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July 12, 2011  
M&A # 05-024-20

Ms. Erin Hardison  
U.S. Army Corps of Engineers, Los Angeles District  
CESPL-PD-RN  
915 Wilshire Blvd  
Los Angeles, California 90017

### **Re: FINAL 6-month Eelgrass Monitoring Report for the Morro Bay Maintenance Dredging Project, Morro Bay, CA (#W912PL-10-F-0003 Task 8[h])**

Dear Ms. Hardison,

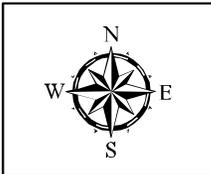
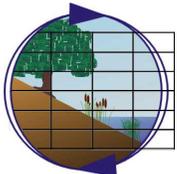
This letter report serves to transmit information regarding the 6-month post-transplant eelgrass (*Zostera marina*) survey completed for the Morro Bay Maintenance Dredging Project in Morro Bay, California. It is intended to satisfy deliverable requirements of Task 8(h) of Order W912PL-10-F-0003

#### **INTRODUCTION**

Merkel & Associates, Inc. (M&A) was retained by the U.S. Army Corps of Engineers, Los Angeles District to conduct an eelgrass (*Zostera marina*) transplant along the western shoreline of Morro Bay, north of the A-1 Anchorage Area, as mitigation for unavoidable impacts to eelgrass resources resulting from completion of maintenance dredging of the Morro Bay entrance bar and navigation channel by the U.S. Army Corps of Engineers at Morro Bay, California (Figure 1). Based on a mitigation agreement between the Corps and National Marine Fisheries Service, it was determined that eelgrass impacts to approximately 1.0 acres (4,049 m<sup>2</sup>) of eelgrass occurred as a result of the Corps' dredging project. The mitigation requirements for the project work require the successful establishment of 1.2:1 replacement for eelgrass loss due to project implementation. The restoration of eelgrass at the eelgrass mitigation site, therefore, is required to achieve a total area of 1.2 acres (4,859 m<sup>2</sup>) of eelgrass compliant with the area, density, and milestone development standards of the Southern California Eelgrass Mitigation Policy (SCEMP, Rev. 11, National Marine Fisheries Service 1991).

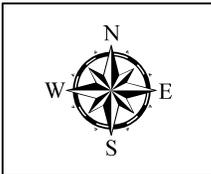
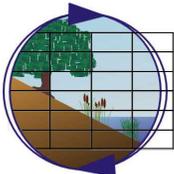
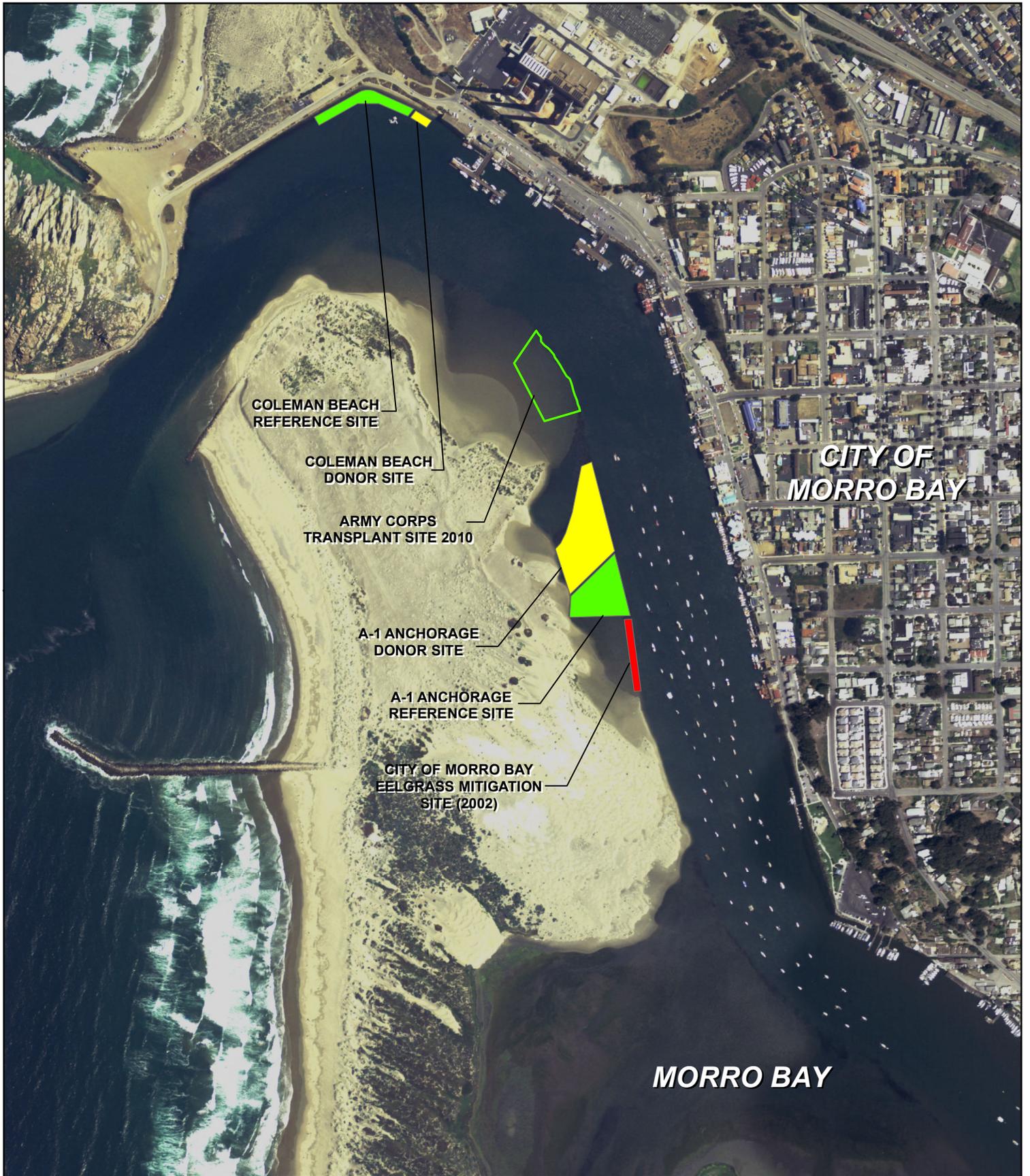
#### **TRANSPLANT SITE HISTORY AND LAYOUT**

A Corps mitigation transplant site was excavated from an unvegetated intertidal sand flat located on the west side of the northern portion of the Bay in accordance with an eelgrass restoration site dredging plan (Figure 2) (Merkel & Associates 2010a). The Corps' dredging contractor prepared the eelgrass mitigation site in accordance with the project's Final Eelgrass Mitigation Dredging Template (Merkel & Associates 2010a). The site was excavated to suitable eelgrass growth elevation over an area in excess of 2 acres. The grading work for the eelgrass site preparation was completed on June 5, 2010, and a one-month period was allotted for site stabilization prior to the commencement of eelgrass transplant work. The site ranges in depth from 0.0 ft MLLW down to -1.6 ft MLLW. The substrate is clean sand sloping to silty sand at the deeper end of the site. To achieve the contractual transplant requirements and the planting minimum required under the Final



**Vicinity Map**  
Estero Bay Maintenance Dredging Project  
Morro Bay, CA

**Figure 1**



**Eelgrass Transplant, Donor, and Reference Sites**  
Morro Bay Maintenance Dredging Project  
Morro Bay, CA

**Figure 2**

Eelgrass Mitigation and Monitoring Plan in support of the Morro Bay Maintenance Dredging Project, Morro Bay, California (Merkel & Associates 2010b), a total of 4,858 eelgrass planting units were required to be planted over an area of 1.2 acres (4,859 m<sup>2</sup>) on 1-meter centers. However, to supplement the transplant program to ensure a total of 1.2 acres of eelgrass mitigation after 5 years, a total of 5,584 eelgrass-planting units (15 percent more units) were prepared and planted at the eelgrass mitigation site. While a small number of the supplemental units were used to expand the 1-meter on center planting to 1.3 acres (5,270 m<sup>2</sup>), the majority of the supplemental units were planted on approximately 3-meter centers to effectively double the planting area creating a planting area of 2.4 acres (9,720 m<sup>2</sup>). The eelgrass transplanting program was conducted between July 6 and July 9, 2010. At the time of the transplant, the planting units appeared to be healthy and secure in the substrate.

The transplant made use of biodegradable soft anchors to fasten bare-root units to the bottom. Eelgrass was harvested from two natural donor beds along the shorelines southeast and northwest of the mitigation site, where less than 10% of the bed was harvested. Eelgrass was harvested by hand and processed into planting units of 6-10 leaf-shoots per unit. These planting units were processed the same day that harvesting was completed and were planted within 24 hours. Harvesting and planting were accomplished by SCUBA divers, planting each unit on 1-meter centers over 1.3 acres (5,270 m<sup>2</sup>) of the site and on approximately 3-meter centers over 1.1 acres (4,454 m<sup>2</sup>) of the site.

#### **MITIGATION SUCCESS CRITERIA**

This eelgrass-monitoring program includes milestone success monitoring to verify that minimum coverage and density requirements are achieved per the requirements of SCEMP. The coverage and leaf shoot density of eelgrass within the restoration and reference areas will be mapped and measured at each monitoring interval. Mitigation will be deemed successful when it has met the success criteria outlined in the SCEMP. Criteria for determination of transplant success will be based upon a comparison of vegetation coverage (area) and density (leaf shoots per square meter) between the reference areas and the restoration areas. Extent of vegetation cover is defined as the area where eelgrass is present and where gaps in coverage are less than one meter between individual leaf shoot clusters. Density of shoots is identified as the number of leaf shoots per square meter, as measured from representative areas within the control or transplanted beds. Key success criteria are as follows:

- A) A minimum of 70 percent areal coverage and 30 percent density should be achieved after the first year.
- B) A minimum of 85 percent areal coverage and 70 percent density should be achieved after the second year.
- C) A minimum of 100 percent areal coverage and 85 percent density should be achieved for the third, fourth, and fifth years.

Areas that do not meet the above success criteria will be revegetated and again monitored for another five-year period, until the final goal is achieved.

#### **SURVEY METHODOLOGY**

The 6-month post transplant survey was conducted on April 16 and 17, 2011. Data were collected using a sidescan sonar operating at 600 kHz scanning out 20 meters on both the starboard and port channels for a 40-meter wide swath. All data were collected in latitude and longitude, using the North American Datum of 1982 (NAD 83), and converted to the Universal Transverse Mercator system in meters (UTM).

Following completion of the survey, sidescan sonar traces were joined together and geographically registered. Eelgrass was then digitized as a theme to calculate the amount of eelgrass coverage and show its distribution. This method of eelgrass distribution calculation allows for monitoring eelgrass trends at the project site with a substantial degree of accuracy and repeatability over time.

The density of actively growing leaf shoots was determined by conducting shoot counts within 1/16-m<sup>2</sup> quadrats. Replicate quadrats were randomly placed within the eelgrass beds of the restoration and reference areas to obtain a mean shoot density for eelgrass beds.

## RESULTS

The mitigation site, like the entirety of the bay, was affected by the tsunami that followed the March 11, 2011 Japanese earthquake. Staff at the Morro Bay Harbor Department reported water level swings of up to 9 feet over periods of approximately 15 minutes. They also reported seeing water flowing off of eelgrass beds into the channel as if the beds were located on the crest of a weir. Following the tsunami, Annie Gillespie of the Morro Bay National Estuary Program (NEP) reported observing considerable eelgrass floating free on the surface of the bay, apparently washed out of the sediment. Loose rhizomes were detected at the bayward edge of the A-1 Anchorage Reference Site, however, overall neither reference areas nor the transplant area appear to have suffered widespread tsunami damage. Within the transplant area, a small sand chute developed off the planting area near the center of the site. This chute cuts slightly into the developing eelgrass beds and likely was the result of concentrated discharge across the site during the tsunami. Because this chute is found at the lowest portion of the site and is not expected to experience comparable energy as that occurring during the 2011 tsunami, there is little reason to believe it will have any long-term adverse effects on the site.

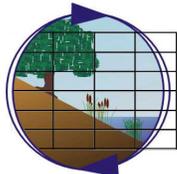


*Rhizomes freed from sediment near the edge of eelgrass beds at the A-1 Anchorage Reference Site*

There has also been a notable trend in eelgrass declines systemwide over the past several years based on annual surveys conducted by the NEP as well as more limited quantitative and qualitative observations by Merkel & Associates over the past two years (unpub. data). These declines in eelgrass have been most pronounced in the southern portion of the Bay with lesser declines towards the mouth. It is not clear at the present time what the causative agent of decline has been, however, patterns suggest the declines may be related to unusually high runoff from the watershed, potentially resulting in increased nutrient or sediment loading, or prolonged salinity reduction. There are indications that the A-1 reference site may be experiencing declines related to this large-scale changing in the system while similar declines are not being observed in the more northerly transplant site or the Coleman Beach reference site.

### EELGRASS RESTORATION SITE

The current 6-month survey revealed a total of 1.3 acres (5,340 m<sup>2</sup>) of eelgrass planting units within the transplant area (Figure 3). By the 3-month post-transplant survey (October 2010), plants in the



**Eelgrass Distribution, April 17 2011**  
Morro Bay Maintenance Dredging Project  
Morro Bay, CA

**Figure 3**

low-density transplant areas had not expanded substantially from the initial transplant size. At the 6-month survey, plants showed significant increase in size, however individual transplant units generally remained distinguishable from acoustic records. The initial beds planted at 1-meter centers had coalesced to solid eelgrass beds while the more widely distributed plantings at 3-meter centers remained incomplete but expanding by vegetative spread by individual units. No seedling recruitment was observed at the 6-month survey period. At the present time, it appears that most of the initial planting site remains suitable to support eelgrass. There has been some loss of eelgrass at the uppermost portions of the initially constructed site; however, most of the site appear to be fairly stable and is expected to remain suited to support eelgrass.



Eelgrass patches in the Army Corps mitigation site

The eelgrass turion density ( $\pm 1$  SD) within the transplant area was  $134.4 \pm 40.3$  ( $n=20$ ) shoots per square meter. Eelgrass was generally healthy and supported moderate epiphytic loading.

## REFERENCE SITES

The project makes use of two reference areas bracketing the transplant site. These are used as a collective response indicator for comparison to the transplant site. The two sites have performed very differently between the 3- and 6-month surveys; and as a result, the data for each is reported separately followed by the composite results, used for reference site comparison.

During the current 6-month survey, the Coleman Beach reference site was 0.68 acre ( $2,744 \text{ m}^2$ ). This is an inconsequential change from the 0.68-acre ( $2,739 \text{ m}^2$ ) 3-month survey (October 2010). Conversely, the A-1 Anchorage reference site exhibited a 33 percent reduction in eelgrass coverage from 0.75 acre ( $3,056 \text{ m}^2$ ) in October 2010 to only 0.50 acre ( $2,033 \text{ m}^2$ ) in April 2011. Turion densities were not statistically different, but generally lower at the Coleman Beach reference site ( $86.4 \pm 22.9$  ( $n=20$ )) than at the A-1 Anchorage reference site ( $102.4 \pm 33.0$  ( $n=20$ )).

When combined for use as a single reference, the two sites bracketing the transplant area supported a combined total of 1.2 acres ( $4,777 \text{ m}^2$ ) (Figure 3). The eelgrass turion densities ( $\pm 1$  SD) within the reference sites were  $94.4 \pm 29.2$  ( $n=40$ ) shoots per square meter.

## DISCUSSION

The 6-month survey revealed that the planting units were healthy and expanding. Flowering was not observed in either the transplant area nor the reference sites. The planting units exhibited a healthy appearance, with the eelgrass leaves appearing green, floating vertically, and hosting a moderate epiphytic load on some, but not all leaves. The 6-month survey confirmed the continued presence of most of the initially planted units in the transplant areas, although some areas of plant losses were evident. A considerably greater abundance of sand dollar (*Dendraster excentricus*) beds was observed during the 6-month survey than the 3-month survey, although sand dollars have been

present since the time of the initial transplant. The mitigation transplant sites were oversized by a factor of 2.74 in order to ensure that adequate eelgrass is established to meet the mitigation needs. At the present time, the mapped beds support 108 percent of the mitigation need. The bed is expected to expand rather than contract over time.

It is currently believed that the site will meet the success requirements. The 12-month post-planting survey is scheduled to be conducted in July 2011. The short timeframe between the 6-month survey and the 12-month survey is the result of both a delay in completing the 6 month survey until the active growing season, as well as a pre-coordinated delay of the 6-month survey by a month in order to dovetail the survey in with the pre-dredging eelgrass and *Caulerpa* surveys for the 2011 outer channel maintenance dredging project

If you have any questions regarding this report, please do not hesitate to contact me at (858) 560-5465 or kmerkel@merkelinc.com.

Sincerely,



Keith W. Merkel  
Principal Consultant

## **REFERENCES**

- Merkel & Associates. 2010a. Final Eelgrass Survey Map and Memorandum for Estero Bay Maintenance Dredging, Morro Bay, CA and Final Eelgrass Mitigation Dredging Template. Prepared for U.S. Army Corps of Engineers Los Angeles District, March 2010.
- Merkel & Associates. 2010b. Final Eelgrass Mitigation and Monitoring Plan in support of the Morro Bay Maintenance Dredging Project, Morro Bay, California. Prepared for U.S. Army Corps of Engineers Los Angeles District, June 2010.
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- National Marine Fisheries Service 1991. Southern California Eelgrass Mitigation Policy. (1991, Revision 11). R.S. Hoffman, ed.