activities may temporarily disturb up to 10 sea otters per day (when work is conducted in the northern or eastern portion of the restoration area) that are located in either Minhoto or Yampah Marsh outside of the work area. Trains along the UPRR likely generate fairly high noise levels in the vicinity of Hester Marsh within the eastern portion of the project, so construction equipment operated in this area may not elevate ambient noise levels when trains are present.

Sea otters have not been reported as particularly sensitive to sound and/or movement disturbance, especially in comparison to other marine mammals such as pinnipeds (USFWS, 2008). However, construction noise and associated disturbance resulting from the proposed action could exclude individuals from marsh areas adjacent to the restoration area during normal resting and foraging behavior, compelling individuals to temporarily use adjacent areas of Elkhorn Slough. Females and pups are expected to be the most sensitive to human disturbance and the most vulnerable to impacts from this type of dispersal (K. Mayer, pers. comm; T. Nicholson, pers comm. in USFWS, 2010).

Approximately two sea otters that have been observed to use Minhoto Marsh would be temporarily displaced to other areas of Elkhorn Slough. The potential short-term displacement of foraging or resting sea otters would not affect the overall fitness of any individual animal because there is an abundance of suitable foraging[2] and resting habitat available in the greater Elkhorn Slough estuary.

Equipment refueling, fluid leakage, and maintenance activities within or near water bodies pose a risk of accidental water contamination that may result in injury or death to aquatic life, including sea otters. Leaks or spills of petroleum hydrocarbon products found in construction equipment could have adverse effects on sea otters by contaminating their fur and interfering with their insulation and by ingestion during grooming.

## 7.3 Construction Impacts to Harbor Seal

Construction activities have the potential to directly affect harbor seals that may be hauling out, resting, foraging, or engaging in other activities either inside or outside of the project area. These seals may be temporarily disturbed or harassed by construction noise or human presence.

The greatest noise disturbance would occur if sheet pile is used to isolate the construction area from tidal waters, dewater the work area, and allow construction activities in non-tidal conditions. If sheet pile is required, a vibratory hammer may be utilized for installation, which would temporarily increase ambient noise levels at the site for a period of several days. Sheet pile installation could impact an average of 250 harbor seals per day that could occur in or around the Minhoto Marsh, Parsons Slough, and Yampah Marsh at the time of installation (100 around Minhoto marsh, 100 that are typically in Parsons but could be near Minhoto marsh, 50 from closer to the harbor mouth that could move up to the project area). During the 11 month construction period, various types of construction equipment would be utilized for earthmoving such as dozers, loaders, and backhoes that may generate noise above ambient levels. These construction activities may temporarily disturb an average of 50 harbor seals per day (when work is conducted in the northern or eastern portion of the restoration area) that are located in either Minhoto or Yampah Marsh outside of the work area. It would be unlikely that all 250 would be in the area daily. They would likely use other areas of the slough as indicated in Figure 4-4. Trains along the UPRR likely generate fairly high noise levels in the vicinity of Hester Marsh within the eastern portion of the project, so construction equipment operated in this area may not elevate ambient noise levels when trains are present.

Construction noise may cause haul-out site abandonment at Minhoto or Yampah Marsh in the vicinity of the project site. Haul out site abandonment is not considered an adverse effect during the non-breeding season because the larger Elkhorn Slough provides an abundance of haul-out habitat for harbor seals. Abandonment of haul-outs during the pupping season would be considered an adverse effect and could result in reduced pup survival due to mother/pup separation and interrupted suckling bouts. Implementation of the project minimization measures would avoid this potentially adverse effect by restricting construction to the non-breeding season for harbor seals.

---

2 Research on abundance of benthic invertebrates throughout Elkhorn Slough indicates that sufficient prey base is available for otters in other locations throughout the action area (Moss Landing Marine Laboratories, 2007).

Approximately 40 to 50 harbor seals utilize the restoration area. These seals would be inhibited from hauling-out or resting within the project area during the 11 month construction area. The site would be initially isolated during the non-pupping season to avoid impacts to mothers with pups. Non-breeding seals that would have utilized the project area for hauling-out or resting would be displaced. However, seals could use other areas of Elkhorn Slough for resting and haul-out during construction, which would minimize impacts to seals.

Short-term displacement of resting harbor seals that is likely to occur as a result of proposed project noise is not anticipated to affect the overall fitness of any individual animal because there is an abundance of suitable resting habitat available in the greater Elkhorn Slough estuary.

This page intentionally left blank

# SECTION 8
# Anticipated Impacts on Subsistence Uses

Not Applicable. There are no relevant subsistence uses of marine mammals implicated by this action.

This page intentionally left blank

# SECTION 9
# Anticipated Impacts on Habitat

The purpose of the proposed project is to return tidal wetland function to this portion of Elkhorn Slough which has been lost due to prior diking, marsh draining, and construction of the harbor. Conversion of mudflat back to tidal marsh is expected to have an overall beneficial effect on the Elkhorn Slough system. By raising the elevation of the marsh, and increasing the extent of tidal marsh, tidal prism would be reduced. This reduction would slow erosion and sediment and marsh loss within the slough system. It is expected to reduce the loss of soft sediment habitat within the slough that support prey species of marine mammals. Increasing the extent of tidal marsh would also improve water quality by establishing a buffer to absorb upland contaminants and agricultural runoff coming from the Old Salinas River mouth.

## 9.1 Sea Otters

During surveys conducted of the Minhoto Marsh complex in 2013, a maximum of two otters at a time were observed in Minhoto (Beck, E., 2014). As described in Section 7, Minhoto Marsh would be temporarily impacted during restoration activities and otters would not be able to utilize this area. Other areas within the Elkhorn Slough system, including Yampah Marsh and Parsons Slough, would be available during construction, which would minimize the impacts from the temporary loss of habitat.

## 9.2 Harbor Seals

Approximately 40 to 50 harbor seals utilize the restoration area. As described in Section 7, these seals would be temporarily displaced during construction activities within Minhoto Marsh. Short-term displacement of resting harbor seals is not anticipated to affect the overall fitness of any individual animal because there is an abundance of suitable resting habitat available in the greater Elkhorn Slough estuary.

This page intentionally left blank

# SECTION 10

# Anticipated Effects of Habitat Impacts on Marine Mammals

## 10.1 Sea Otters

As described in Section 9, the conversion of mudflat back to tidal marsh will have an overall beneficial effect on the Elkhorn Slough system. Conversion of mudflat back to tidal marsh will likely have a positive effect on the population of sea otters in Elkhorn Slough, as healthy tidal marsh provides excellent foraging and resting opportunities for southern sea otters adjacent to the project area (see references above). It is expected that within a few years sea otters will expand their range into the restored area.

## 10.2 Harbor Seals

As described in Section 9, the conversion of mudflat back to tidal marsh will have an overall beneficial effect on the Elkhorn Slough system. This would likely have a long-term beneficial effect on harbor seals by improving ecological function of the slough. Harbor seals use a small portion of the channel edges within the subsided marsh (now mudflat). During construction these haul-out areas will be unavailable to harbor seals but once construction is complete, these same haul-out areas will once again be available (Figure 4-4). Harbor seals use a very small percentage of the potential haul-out habitat that currently exists in Elkhorn Slough. They will have an abundance of area to haul out on during construction (Figure 4-4); it would probably require huge losses of mudflat habitat for this effect to become limiting to the subpopulation (McCarthy in press, as cited in Vinnedge Environmental Consulting, 2010b).

This page intentionally left blank

# SECTION 11

## Mitigation Measures

The following conservation measure shall be implemented to avoid and/or reduce impacts to marine mammals:

1. A NMFS- and Service approved biologist (see section 13.2) shall conduct mandatory biological resources awareness training for construction personnel. The awareness training shall be provided to all construction personnel to brief them on the need to avoid effects on marine mammals. If new construction personnel are added to the project, the contractor shall ensure that the personnel receive the mandatory training before starting work.

2. A Service- and NMFS- approved biological monitor will monitor for marine mammal disturbance. Monitoring will occur at all times when work is occurring: 1) in water, 2) north of a line starting at 36˚ 48'38.91 N 121˚ 45'08.03 W and ending 36˚ 48'38.91 N 121˚ 45'27.11 W, or 3) within 100 feet of tidal waters. When work is occurring in other areas, monitoring will be implemented for at least the first 3 days of construction. Monitoring will continue until there are 3 successive days of no observed disturbance, at which point monitoring may be suspended. Monitoring will resume when there is a significant change in activities or location of activities within the project area or if there is a gap in construction activities of more than one week. In these cases, monitoring will again be implemented for at least the first 3 days of construction and will not be suspended until there are 3 successive days of no observed disturbance. The biological monitor will have the authority to stop project activities if marine mammals approach or enter the exclusion zone. Biological monitoring will begin 0.5-hour before work begins and will continue until 0.5-hour after work is completed each day. Work will commence only with approval of the biological monitor to ensure that no marine mammals are present in the exclusion zone.

3. To reduce the risk of potentially startling marine mammals with a sudden intensive sound, the construction contractor would begin construction activities gradually each day by moving around the project area and starting tractor one at a time.

4. Biological monitors would have authority to stop construction at any time for the safety of any marine mammals.

5. In-water construction work shall occur only during daylight hours when visual monitoring of marine mammals can be implemented. No in-water work will be conducted at night.

6. If sheet piles are used to isolate construction activities from tidal action, the following shall be implemented:

    a. All piles shall be installed using a vibratory pile driver.

    b. An exclusion zone will be implemented that includes all areas where underwater sound pressure levels are expected to reach or exceed 190 dB re 1 μPa. Since this is less than a foot (0.22m) the radius of the exclusion zone shall be a minimum of 49 feet (15m) to prevent the injury of marine mammals from machinery. Pile extraction or driving shall not commence (or re-commence following a shutdown) until marine mammals are not sighted within the exclusion zone for a 15-minute period. If a marine mammal enters the exclusion zone during sheet pile work, work shall stop until the animal leaves the exclusion zone.

7. If marine mammals are present within the work area, they will be allowed to leave on their own volition. If they are not leaving the work area on their own coordination with NMFS or the Service (as appropriate) will occur to ensure a government official be present should an animal require flushing from within the footprint of the construction area. If a pup less than one week old comes within 20m of where heavy machinery is working, construction activities in that area would be delayed until the pup has left the area. In the event that a pup less than one week old remains within those 20m, NMFS would be consulted to determine the appropriate course of action.

8. Fuel storage and all fueling and equipment maintenance activities will be conducted at least 100 feet from subtidal and intertidal habitat.

# SECTION 12
## Arctic Plan of Cooperation

Not Applicable. The proposed activity will take place in Elkhorn Slough, and no activities will take place in or near a traditional Arctic subsistence hunting area. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action.

This page intentionally left blank

# SECTION 13
# Monitoring and Reporting

## 13.1 Pre-construction Monitoring

As described in Section 4.1.2 for sea otter and Section 4.2.2 for harbor seal, ESNERR has initiated biological monitoring of marine mammals to determine current population abundance and dynamics (Beck, 2014). This monitoring effort has provided a foundation for evaluating effects of the proposed project on marine mammals. Nine daytime counts of marine mammals within Minhoto Marsh were completed between June 2013 and August 2013, accounting for both ebb and flood tide cycles. Observations were made from a vehicle parked near the bank of the Minhoto Marsh complex (see Figure 1) using binoculars and a spotting scope (see Figure 4-2).

Otters did not utilize the monitoring area in large numbers. A maximum of two otters at a time were observed in Minhoto (in M3) during monitoring (see Figure 4-2), and only near or exceeding a tide height of four feet. Harbor seals utilized eight haul out sites in Minhoto; four in the marsh interior and four on the outer edges near the main channel (see Figure 4-5). The maximum number of seals counted was 94, and the average number hauled out increased progressively from morning until afternoon, declining as sunset approached. This is consistent with several previous studies finding that harbor seals leave the Slough in the evening to forage in Monterey Bay.

## 13.2 Construction Monitoring

A Service- and NMFS- approved biological monitor will monitor for marine mammal disturbance. Monitoring will occur at all times when work is occurring: 1) in water, 2) north of a line starting at 36˚ 48’38.91 N 121˚ 45’08.03 W and ending 36˚ 48’38.91 N 121˚ 45’27.11 W, or 3) within 100 feet of tidal waters. When work is occurring in other areas, monitoring will be implemented for at least the first 3 days of construction. Monitoring will continue until there are 3 successive days of no observed disturbance, at which point monitoring may be suspended. Monitoring will resume when there is a significant change in activities or location of activities within the project area or if there is a gap in construction activities of more than one week. In these cases, monitoring will again be implemented for at least the first 3 days of construction and will not be suspended until there are 3 successive days of no observed disturbance. The biological monitor will have the authority to stop project activities if marine mammals approach or enter the exclusion zone. Biological monitoring will begin 0.5-hour before work begins and will continue until 0.5-hour after work is completed each day. Work will commence only with approval of the biological monitor to ensure that no marine mammals are present in the exclusion zone.

Throughout construction activities that require a monitor, the biological monitor will maintain a log that documents numbers of marine mammals present before, during, and at the conclusion of daily activities (See Appendix B for a detailed description of the monitoring protocol ). The monitor will record basic weather conditions and marine mammal behavior. A final report shall be submitted to NMFS and the Service within 90 days of the conclusion of monitoring efforts, or as required by the agencies. The report shall detail the monitoring protocol, summarize the data recorded during monitoring, and contain an estimate of the number of marine mammals that may have been harassed.

Service and NMFS approved biologists will have qualifications consistent with those of NMFS Protected Species Observers as follows:

1. Independent observers (i.e., not construction personnel) are required.
2. At least one observer must have prior experience working as an observer.
3. Other observers may substitute education (undergraduate degree in biological science or related field) or training for experience.
4. Where a team of three or more observers are required, one observer should be designated as lead observer or monitoring coordinator. The lead observer must have prior experience working as an observer.
5. Submission and approval of observer CVs by the Service and NMFS is required.

Other important qualifications:

1. Ability to conduct field observations and collect data according to assigned protocols.
2. Experience or training in the field identification of marine mammals, including sea otters and harbor seals, and the identification of their behaviors.
3. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
4. Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction sound of marine mammals observed within a defined shutdown zone; and marine mammal behavior.
5. Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

## 13.3 Post-construction Monitoring

Additional monitoring may occur (if funding allows) consisting of a monthly census of marine mammals during peak occupational times and tidal cycles for six months post-construction. Funding will depend on construction costs. Data collected after the first 30 days of post-construction monitoring will be reported as an addendum.

# SECTION 14
# Suggested Means of Coordination

All marine monitoring data collected before, during and after construction of the proposed project would be made available to NMFS, NOAA, the Service and the general public.

This page intentionally left blank

# SECTION 15
## References


Ainley, D., H. Huber, R. Henderson, & T. Lewis (1977). Studies of marine mammals at the Farallon islands, California, 1970-1975. *Final report to US Marine Mammal Commission, Washington, DC (Contract MM4AC002)*.

Allen, S., D. Ainley, G. Page, & C. Ribic. (1984). The effect of disturbance on harbor seal haul out patterns at Bolinas Lagoon, *California.Fishery Bulletin*, *82*(3), 493-500.

Beck, Emily, 2014. Draft. Summary of Sea Otter and Harbor Seal Utilization of the Minhoto Marsh Complex and Nearby Areas of the Elkhorn Slough.

Callaway, J., B. Largay, M. Brennan, S. Crooks, J. Lacy, D. Smith, E. Van Dyke, K. Wasson, E. Watson, L. Windham-Meyers, A. Woolfolk, 2012. Statement of Agreement on Tidal Marsh Dieback. Prepared for Elkhorn Slough Foundation.

Carretta, J.V., E.M. Oleson,, J. Baker, D.W. Weller, A.R. Lang, K.A. Forney, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, R.L. Brownell. 2015. U.S. Pacific marine mammal stock assessments. NOAA Technical Memorandum NMFS-SWFSC-561, 426pp.

Eby, D.M.R. and R. Scoles, 2010. Impact of proposed alterations of tidal flows on sea otters and harbor seals using Elkhorn Slough and Parsons Slough Complex. Technical Report by Okeanis. 20pp.

Elkhorn Slough Foundation and Elkhorn Slough National Estuarine Research Reserve official website, http://www.elkhornslough.org/esf/properties/index.htm, accessed June 30, 2014.

Elkhorn Slough National Estuarine Research Reserve (ESNERR), 2011. Parsons Slough Project 30 Day Post Construction Report. 3/25/2011

Elkhorn Slough Tidal Wetland Project Team (ESTWPT), 2007. Elkhorn Slough Tidal Wetland Strategic Plan. A report describing Elkhorn Slough's estuarine habitats, main impacts, and broad conservation and restoration recommendations. 100 pp.

Environmental Science Associates (ESA), 2013. Field Data Collection Review for Field Day #1, January 15, 2013. Memo to Elkhorn Slough Foundation as part of the Elkhorn Slough Tidal Marsh Restoration Project (ESA #D120505.00). February 4th, 2013.

ESA, 2014a. Final Elkhorn Slough Tidal Marsh Restoration Project Existing Conditions Report. Prepared for Elkhorn Slough Foundation and Elkhorn Slough National Estuarine Research Reserve. July 1, 2014.

ESA, 2014b. Elkhorn Slough Tidal Marsh Restoration Project Restoration Plan. Final. Prepared for Elkhorn Slough National Estuarine Research Reserve and Elkhorn Slough Foundation. July 1, 2014.

ESA, 2015. Elkhorn Slough Tidal Marsh Restoration Project Initial Study/Mitigated Negative Declaration. Prepared for California Department of Fish and Wildlife. June 2015.

Estes, J.A., Brian B. Hatfield, K. Ralls, and J. Ames, 2003. Causes of mortality in California sea otters during periods of population growth and decline. Marine Mammal Science. 19:198-216.

Fancher, L. E. (1979). *The Distribution, Population Dynamics, and Behavior of the Harbor Seal (Phoca vitulina richardi) in South San Francisco Bay, California*. Doctoral dissertation, Calif. State University, Hayward.

Fountain, Monique, 2015. Tidal Wetland Project Director for ESNERR. Email correspondence between Fountain and Michelle Giolli-Hornstein regarding turbidity studies at Minhoto Marsh. September 17, 2015.

Grigg, E., S. Allen, D. Craven-Green, A. Klimley, H. Markhowitz, & D. Eliot-Fisk (2012). Foraging distribution of Pacific harbor seals (Phoca vitulina richardii) in a highly impacted estuary. Journal of Mammalogy, 93(1), 282-293.

Gunvalson, M. (2011). Reducing Disturbances to Marine Mammals by Kayakers in the Monterey Bay. Master's Thesis, San Jose State University. 88 p.

Hanan, D. (1996). Dynamics of abundance and distribution for Pacific harbor seal, *Phoca vitulina richardsi*, on the coast of California. PhD Dissertation, University of California Los Angeles. 167 p.

Harvey, J. T., Helm, R. C., & Morejohn, G. V. 1995. Food habits of harbor seals inhabiting Elkhorn Slough, California. California Fish and Game, 81(1), 19.

Hatfield, Brian, and Tim Tinker, 2014. Spring 2014 California Sea Otter Census Results. USGS Western Ecological Research Center. Santa Cruz Field Station. September 22, 2104.

Holland, R., 1986. Preliminary descriptions of the terrestrial natural communities of California. California Department of Fish and Game, Natural Heritage Division. Sacramento, CA.

Hughes, B., J. Haskins, and K. Wasson, 2010. Assessment of the effects of nutrient loading in estuarine wetlands of the Elkhorn Slough watershed: a regional eutrophication report card. Elkhorn Slough Technical Report Series 2010:1.

Hughes, B, J. Haskins, K. Wasson, and E. Watson, 2011. Identifying factors that influence expression of eutrophication in a central California estuary. Marine Ecology Progress Series 439:19-30.

Johnson K., 2010. Water quality challenges related to restoration alternatives in Elkhorn Slough. Powerpoint presentation to the Elkhorn Slough Tidal Wetland Project on 6/23/2010. http://www.elkhornslough.org/tidalwetland/downloads/ KenJohnsonJune2010_WQSummary.pdf

Jones T.L. 2002. Archaeology and prehistory. In: Changes in a California estuary: a profile of Elkhorn Slough (Caffrey, J.C., M. Brown, W.B. Tyler, M. Silberstein, eds). Moss Landing, California: Elkhorn Slough Foundation.

Kieckhefer, T.R., J. Cassidy, J. Hoffman, S.L. Reif and D. Maldini, 2004. Rise and Fall of Southern Sea Otters (Enhydra lutris nereis) in Elkhorn Slough, California, 1994-2003. Research poster at Monterey Bay National Marine Sanctuary Symposium. Sanctuary Currents 2004. Clean Waters, Healthy Oceans. Presented March 6, 2004.

King, J.M., 1982. Elkhorn Slough Estuarine Sanctuary: Cultural resource management. California Department of Fish and Game, 1982.

Kutcher, T., 2008. Habitat and land cover classification scheme for the National Estuarine Research Reserve System. Report prepared for the National Estuarine Research Reserve System (NERRS).

Maldini, Daniela, R. Scoles, and R. Eby. 2009. Impact of Proposed Alterations of Tidal Flow on Sea Otters and Harbor Seals Using Elkhorn Slough and the Parsons Slough Complex: Preliminary Results for October 2009.

Maldini, Daniela, R. Scoles, and R. Eby, 2010. Impact of Proposed Alterations of Tidal Flow on Sea Otters and Harbor Seals Using Elkhorn Slough and the Parsons Slough Complex.

McCarthy, E., 2010a. Harbor seals: Factors that control distribution and abundance in Pacific Coast estuaries and a case study of Elkhorn Slough, California. Elkhorn Slough Technical Report Series 2010: 8). Moss Landing, CA: Elkhorn Slough National Estuarine Research Reserve.

McCarthy, E., 2010b. Sea otters: factors that control distribution and abundance in Pacific Coast estuaries and a case study of Elkhorn Slough, California. Elkhorn Slough Technical Report Series 2010:7.

Monterey Bay Aquarium Research Institute (MBARI) Land/Ocean Biogeochemical Observatory in Elkhorn Slough (LOBO). http://www.mbari.org/lobo/

National Cooperative Soil Survey, Natural Resources Conservation Service, United States Department of Agriculture (NCSS-NRCS), 2013. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda. gov/app/HomePage. htm. Accessed January 2013.

National Oceanic and Atmospheric Administration (NOAA), 2015. Interim Sound Threshold Guidance. Available at http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html. Accessed on December 15, 2015.

Osborn, L. S. 1985. Elkhorn Slough: Assessment of boating and seal activity in 1984 (Baseline Report): California Department of Transportation.

Osborn, L. 1992. Harbor seal studies in Elkhorn Slough 1989 to 1991 (Report of Preliminary Findings). Monterey, CA: California Department of Fish and Game.

Oxman, D. S. 1995. Seasonal abundance, movements, and food habits of harbor seals (*Phoca vitulina richardsi*) in Elkhorn Slough, California. Unpublished M.S. Thesis, California State University, Stanislaus and Moss Landing Marine Laboratories, Moss Landing, CA.

Philip Williams and Associates (PWA), H. T. Harvey & Associates, 2nd Nature, E. Thornton, and S. Monismith, 2008. Hydrodynamic Modeling and Morphologic Projections of Large-Scale Restoration Actions: Final Report prepared for the Elkhorn Slough Tidal Wetlands Project. June 6.

Richman, S. E. 1997. Seasonal abundance and distribution of marine mammals and birds in Elkhorn Slough, Moss Landing, California from July 1994 to July 1997 (Independent Study Report). Santa Cruz, CA: University of California Santa Cruz.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens, 2009. A Manual of California Vegetation. 2nd edition. California Native Plant Society, Sacramento, CA.

Scoles, R., R. Eby, R. Chaffin, and D. Maldini, 2012. Sea Otters at Elkhorn Slough estuary: Linking Land to Sea. Research poster at Monterey Bay National Marine Sanctuary Symposium. Sanctuary Currents 2012. From Lions to Luminescence: Linking Land and Sea. Presented April 14, 2012.

Silberstein, M., C. Zabin, L. Newberry, D. Mountjoy, L. Strnad, and J. Caffrey, 2002. History of Land Use, Changes in a California Estuary: A profile of Elkhorn Slough. Pages 163-185. Caffrey, J., M. Brown, W.B. Tyler, and M. Silberstein (editors). Prepared for the Elkhorn Slough Foundation. Moss Landing, CA.

Stewart, B., & P. Yochem. (1994). Ecology of harbor seals in the Southern California Bight. *The Fourth California Islands Symposium: update on the status of resources (pp. 123-134).*

Trumble, S. (1995). Abundance, movements, dive behavior, food habits, and mother-pup interactions of harbor seals(Phoca vitulina richardsi) near Monterey Bay, California. Master's Thesis, California State University Fresno. 110 p.

US Fish and Wildlife Service, 2003. Final Revised Recovery Plan for the Southern Sea Otter (Enhydra lutris nereis). Portland, Oregon. xi + 165 pp.

US Fish and Wildlife Service, 2008. Marine Mammals Incidental Take During Specified Activities, Notice of receipt of application and proposed incidental harassment authorization. Federal Register. Volume 73, Number 167. Pages 50634-50641.

US Fish and Wildlife Service, 2010. Biological Opinion on the Parson's Slough Project, Santa Cruz County, California (8-8-10-F-49). August 3, 2010.

Van Dyke, E. and K. Wasson, 2005. Historical Ecology of a Central California Estuary: 150 Years of Habitat Change. Estuaries 28:173-189.

Vinnedge Environmental Consulting, 2010a. Biological Assessment, Essential Fish Habitat Assessment and Request for Incidental Harassment Authorization: Parsons Slough Project. Prepared for Elkhorn Slough National Estuarine Research Reserve and National Oceanic and Atmospheric Administration.

Vinnedge Environmental Consulting, 2010b, Request for Incidental Harassment Authorization Parsons Slough Project Monterey County, California. Project Applicant" National Oceanic NOAA Restoration Center Southwest Region. August, 2010.

Vinnedge Environmental Consulting, 2010c. letter to Mr. Kit Crump at NMFS, Addendum to the Parsons Slough Project Biological Assessment for Project Biological Assessment, Essential Fish Habitat Assessment and Request for Incidental Harassment Authorization.

Wasson, K, A D'Amore, M. Fountain, A. Woolfolk, M Silberstein, B. Suarez and D. Feliz, 2012. Large-scale restoration alternatives for Elkhorn Slough: summary of interdisciplinary evaluations and recommendations. Report prepared by the Elkhorn Slough National Estuarine Research Reserve (ESNERR) and Elkhorn Slough Foundation for the Elkhorn Slough Tidal Wetland Project. Moss Landing, CA.

Wasson, K. and A. Woolfolk, 2011. Salt marsh-upland ecotones in central California: vulnerability to invasions and anthropogenic stressors. Wetlands 31:389-402

Watson, E.B., K. Wasson, G.B. Pasternack, A. Woolfold, E. Van Dyke, A.B. Gray, A. Pakenham, and R.A. Wheatcroft, 2011. Applications from Paleoecology to Environmental Management and Restoration in a Dynamic Coastal Environment. Restoration Ecology Vol. 19, No. 6, pp. 765-775.

Woolfolk, A. and Q. Labadie, 2012. The significance of pickleweed-dominated tidal salt marsh in Elkhorn Slough, California. Elkhorn Slough Technical Report Series 2012:4.

Zimmerman, R.C. and J.M. Caffrey, 2002. Primary producers. In a California Estuary: A profile of Elkhorn Slough. Pages 118-133. Caffrey, JM Brown, WB Tyler, and M Silberstein (editors). Prepared for the Elkhorn Slough Foundation. Moss Landing, CA.

This page intentionally left blank

# Appendix A – Noise memo

ESA

550 Kearny Street
Suite 800
San Francisco, CA 94108
415.896.5900 phone
415.896.0332 fax

www.esassoc.com

# memorandum

date July 15, 2016

to Monique Fountain, Tidal Wetland Project Director (ESNERR)

from Chris Sanchez, Senior Technical Associate;
Eli Davidian, Regulatory Task Leader

subject Hydroacoustic Impact Zone for Sheetpile Driving in Elkhorn Slough

ESA has prepared this Technical Memorandum to report on the potential extent of the area that would be subject to the potentially adverse behavioral disruption threshold for marine mammals as result of vibratory driving of sheet piles in Elkhorn Slough and identify available measures to be taken to reduce potential hydroacoustic impacts to marine mammals. The National Oceanic and Atmospheric Administration (NOAA) has adopted interim sound threshold guidance and impact thresholds for marine mammals. The Level B behavioral disruption threshold for non-pulse noise such as vibratory pile driving is 120 decibels (dBrms)[1]. NOAA describes its thresholds as conservative and its guidance also states that the120 dBrms threshold may be slightly adjusted if background noise levels are at or above this level[2].

Data on measured reference levels for the in-water noise generated by sheet pile driving is available from a variety of sources including Caltrans' 2012 Compendium of Pile Driving Sound Data. However, location, soil type, water depth and depth of pile insertion are important factors in selecting a representative reference noise level for application to a given work site. For this reason, ESA selected monitored noise data for the 2010 Parson Slough Sill Project which occurred approximately one half mile to the east adjacent to Elkhorn Slough. In-water noise data monitored during insertion of sheet piles using a vibratory driver indicated this activity generated a maximum noise level of 165 dBrms at a reference distance of 10 meters from the pile location[3] which was used as the reference level for sheet pile driving in the Parsons Slough Project, although sound levels as low as 145 dBrms were measured at the 10 meter reference distance. This noise level is consistent with data within Caltrans' 2012 Compendium of Pile Driving Sound Data for monitoring of sheet pile installation at the Port of Oakland.[4]

---

[1] All decibel levels reported herein are root-mean square decibels referenced to 1 micropascal.
[2] NOAA, Marine Mammals Interim Sound Threshold Guidance, Website accessed July, 13, 2016, available at http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html.
[3] Elkhorn Slough National Estuarine Research Reserve, Parsons Slough Project 30-day Post Construction Report, Appendix V, March 25, 2011.
[4] Caltrans, Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish, Appendix I: Compendium of Pile Driving Sound Data, Updated October, 2012.

ESA used this reference noise level and the hydro acoustic noise impact model developed by the NMFS[5] to estimate the distance to the Level B behavioral disruption threshold for non-pulse noise. Table 1 presents the attenuation with distance predicted by the NMFS model for an open water site.

**Table 1. In-Water Noise Levels from Vibratory Sheet Pile Driving in Open Water**

| Distance from Pile (meters) | Noise level (dBrms) |
| --- | --- |
| 0.22 | 190 |
| 10 | 165 |
| 50 | 155 |
| 100 | 150 |
| 500 | 140 |
| 1,000 | 135 |
| 5,000 | 125 |
| 10,000 | 120 |

As can be seen from Table 1, the distance to the Level B behavioral disruption threshold could occur up to10 kilometers from the source in open water. However, in a narrow and relatively shallow slough, the distance to the 120 dB marine mammal safety zone would be substantially less even for a worst-case scenario. Sound exposure would be restricted to animals in the slough, or animals in the main Elkhorn Slough that would be in a direct transmission path with the sound source. Bends in the slough and topographic changes in the bottom would act to reflect sound and attenuate sound levels. The 10,000 meter distance to a 120 dB sound level in open water can be compared to that an estimate attenuation distance for the Parsons Slough Project of 7,400 meters (also in open water) which was estimated based on transmission loss that was monitored at 10 meter and 29 meter distances[6]. In summary, the channel configuration of the project area has a much greater influence on sound transmission and attenuation in the water column and would greatly eclipse the attenuation rate in open water. For example, the straight line distance from the coffer dam site (source of the sound) to the north bank of Elkhorn Slough is only about 525-600 meters.

It is also possible that the existing background in-water sound level within the slough is higher than the Level B behavioral disruption threshold. Unfortunately, the noise data collected for the Parson Slough Sill Project does not include an assessment of the acoustical background noise level within the slough (only an airborne background noise level was reported). Data collected during installation of "H-piles" indicates a recorded in-

[5] National Marine Fisheries Service, Underwater Sound Propagation Model, on-line model available at http://www.dot.ca.gov/hq/env/bio/fisheries_bioacoustics.htm, 2012.

[6] Vinnedge Environmental Consulting, Request for Incidental Harassment Authorization, Parsons Slough Project, August 2010.

water noise level of 130 dBrms, indicating that the background noise level is no more than this. If monitoring of ambient noise conditions were to demonstrate background noise levels of 130dB, and the Level B behavioral disruption threshold adjusted for this background level, the revised threshold would be reached at approximately 2.2 kilometers from the source in open water, but would only affect an area up to about 525-600 meters from the sound source. Figure 1 presents an approximated Zone of Impact (120 dBrms) that conservatively considers the limitations of propagation of underwater sound levels due to the presence of channel banks and surrounding topography. Figure 2 presents an approximated Zone of Exclusion (190 dBrms) which would be a narrow boundary 0.22 meters on either side of the sheet piles being driven.

Bubble curtains are a commonly employed means of reducing in-water noise levels from pile driving activities. Caltrans' 2012 Compendium of Pile Driving Sound Data contains measured reductions of in-water noise from the use of bubble curtains during pile driving. However, none of these measurements in the compendium includes bubble curtain applications to sheet pile driving. A paper presented at NOISE-CON 2014[7] reports reductions of 3 to 4 dBrms only but cites limited airflow as a potential reason for this modest reduction. Such a reduction would likely not meaningfully reduce the extent of the Level B behavioral disruption area.

Available measures to reduce the potential harassment impacts to marine mammals could include the following:

1. A qualified biologist shall conduct mandatory biological resources awareness training for construction personnel. The awareness training shall be provided to all construction personnel to brief them on the need to avoid effects on marine mammals. If new construction personnel are added to the project, the contractor shall ensure that the personnel receive the mandatory training before starting work.

2. Pile driving activities shall be timed to avoid the peak of the pupping season for sea otters and harbor seals, as determined by consultation with regulatory agency staff.

3. To reduce the risk of potentially startling marine mammals with a sudden intensive sound, the construction contractor would begin construction activities gradually. A soft start technique may be used at the onset of all pile driving to allow any marine mammal that may be in the immediate area to leave before the pile hammer reaches full energy. For vibratory pile driving, contractors will initiate noise from the vibratory hammer for 15 seconds at 40 to 60 percent reduced energy, followed by a 1-minute waiting period. The procedure will be repeated two additional times before full energy may be achieved. The soft-start procedure will be conducted prior to driving each pile if vibratory hammering ceases for more than 30 minutes.

4. Prior to the use of a pile driver, a NMFS-approved biologist shall survey the area identified as the Marine Mammal Exclusion Zone to verify that there are no marine mammals present. If marine mammals are present, vibratory sheet pile installation would be delayed until they leave the area. Biological monitors would have authority to stop construction if marine mammals appear severely distressed or in danger of injury.

5. In-water construction work shall occur only during daylight hours when visual monitoring of marine mammals can be implemented.

6. Pile driving will be done at low tide, to the extent practicable, when minimal water is present to minimize underwater sound impacts. Once pile driving begins for the day, it can continue until pile or sheet pile driving is completed for the day.

[7] Thalheimer et. al., *Development and Implementation of an Underwater Construction Noise Program,* Presentation to NOISE-CON, September 2014.


SOURCE: Google Earth; ESA



**Figure 1**
Approximated Zone of Influence for Sheet Pile Driving in Elkhorn Slough


SOURCE: Google Earth; ESA



**Figure 2**
Zone of Exclusion 0.22 meters on
Either Side of Proposed Sheetpiles

# Appendix B – Monitoring Protocol

**Elkhorn Slough Tidal Marsh Restoration**
**Marine Mammal Monitoring Protocol**

**Goals**

1. Ensure that marine mammals are not subject to injury under the Marine Mammal Protection Act and the Federal Endangered Species Act.
2. Collect field data about the movement and activity of marine mammals during construction monitoring, which will inform NMFS and USFWS on marine mammal sensitivity to disturbance and provide reference for future construction projects.

**Objectives**

1. Ensure that construction activity is halted when there is a reasonable possibility that marine mammals will enter the exclusion zone (within 15 m of pile driving or other construction activity) in order to avoid any potential for physical injury.
2. Ensure that presence, distribution, movement and behavior of harbor seals and sea otters within the project area and surrounding vicinity is recorded when there is a reasonable possibility that marine mammals will experience behavioral harassment.

**Observation location (Figure 1)**

Monitoring during construction will occur from one observation area at Yampah Island. It is accessed by foot and provides a vantage point of the entire construction area, main channel of Elkhorn slough, Yampah marsh and Parsons. This includes the entire area within which harbor seals and sea otters present might reasonably be expected to experience disturbance due to construction activities.

**Monitoring protocol**

A Service- and NMFS- approved biological monitor will monitor for marine mammal disturbance. Monitoring will occur at all times when work is occurring: 1) in water, 2) north of a line starting at 36˚ 48’38.91 N 121˚ 45’08.03 W and ending 36˚ 48’38.91 N 121˚ 45’27.11 W, or 3) within 100 feet of tidal waters. When work is occurring in other areas, monitoring will be implemented for at least the first 3 days of construction. Monitoring will continue until there are 3 successive days of no observed disturbance, at which point monitoring may be suspended. Monitoring will resume when there is a significant change in activities or location of activities within the project area or if there is a gap in construction activities of more than one week. In these cases, monitoring will again be implemented for at least the first 3 days of construction and will not be suspended until there are 3 successive days of no observed disturbance.

The biological monitor will have the authority to stop project activities if marine mammals approach or enter the exclusion zone.  Biological monitoring will begin 0.5-hour before work begins and will continue until 0.5-hour after work is completed each day. Work will commence only with approval of the biological monitor to ensure that no marine mammals are present in the exclusion zone.  In addition, biological monitors will, to the extent feasible, monitor for fish, including listed species that may occur within the project site.

*Pre and post construction daily censuses* - A census of marine mammals in the project area and the area surrounding the project will be conducted 30 minutes prior to the beginning of construction on monitoring days, and again 30 minutes after the completion of construction activities.

Data collected during censuses will include:

- Environmental conditions (weather condition, tidal conditions, visibility, cloud cover, air temperature and wind speed), recorded during pre- and post-construction daily census counts
- Numbers of each species spotted
- Location of each species spotted
- Status (in water or hauled out)
- Behavior

*Hourly counts* - Conduct hourly counts of animals hauled out and in the water.

- Data collected will include:
  - Numbers of each species
  - Location, including zone and whether hauled out or in the water
  - Time
  - Tidal conditions
  - Primary construction activities occurring during the past hour
  - Number of mom/pup pairs and neonates observed

    - Notable behaviors, including foraging, grooming, resting, aggression, mating activity, and others
    - Tag color and tag location (and tag number if possible)—for sea otters, note right or left flipper and location between digits (digits 1 and 2 are inside; digits 4 and 5 are outside)
- Notes may include any of the following information to the extent it is feasible to record:
    - Age-class
    - Sex
    - Unusual activity or signs of stress
    - Any other information worth noting

*Construction related reactions*- Record reaction observed in relation to construction activities including:

- Time of reaction
- Concurrent construction activity
- Location of animal during initial reaction and distance from the noted disturbance.
- Activity before and after disturbance
- Status (in water or hauled out) before and after disturbance

Code reactions:

| Level | Type of response | Definition |
|---|---|---|
| 1 | Alert | Head orientation or brief movement in response to disturbance, which may include turning head towards the disturbance, craning head and neck or (in the case of seals) craning head and neck while holding the body rigid in a u-shaped position, changing from a lying to a sitting position, or brief movement of less than twice the animal's body length. Alerts would be recorded, but not counted as a 'take'. |
| 2 | Movement | Movements away from the source of disturbance, ranging from short withdrawals at least twice the animal's body length to longer retreats, or if already moving a change of direction of greater than 90 degrees. **These movements would be recorded and counted as a 'take'.** |
| 3 | Flush | **All retreats (flushes) to the water. Flushing into the water would be recorded and counted as a 'take'. For sea otters, any change from in-water resting to diving/swimming would also be considered a flush and counted as a 'take.'** |

*Construction shutdown - if applicable*

Sheet pile **placement** prior to driving with vibratory hammer

1. Allow pile placement to occur while continuing with standard data collection (as described above)
2. After pile placement, biological monitor must give clearance prior to beginning pile driving:

Vibratory pile **driving**

1. Clearance must be given prior to commencement of vibratory hammer pile driving
2. Give clearance if no marine mammal is within 10 meters of pile driver *and* no marine mammal is traveling toward and in immediate danger of entering 10-meter zone
3. Postpone beginning of pile driving if a marine mammal is within 10 meters of pile driver *or* a marine mammal is traveling toward and in immediate danger of entering 10-meter zone
4. Give clearance to begin driving when animal is seen outside of 10-meter zone or is not spotted for 15 minutes.
5. Conduct standard data collection during driving, include closest distances to drivers and indicate soft start or full force driving phase when recording reactions

**Steps for shutting down and resuming construction**

1. Alert construction foreman of animal using the red flag and handheld radio (use 1 blow from air horn if needed)
2. Record the construction activity and the time of shutdown
3. Record the reaction and location of the animal
4. Give clearance signal (green flag) and handheld radio for construction activities when animal is seen outside of 10-meter zone and traveling away from the construction area, or when the animal is not spotted for 15 minutes
5. Record the time construction resumes

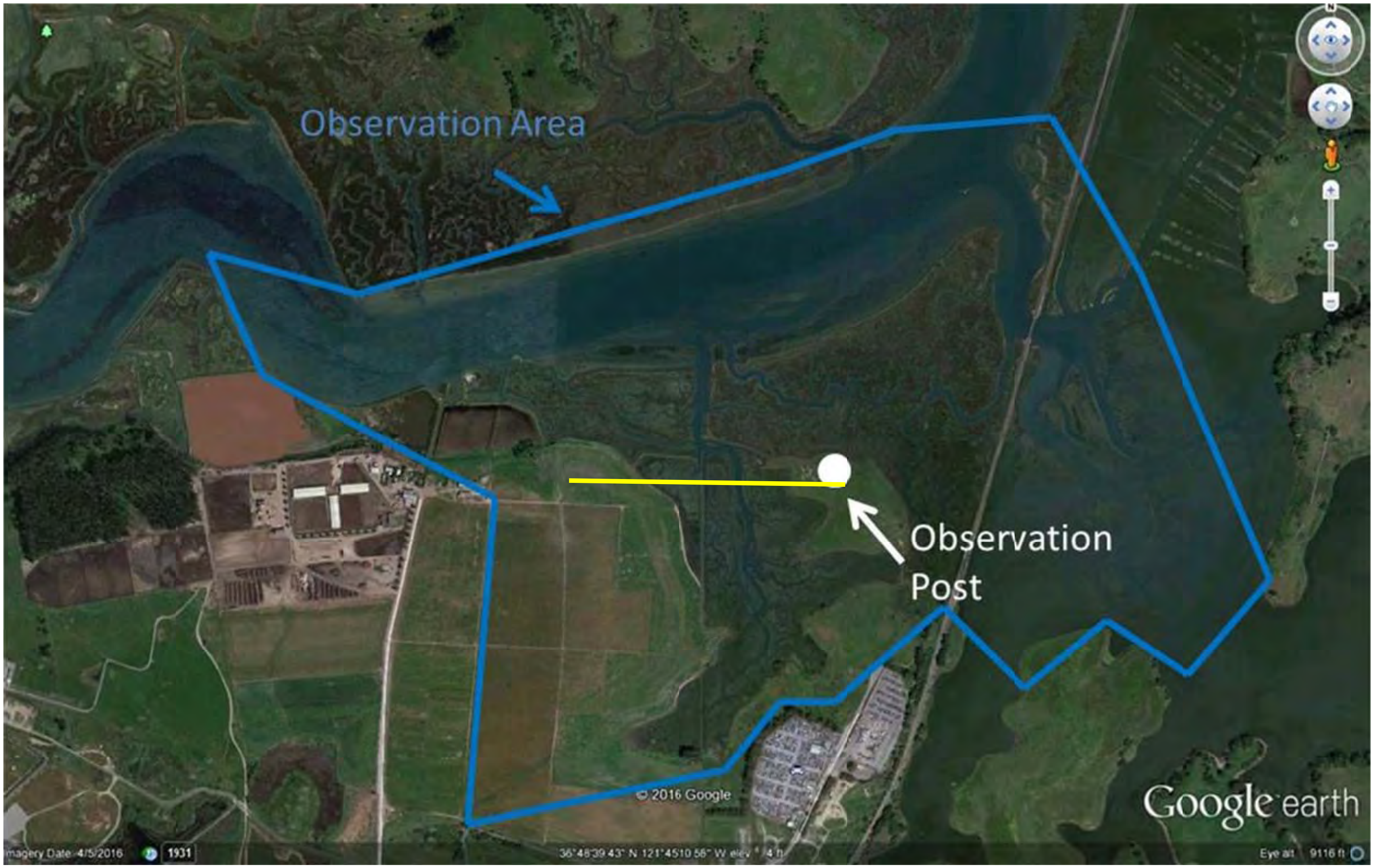



Figure 1. Observation post and observation area. Note: Some areas around the railroad tracks and within the healthy marsh just north of the post cannot be seen at low tides. All work north of the yellow line will be monitored continuously.

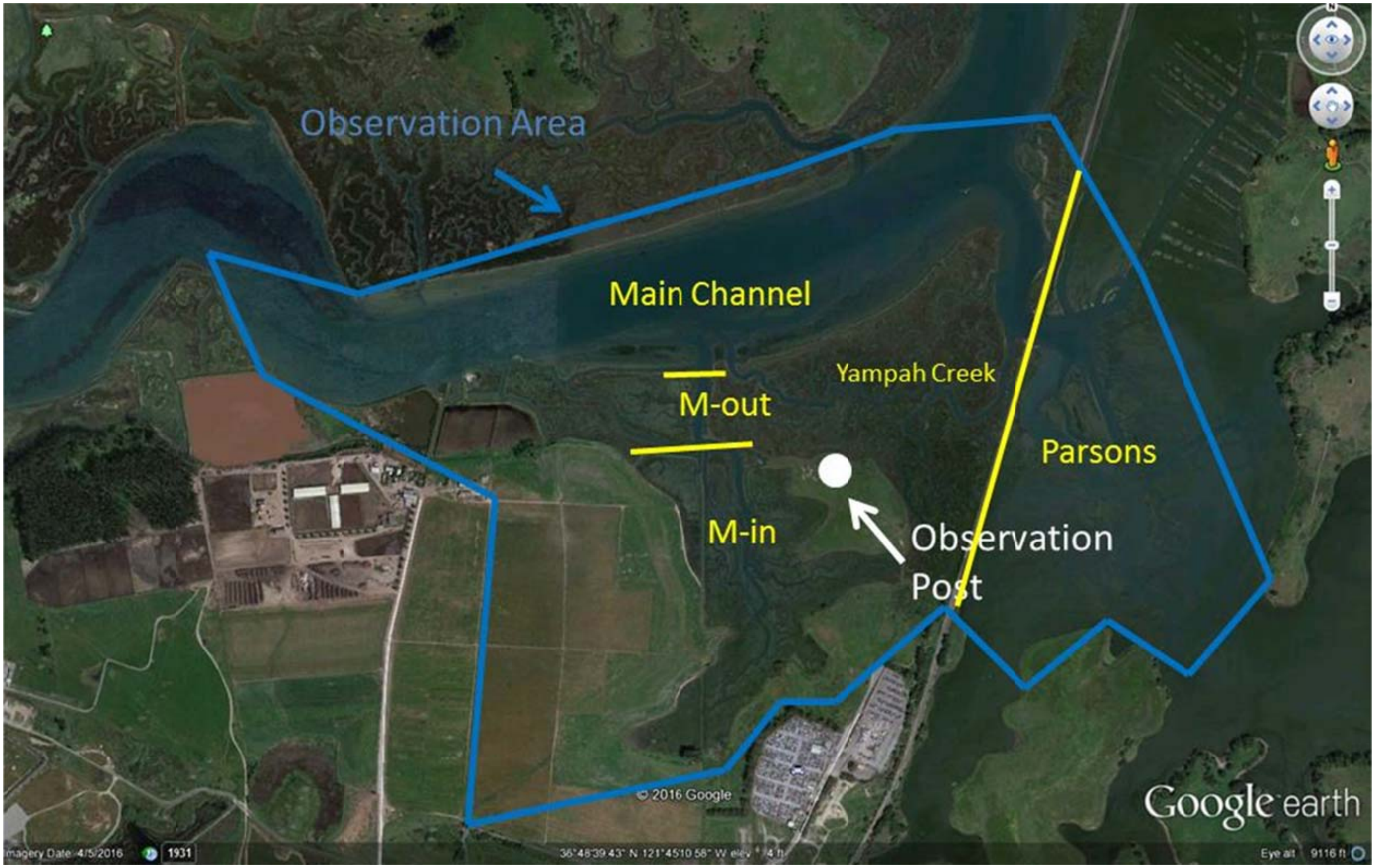


Figure 2. Observation zones