M&A # 15-048-01

EELGRASS MITIGATION AND MONITORING PLAN
IN SUPPORT OF THE
MISSION BAY PARK NAVIGATIONAL SAFETY DREDGING PROJECT
MISSION BAY, SAN DIEGO, CALIFORNIA

Prepared for:
City of San Diego
Public Works, E&CP, AEP Division
Contact: Ms. Coselyn Goodrich
525 B Street, MS908A
San Diego, CA 92101
Phone: 619-533-4633

Prepared by:
Merkel & Associates, Inc.
Contact: Keith W. Merkel
5434 Ruffin Road
San Diego, CA 92123
Phone: 858-560-5465
E-mail: kmerkel@merkelinc.com

October 2016
(Revised December 2016)

Keith Merkel, Principal Consultant

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Final Eelgrass Mitigation and Monitoring Plan in Support of the Mission Bay Park Navigational Safety Dredging Project Mission Bay, San Diego, California

INTRODUCTION

Merkel & Associates Inc. (M&A) was retained by the City of San Diego (City) to review bathymetry and sediment dynamics within Mission Bay, in San Diego, California, and subsequently, to complete a baywide bathymetry and eelgrass (*Zostera marina*) distribution survey. Subsequent to this investigation, M&A was engaged to support the City with identifying boundaries of navigational hazards, conducting sediment characterization, and identification of project impacts and mitigation measures.

The San Diego Fire Department, Lifeguard Services and the Mission Bay Park Improvement Fund Oversight Committee identified areas within the bay that currently require maintenance dredging in order to remove shoals that are causing navigational hazards. Eelgrass is present in all of these locations, and maintenance dredging would result in impacts to eelgrass that requires mitigation. In compliance with the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014), eelgrass impacted by dredging activities would require successful mitigation to be achieved at a 1.2:1 mitigation ratio with an initial revegetation effort totaling not less than 1.38:1, if mitigation is completed concurrent with or following the project impacts. This mitigation and monitoring plan provides a description of existing bathymetry and eelgrass conditions within Mission Bay, and identifies anticipated project impacts, eelgrass restoration plans, and monitoring methods to offset impacts to eelgrass in accordance with the CEMP (Appendix A).

PROJECT BACKGROUND

Mission Bay is a recreational bay located in San Diego, California (Figure 1). Historically, the Bay was dominated by tidal mudflat, separated from the Pacific Ocean by a sand spit that is the location of the present day community of Mission Beach. As development progressed in coastal San Diego, a long process was initiated to dredge the mudflats, re-contour the shorelines, and convert Mission Bay into a generally subtidal recreational bay. The majority of work was completed by 1963; however, intermittent maintenance dredging and shoreline stabilization operations have continued in Mission Bay to present day.

Mission Bay is considered to be a dynamic, low-flux sedimentary environment with sediment transport dominated by tidal and wave action. The main inputs of sediments into the bay are littoral sands entering the bay via the Mission Bay entrance channel, fluvial inputs from Rose Creek and Tecolote Creek as well as the San Diego River, and bay beach erosion resulting from wind, wave, and oceanic swell erosion. Other minor inputs include urban storm drains and atmospheric particulates. The main sediment outputs from the bay include tidal export out of the entrance channel, dredging, and shoal or beach reclamation activities.

Figure 1. Project Vicinity Map

The City has an active beach maintenance program within Mission Bay Park. Maintenance activities include beach grooming and sand management, trash and debris removal, fire ring cleaning (Merkel & Associates 2008). As a result, most of the sand management activities such as scarp reduction are addressed by beach grooming and raking in the upper portion of the beach environment. However, this active beach management is not capable of addressing sand that migrates within the beach littoral cells below the high tide line or which is transported below the beach within the bay and which develops into shoal formations.

Shoal development as a result of bed transport and deposition of sediment, fluvial inputs, or littoral transport to shoal deposits occur at a low rate and as a result of punctuated events within the dredged waterways of Mission Bay. When these shoals rise to a level that they effect navigation, they are potentially subject to maintenance dredging removal. Not all shoaling must be removed as the ramifications of shoaling on public health and safety is not evenly distributed throughout the Bay. However, where shoals threaten vessel grounding in high speed or high traffic areas, or where shoaling limits access for emergency response, these have been identified as navigational hazards by the City Fire Department Lifeguard Services. These hazards to navigation are the focus of removal under the present dredging program.

Several areas of the Bay have been identified where sediment accretion has decreased water depth to a point that has resulted in a navigation hazard (Figure 2). There are 14 identified dredge areas identified as Dredge Areas 1 through 15 omitting Dredge Area 8. Dredge Area 8 on the western tip of Crown Point at Riviera Shores has been omitted from the project, although originally contemplated for dredging (still outlined but not labeled). This omission was based on the fact that activities at this site are not considered to be maintenance activities to return the bay to original chart conditions. Rather the shoreline has eroded back so far in this area as to generate a navigation concern at high tide due to loss of shoreline and not infill of original navigational waters. Further, it is believed that this area cannot be corrected by replacing sand alone and requires greater engineering consideration for shoreline stabilization that exceeds the purpose of this project. For this reason, the site has been removed from the project. Site numbering has been retained, as there have been several prior documents as well as coordination activities that have been based on the original numbering sequence. A small dredge area identified as 5B has also been removed since earlier evaluations.

Concurrent with proposed navigational safety dredging, multiple sediment reuse areas have been identified. These include the partial backfilling of borrow pits in Sail Bay that were excavated to generate sand for shoreline widening in Sail Bay in 1986 under the Sail Bay Improvements Project. The backfilled pits would allow for eelgrass restoration as partial mitigation of eelgrass impacts. Additional reuse would occur within Leisure Lagoon to raise the lagoon floor to elevations suitable to improve water flushing leading to better water quality and support of eelgrass habitat. Final reuse areas are located on Crown Point Shores and northeast Vacation Isle where beach sand has eroded down to feed the adjacent shoals that would be removed for navigational safety reasons. These shoals and beach replacements are not authorized operations of the City’s mechanized beach maintenance crews and thus must be included within project permits in order to allow completion of work.

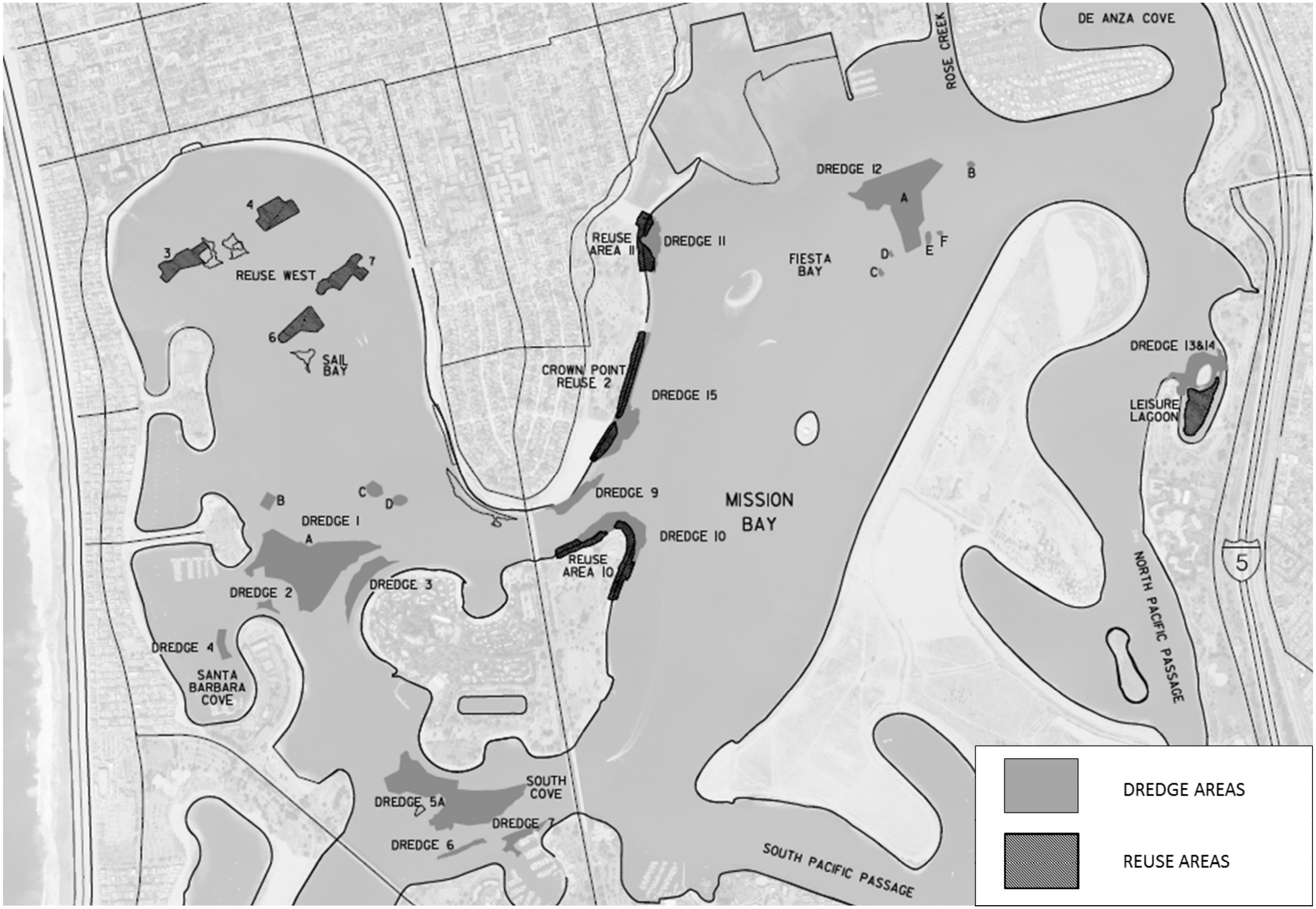


Figure 2. Project Site Map

EELGRASS IMPACTS AND MITIGATION REQUIREMENTS

Summary of Project Eelgrass Impacts

Maintenance dredging at the identified locations would eliminate hazards improving safety along shorelines and in open navigation zones of the Bay. It is anticipated that between 122,000 and 220,850 cubic yards of sediment would be dredged. The broad range in volumes is based on allowable overdepth dredging in generally very shallow dredge cuts. Table 1 summarizes the dredging by individual dredge areas and includes the area, volume of cut, and lower design elevation of the final dredged area. In addition, the table identifies the extent of eelgrass impact anticipated to occur at each dredge area. The extent of dredging and volumes of dredge material generated are derived from the Mission Bay Navigational Safety Dredging project plans (Rick Engineering Company 2016). The project plans are included as Appendix B. The extent of eelgrass impact is based on the extent of eelgrass as determined during 2013 baywide eelgrass surveys (Figure 3). The extent of eelgrass is subject to variability through time and as such, the survey results from 2013 are considered to be a planning benchmark (M&A 2013). Mitigation will be determined based on pre-dredging and post-dredging surveys conducted under the guidance of the CEMP (NMFS 2014).

Table 1. Dredge Area Summary.

LOCATION	AREA (ACRES)	DREDGE ELEV. (FT NGVD29/MLLW)	CUT VOL (CY)	FILL VOLUME (CY)	1-FT OVERDREDGE (CY)	2-FT OVERDREDGE (CY)	EELGRASS IMPACT (ACRES)
DREDGE AREA							
DREDGE 1A	15.87	-10.5' NGVD /-8.1' MLLW	22,690	-	25,600	-	15.87
DREDGE 1B	0.52	-10.5' NGVD /-8.1' MLLW	590	-	840	-	0.52
DREDGE 1C	0.63	-10.5' NGVD /-8.1' MLLW	720	-	1,020	-	0.63
DREDGE 1D	0.41	-10.5' NGVD /-8.1' MLLW	500	-	660	-	0.41
DREDGE 2	0.41	-10.5' NGVD /-8.1' MLLW	470	-	660	-	0.41
DREDGE 3	2.84	-10.5' NGVD /-8.1' MLLW	5,450	-	4,580	-	2.57
DREDGE 4	0.8	-10.5' NGVD /-8.1' MLLW	610	-	1,290	-	0.64
DREDGE 5A	13.5	-10.5' NGVD /-8.1' MLLW	19,850	-	21,780	-	13.30
DREDGE 5B	NO WORK	NO WORK	NO WORK	-	NO WORK	NO WORK	NO WORK
DREDGE 6	0.67	-10.5' NGVD /-8.1' MLLW	850	-	1,080	-	0.42
DREDGE 7	1.3	-10.5' NGVD /-8.1' MLLW	3,380	-	2,100	-	1.30
DREDGE 8	NO WORK	NO WORK	NO WORK	-	NO WORK	NO WORK	NO WORK
DREDGE 9	1.94	-10	4,770	-	-	-	0.97
DREDGE 10	3.61	-10.5' NGVD /-8.1' MLLW	15,300	8,780	-	-	2.01
DREDGE 11	1.67	-7.0' NGVD /-4.6' MLLW	5,900	5,900	-	-	0.64
DREDGE 12A	11.44	-10.5' NGVD /-8.1' MLLW	22,890	-	-	36,930	0.99
DREDGE 12B	0.13	-10.5' NGVD /-8.1' MLLW	230	-	-	410	0.00
DREDGE 12C	0.11	-10.5' NGVD /-8.1' MLLW	190	-	-	350	0.06
DREDGE 12D	0.07	-10.5' NGVD /-8.1' MLLW	120	-	-	210	0.04
DREDGE 12 E	0.21	-10.5' NGVD /-8.1' MLLW	380	-	-	680	0.04
DREDGE 12F	0.08	-10.5' NGVD /-8.1' MLLW	140	-	-	260	0.00
DREDGE 13 & 14	3.78	-5.0' NGVD /-2.6' MLLW	8,320	8,320	-	-	0.78
DREDGE 15	3.37	-7.0' NGVD /-4.6' MLLW	9,050	9,050	-	-	1.31
TOTAL DREDGE	**63.36**		**122,400**	**32,050**	**59,610**	**38,840**	**42.93**

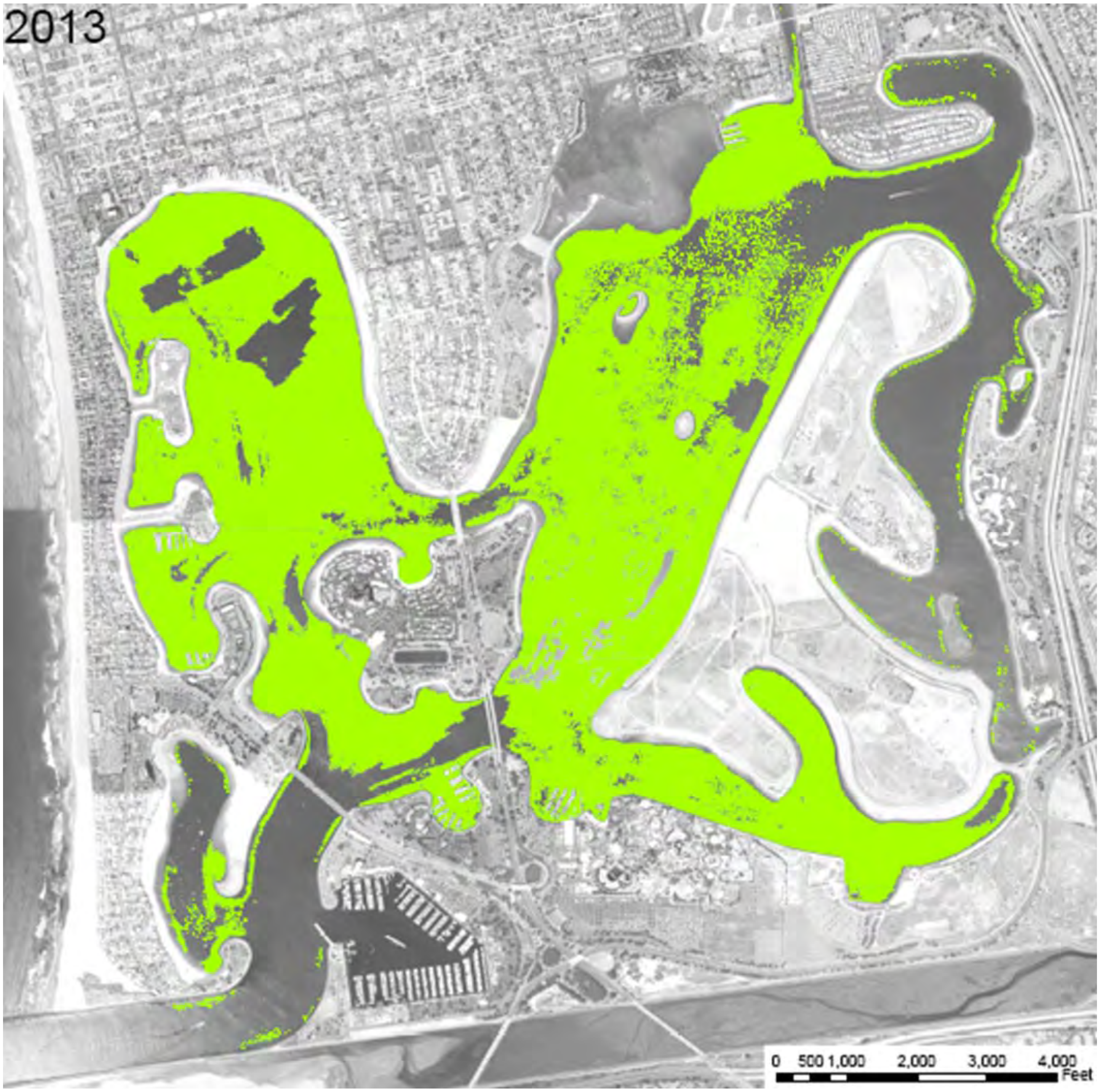


Figure 3. Eelgrass Distribution during 2013 Baywide Eelgrass Survey

The proposed dredging project is expected to impact considerable eelgrass, principally located within the shoals that have developed in the western portions of the bay. Two shoaling regions in particular account for the majority of the shoal development that is considered a navigational hazard. These are dredge areas are located at the flares in the channel fed by the Mission Bay federally maintained entrance channel that was maintenance dredged in the long deferred Army Corps of Engineer's 2010-2011 maintenance dredging project in Mission Bay. Dredge areas comprising the shoals just bayward of the federal channel and at the northern flare as the branching channel passes Bahia Point include Dredge Areas 1, 2, 3, 5, 6, and 7. These dredge areas support 85 percent (35.4 acres) of eelgrass anticipated to be impacted by the maintenance dredging project. Because the Corps' dredging improved channel flow conditions within the entrance channel, it is believed this allow greater migration of sand from areas around West Mission Bay Drive into shoals where the channels flare. As a result, it is anticipated that rate of shoal accumulation will not be sustained as the effects of the Corps' dredging stabilize.

Dredged material is to be fully reused in the development of eelgrass mitigation areas and to repair short segments of three beaches that have eroded into the shoals to be dredged. Table 2 outlines the proposed sediment reuse by site as identified in Figure 2. The fill volumes in these reuse areas has been calculated as the maximum volume generated by the project assuming that full allocated over depth is achieved by the Contractor to ensure that minimum navigation clearances are met. The sediments to be dredged have been determined to be chemically and physically suited to the proposed restoration reuse through collection and testing under the EPA/ACOE-approved SAP (M&A 2015 a and 2015b). The testing program conducted consistent with the Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. (Inland Testing Manual [ITM]) (USEPA/USACE 1998), demonstrated the material to be of similar physical and chemical condition to the sediments native to the reuse sites.

Reuse areas are not proposed to impact eelgrass and will be adjusted spatially as necessary to ensure eelgrass impact avoidance or minimization at the time of construction. Because eelgrass impacts under the CEMP are to be determined through pre-dredging and post-dredging surveys and eelgrass varies somewhat in distribution, it is recognized that some adjustments may be required in the final fill positioning for the reuse areas to best serve their intended mitigation function. In addition, the final fill volumes cannot be known at this time since it is dependent upon the extent of overdredge conducted. This will be accommodated by shifts in fill location, lowering fill elevations, or slight footprint expansions to best meet mitigation needs. In no instance will the reuse areas expand beyond the existing borrow pit boundaries or above the specified elevations.

Table 2. Reuse Area Summary.

BENEFICIAL RESUE EELGRASS MITIGATION SITE MITIGATION SITE	AREA (ACRES)	FILL ELEV. (FT NGVD29/MLLW)	FILL VOL (CY)
RESUSE SITES			
RESUSE WEST 3 **	2.51	-10.5' NGVD /-8.1' MLLW	41,270
RESUSE WEST 4 **	2.69	-10.5' NGVD /-8.1' MLLW	50,060
RESUSE WEST 6 **	2.23	-10.5' NGVD /-8.1' MLLW	48,690
RESUSE WEST 7 **	2.50	-10.5' NGVD /-8.1' MLLW	48,780
CROWN POINT REUSE 2	3.35	BEACH	9,050
REUSE AREA 10	3.75	BEACH	8,780
LEISURE LAGOON	2.45	-7.5' NGVD /-5.1' MLLW	8,320
REUSE AREA 11	2.06	BEACH	5,900
TOTAL REUSE	**19.47**		**220,850**
**FILL VOLUME INCLUDES DREDGING CUT VOLUME AND 1-FT AND 2-FT OVER DREDGING VOLUMES			

Eelgrass impact mitigation requirements under the CEMP require replacement of lost eelgrass by establishment of compensatory eelgrass mitigation at ratios that fully offset losses. This requires eelgrass to be restored at an equivalent area and density as well as replacing lost functions that accrue with delays between impact and restoration of replacement eelgrass.

For mitigation projects that are implemented concurrent with or immediately following project impacts, mitigation ratios require successful establishment of 1.2 acres of eelgrass for each acre of eelgrass lost. This 1.2:1 mitigation ratio is outlined in the CEMP along with scaled increases in mitigation for mitigation delay. While the requirements for successful implementation of eelgrass mitigation are outlined in the CEMP, the CEMP also includes a requirement for a minimum planting effort above the final mitigation need. In southern California this minimum planting effort is 1.38 acres for each acre impacted. The minimum targeted acreage is based on variable regional success rates and is intended to offset failure risks. The minimum planting rate of 1.38:1 does not alter the overall success requirement of 1.2: 1 outlined under the CEMP (NMFS 2014). Mitigation that is fully installed and functional prior to impact may be applied in compensation under the CEMP at a 1:1 ratio.

Eelgrass Mitigation Needs

With the proposed project, there is a baseline anticipated mitigation need to offset impacts to 42.93 acres of eelgrass. Impacts are proposed to be compensated for by a combination of application of existing mitigation credit that the City has developed in Mission Bay Park for offset of impacts in Mission Bay Park, as well as new restoration both within dredge areas and sediment reuse areas intended to develop eelgrass restoration areas in sites that are presently too deep to support eelgrass.

Depending upon the extent of mitigation derived from existing completed mitigation sites that have been established for over 3 years and that which will be derived from project associated restoration, the successful mitigation required may range from mitigation to impact ratios from 1:1 to 1.2:1 with associated initial planting requirements being as high as 1.38:1. Assuming no eelgrass were present within the previously established eelgrass mitigation sites at the time of mitigation, the anticipated 42.93 acre impact to eelgrass would require successful establishment of 51.51 acres of eelgrass from an initial planting of 59.24 acres of eelgrass. The ultimate mitigation need is to be based on a comparison of pre-dredging and post-dredging eelgrass surveys and deduction of the amount of eelgrass available from previously established eelgrass as discussed below.

EELGRASS MITIGATION APPROACH

Existing Eelgrass Mitigation Lands

The CEMP incorporates potential for use of established eelgrass as a mitigation tool for offsetting impacts at a 1:1 mitigation ratio. This applies for mitigation banks or applicant sponsored pre-impact mitigation implementation. In 1999, the City of San Diego developed an eelgrass and intertidal habitat mitigation Memorandum of Agreement (MOA) in order to track and utilize surplus mitigation generated during the completion of other maintenance and capital projects within Mission Bay Park. The MOA, identified as the Mission Bay Park Mitigation Bank Agreement (City of

San Diego, 1999) recognized the development of larger than required eelgrass and intertidal mitigation areas within Mission Bay Park in order to ensure permit compliance needs were met and allowed the City to track and manage the mitigation for future mitigation requiring projects within Mission Bay Park. In some cases, the allowance for “banking” of mitigation surplus was explicit in authorizing permits, in others it was authorized by adoption of the Southern California Eelgrass Mitigation Policy (NMFS 1991), which allowed for surplus banking under provision 11 of the SCEMP. The MOA was adopted by National Marine Fisheries Service and U.S. Fish & Wildlife Service by signature. Banking was established by Coastal Commission through permit conditions under CDP 6-03-208 and 6-93-163. The Corps of Engineers and the California Department of Fish & Game (Wildlife) did not enter into the MOA. The last application of the banking document was in 2011 in association with the Rose Creek Bike/Pedestrian Path and Bridge Project (CDP 6-10-052). At the time of last valuation in this transaction, the Mission Bay Mitigation Bank had 13.01 acre of surplus eelgrass and 4.51 acre of intertidal habitat distributed across four sites; South Shores Embayment, Ventura Cove, East Ski Island, and the Stribley Marsh Reserve (renamed from the Crown Point Shores Intertidal Mitigation Area, after the passing of Robin Stribley, the City’s Natural Resource Manager) (Merkel & Associates 2011).

It is intended that all of the available mitigation within the established mitigation areas be applied to the mitigation needs for the maintenance dredging project in order to offset the overall scale of successful mitigation required to be developed for the project impacts. This mitigation area would be applied at a 1:1 area ratio.

In order to apply this mitigation to the project, a post-dredging survey of the existing mitigation sites under the MOA will be completed and the mitigation ledgers will be updated and submitted as a part of the post-dredging eelgrass survey. These ledgers will provide a calculated offset of the total mitigation needed for the project. The residual eelgrass mitigation will be derived from restoration of the dredge areas and subtidal resuse areas to be restored to eelgrass under this mitigation plan.

Project Developed Eelgrass Mitigation Sites

Dredge Area Restoration

All of the dredge areas lowered for navigation within the western basin of Mission Bay (defined as being west of the Ingraham and Glenn Rick Bridges) will be replanted with eelgrass following excavation of the shoals. In addition, the shoreline dredge areas and the reuse area within Leisure Lagoon will be planted with eelgrass. Dredge Area 12 within the outer Rose Creek delta will not be replanted with eelgrass as the area presently supports very limited eelgrass and has not had a high frequency of eelgrass occupancy historically. As a result, it is anticipated that the maintenance dredging will further reduce the suitability of this site to support eelgrass in the future.

Replanting of dredged areas will be performed using anchored bare root planting units as discussed later in this document. The restoration planting will be subject to a 1.2:1 successful mitigation requirement with a minimum of 1.38:1 initial restoration planting effort as dictated by the CEMP.

In order to prepare the replanted dredge areas for restoration planting, dredging in the dredge sites will be cut to an overdredge depth of not more than 1-foot below target design grade. The slopes within the cut will be flattened to an undulating condition of not more than ±1 foot over 5 running feet in order to maintain plantable slopes and limited site rugosity. Leveling will be done by the dredging Contractor at the time of construction but may be supplemented prior to planting by the eelgrass restoration team.

Reuse Area Restoration

In addition to use of the dredge area replanting, the project also relies on restoration planting within the subtidal sediment reuse areas. These areas have been explicitly planned to accept the dredged material in a manner that allows for staged filling of the deep basins in lifts based on the sediment character and extent of eelgrass within the dredged material.

To best develop the eelgrass mitigation site conditions desired at the reuse areas fills in the borrow sites within Sail Bay will be placed in lifts of sediment derived first from the fine sediments to be removed from Dredge Area 12, the outer end of the Rose Creek delta. This material is very fine and not desirable for eelgrass restoration. However, by placing it first in the bottom three feet of the Reuse Sites, it will be contained by the borrow pit walls and allow subsequent sands to be placed to a higher fill elevation. This fine material from the Rose Creek shoal (Dredge Area 12) is considered to be highly compressible and thus will not provide an equivalent volume in the fill area as it presently occupies in the dredge area. As a result, a minor reduction in final fill elevation is anticipated within the Reuse West areas. The rate of consolidation is anticipated to be fairly rapid given the substantial sand load to be placed above the silty materials.

After Dredge Area 12 material is placed in the Reuse West areas, filling of these areas will progress placing the remaining sandier dredge material into the fill site commencing first with the dredge material derived from sites with the least amount of eelgrass present. As these areas are depleted, sites with increasing amounts of eelgrass will be dredged and placed such that the final fill will include substantial amounts of eelgrass rhizome and root material. The final fill elevation within the Reuse West areas will be at or below -10.5 feet NGVD29 (-8.1 feet MLLW).

Because eelgrass is a rhizomatous seagrass that spreads vegetative from rhizomes, this fill staging will result in substantial amounts of viable eelgrass plant material being placed in the top fill elevations and is expected to aid in rapid establishment of eelgrass within the Reuse West sites.

In addition to the Reuse West sites in Sail Bay, material is to be placed into the deep basin of Leisure Lagoon to raise the floor of the lagoon to accept eelgrass restoration and to improve water circulation and quality. Leisure Lagoon is to be filled by material derived from the shoals that extend across the lagoon mouth. This material will be moved from the mouth and placed within the deeper basin floor to raise this basin floor up to an elevation of approximately -7.5 feet NGVD29 (-5.1 feet MLLW).

Anticipated Eelgrass Mitigation Yield

The proposed site restoration is anticipated to yield eelgrass at both replanted dredged sites and replanted subtidal reuse sites. Beach reuse sites are well above suitable elevations to support eelgrass and are thus not proposed to be planted.

Eelgrass occurs within low intertidal and shallow subtidal environments controlled by a number of environmental parameters. In Mission Bay there are two parameters of greatest importance to defining eelgrass distribution. These include desiccation stress at the upper margin of eelgrass growth. This typically limits eelgrass to a tidal elevation below approximately -1.9 feet NGVD29 (+0.5 feet MLLW). However, the upper margin of eelgrass migrates upward during the winter and lowers during the peak of the summer due to tidal conditions and prevailing climate. At its lower margin, eelgrass is restricted by a lack of adequate hours of light required to meet metabolic demands. Over multiple years of monitoring there are several other environmental parameters that have been known to drive eelgrass temporal and spatial dynamics in Mission Bay on a less expansive or less frequent basis. These include slope instability, current velocities, disease, climatic variance, and anthropogenic and biogenic disturbances (Merkel & Associates 2013).

Light availability (a function of water depth and water clarity) is of paramount importance for eelgrass growth (Merkel & Associates, Inc. 2000, 2005). The west basin of Mission Bay is located closer to the entrance channel of the Bay and tends to contain well circulated and clear waters. In contrast, the east basin of the Bay is farther from the entrance channel and is not as well flushed. In addition, creeks and large storm drains enter the Bay in the east basin (the largest of which are Rose Creek and Tecolote Creek) and input fine sediment and debris into the eastern portions of the Bay. Baywide eelgrass surveys illustrate that both the presence and persistence of eelgrass is the west basin of Mission Bay is greater than in the east basin (Merkel & Associates, Inc. 2013). When examining eelgrass occurrence frequency data derived from multiple years of survey over the past three decades, the relative stability of eelgrass in the western portion of the bay can be seen in strong contrast to the more variable eelgrass presence in the eastern portions of the bay (Figure 4). What is not immediately clear from the frequency analyses in Figure 4 that applies all eelgrass cover classes (sparse to dense eelgrass) evenly, is that the eastern basin also generally supports a low overall coverage of eelgrass across the bottom, even when present.

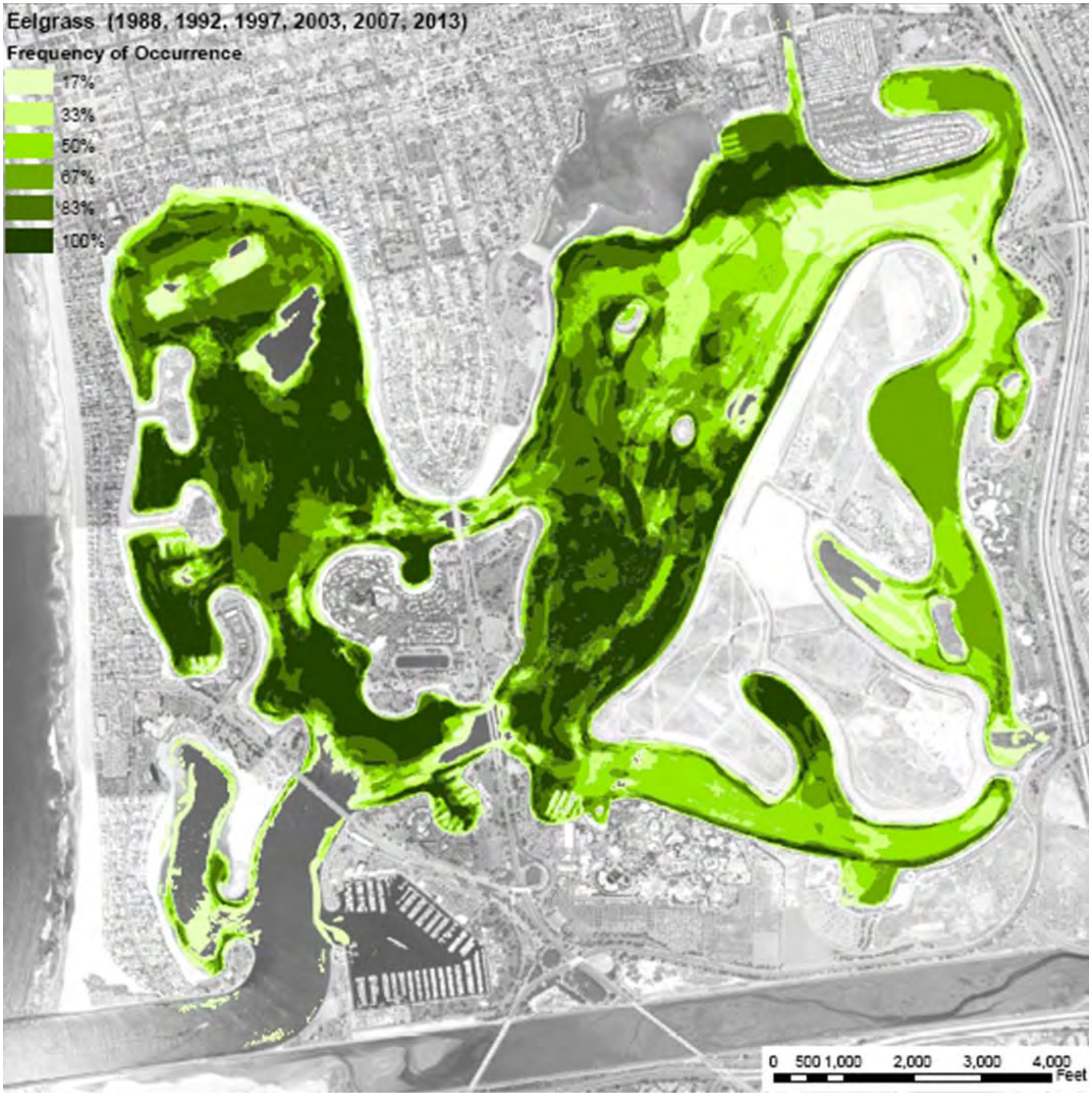


Figure 4. Eelgrass Occurrence Frequency Distribution

Based on the controlling factors that influence the distribution in the bay, it is not possible to assume that all areas within the bay waters are equally suited to support eelgrass. In order to estimate potential for success of restored eelgrass at each site following completion of dredging, the Bay was first separated into east (Fiesta Bay) and west (Sail Bay) basins, using the two bridges of Ingraham Street that cross the bay at Vacation Isle as a dividing line. Using bathymetry and eelgrass coverage from the 2013 baywide survey (Merkel & Associates, Inc. 2013), total acres of intertidal and subtidal habitat was determined by water depth for each basin using ESRI® ArcGIS. All biological analytical work has been conducted in MLLW rather than the project design and engineering datum of NGVD29 (Rick Engineering Company 2016). For this analysis, water depth was divided by half foot increments (e.g., -0.5 to -1.0 feet MLLW, -1.0 to -1.5 feet MLLW, etc.). The total acres of eelgrass within each depth range were then calculated for each basin. Finally, the percent of eelgrass-occupied habitat was determined as acres of eelgrass divided by total acres of habitat available at each depth range.

The results of the analysis are presented in Figure 5. Within the west basin, the water depths that support the greatest percent of eelgrass-occupied habitat occur between -4 and -9 feet MLLW. At -8 feet MLLW (the project design depth for maintenance dredging sites) within the west basin, the percent of habitat occupied by eelgrass is 95 percent. Within the east basin, the water depths that support the greatest percent of eelgrass-occupied habitat occur between -2 and -5 feet MLLW. This result is expected as the lower water clarity in the east basin of the Bay leads to less light available for growth, and therefore, lower eelgrass coverage in deeper waters. At the -8 foot MLLW target depth for maintenance dredging in the east basin, the percent of available habitat occupied by eelgrass is 52 percent, far lower than at the same water depth in the west basin. Further, as indicated previously, the density and sparseness of coverage in this basin as the lower limits is also much lower than similar depths within the west basin.

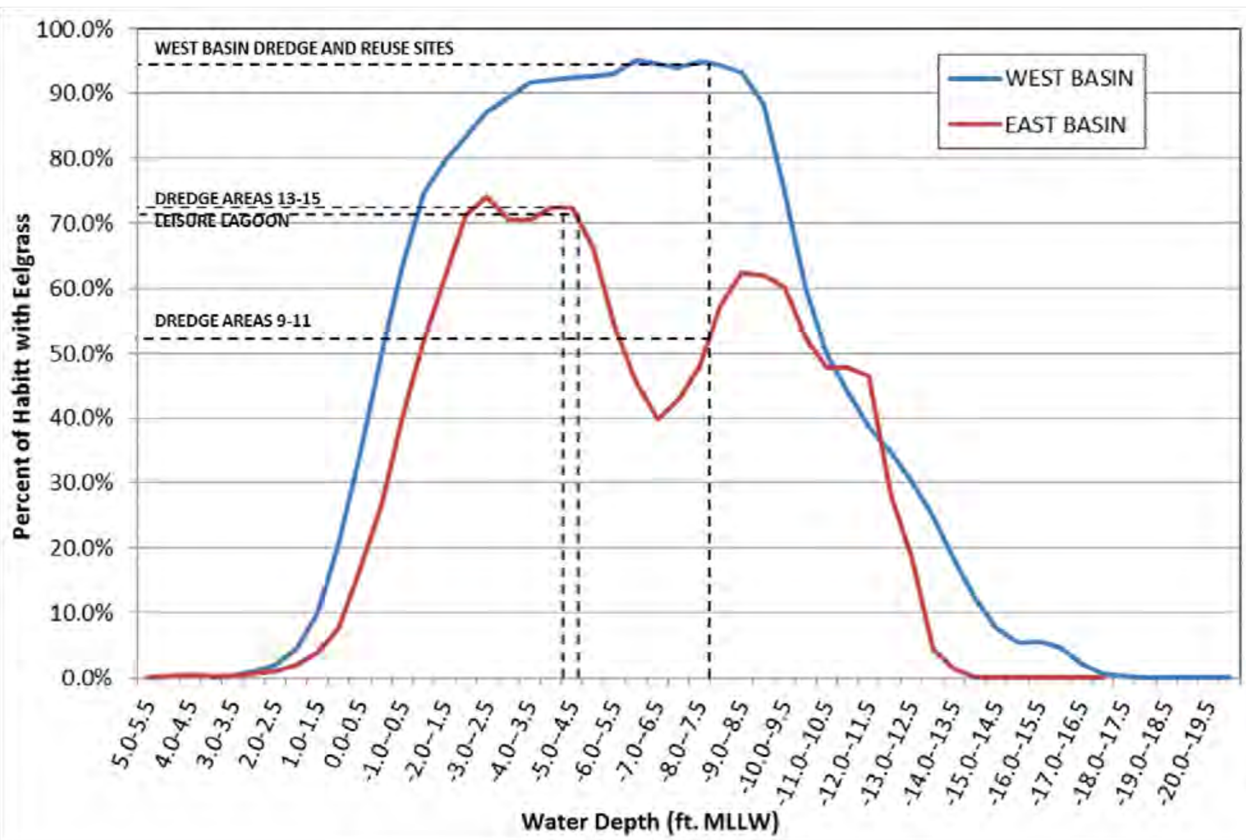


Figure 5. Percent of total available habitat by depth range that supports eelgrass within west and east basins of Mission Bay.

Based on this analysis the assumption can be made that restoration of eelgrass at the maintenance dredging sites following project construction would yield less than 100% coverage of eelgrass, and that restored sites in the east basin would yield substantially lower eelgrass coverage of those restored in the west basin. Using the design depths for the various dredge and reuse sites, eelgrass restoration success has been predicted using the existing eelgrass depth distribution information presented in Figure 5. By multiplying the area of dredge or reuse sites by the predicted eelgrass success rate, the individual site yields can be estimated and the overall successful restoration area can be predicted from restoration plantings.

Table 3 summarizes the extent of dredged areas, eelgrass impacts anticipated eelgrass planting aea and predicted eelgrass restoration return within project areas. Dredge Area 12 is not proposed to be planted, but may be planted in the final restoration program if the depth distribution suggests benefit in planting at the time of completion of the pre-dredging and post-dredging surveys. Under the proposed restoration program a total area of 63.69 acres would be replanted. This area would exceed the minimum required initial planting of 59.24 acres by 8 percent. The anticipated yield from this planting is 55.07 acres which exceeds the minimum of 51.51 acres required by 7 percent. The ultimate mitigation area planting and success requirement is dependent upon the determined impact under the CEMP required pre- and post-dredging surveys as well as the extent of eelgrass already developed within mitigation sites.

An additional factor that may affect the extent of eelgrass planting is the extent of eelgrass establishment success within the Reuse West sites that are capped with eelgrass rich sands. It is expected that this final material placement will generate a good initial eelgrass colonization of this site, thus reducing the overall planting needs within the Reuse Sites. Dredged areas, however, are expected to require full planting.

Table 3. Total dredge area, eelgrass impact and predicted eelgrass from restoration actions

SITE	AREA (ACRES)	EELGRASS IMPACT (ACRES)	EELGRASS TRANSPLANT AREA (ACRES)	PREDICTED SUCCESS RATE (%)	PREDICTED EELGRASS RESTORED (ACRES)
DREDGE SITES					
DREDGE 1A	15.87	15.87	15.87	95%	15.08
DREDGE 1B	0.52	0.52	0.52	95%	0.49
DREDGE 1C	0.63	0.63	0.63	95%	0.60
DREDGE 1D	0.41	0.41	0.41	95%	0.39
DREDGE 2	0.41	0.41	0.41	95%	0.39
DREDGE 3	2.84	2.57	2.84	95%	2.70
DREDGE 4	0.8	0.64	0.80	95%	0.76
DREDGE 5A	13.5	13.30	13.50	95%	12.83
DREDGE 6	0.67	0.42	0.67	95%	0.64
DREDGE 7	1.3	1.30	1.30	95%	1.24
DREDGE 9	1.94	0.97	1.94	52%	1.01
DREDGE 10	3.61	2.01	3.61	52%	1.88
DREDGE 11	1.67	0.64	1.67	52%	0.87
DREDGE 12A	11.44	0.99	0.00	NA	0
DREDGE 12B	0.13	0.00	0.00	NA	0
DREDGE 12C	0.11	0.06	0.00	NA	0
DREDGE 12D	0.07	0.04	0.00	NA	0
DREDGE 12 E	0.21	0.04	0.00	NA	0
DREDGE 12F	0.08	0.00	0.00	NA	0
DREDGE 13 & 14	3.78	0.78	3.78	71%	2.68
DREDGE 15	3.37	1.31	3.37	70%	2.36
TOTAL DREDGE	**63.36**	**42.93**	**51.32**		**43.90**
RESUSE SITES					
RESUSE WEST 3	2.51	-	2.51	95%	2.38
RESUSE WEST 4	2.69	-	2.69	95%	2.55
RESUSE WEST 6	2.23	-	2.23	95%	2.12
RESUSE WEST 7	2.50	-	2.50	95%	2.37
LEISURE LAGOON	2.45	-	2.45	95%	1.74
TOTAL REUSE	**12.37**	**-**	**12.37**		**11.17**
PROJECT TOTAL	**75.73**	**43**	**63.69**		**55.07**

Site Stabilization for Planting

Dredging is anticipated to result in generally acceptable surfaces for eelgrass planting based on construction criteria requiring elevations of the site to be controlled to design tolerances with internal site rugosity being controlled by specification of maximum undulations of not more than 1 foot over 5 running feet. In addition, it is anticipated that dredged and filled sites will weather somewhat following dredging. However, the extent of post-dredging weathering will vary by site location and additional flattening of high points may be required by dragging an I-beam or swinging a dredge bucket across the bottom to knock ridges into valleys and create a more suitable planting condition.

The planting of the mitigation site will follow dredging allowing for a period of site stabilization that will vary from area to area based on the site developing suitable planting conditions. Because the dredging work is proposed to be completed during the winter months and eelgrass planting is best completed during the active growing season, some sites will have a longer period to stabilize than others before planting may occur. Sites will be inspected for stability and suitability to accept eelgrass planting units. This requires the site surface sediments to not be shifting excessively, the site should not trap large amounts of detritus, and the site sediments should be consolidated adequately to hold anchored planting units within the prevailing current and wave regimes.

Given the character of the dredge material as generally silty to clean sand, it is expected that site conditions it is expected that the individual dredge and reuse areas will rapidly become suitable to support eelgrass soon after site construction and certainly within not more than 1 to 3 months. The sites will be planted following a sediment stabilization period, once tidal elevation and sediment suitability have been met.

EELGRASS PLANTING PLAN

Planting Challenges and Requirements

The eelgrass restoration planting program required for the Mission Bay Navigational Safety Dredging is larger than any prior active eelgrass restoration project undertaken in California in a single planting season. However, multiple prior eelgrass planting projects have been completed with active planting exceeding 10 acres. These include eelgrass restoration for the Mission Bay Shoreline Protection Projects I & II (11.9 acres), Navy Eelgrass Mitigation Site 5 in San Diego Bay (17.5 acres), Agua Hedionda Lagoon Dredging (14.2 acres), the Port of Los Angeles Pier 300 Eelgrass Expansion Area (14.5 acres), and the San Diego Bay South Bay Borrow Site Transplant (10.5 acres). The scale of the restoration effort is, itself a major challenge to be considered in the completion of work and experience in large scale eelgrass restoration projects is required to be successful.

The transplant areas are further located within a highly active recreational embayment. Given the seasonal overlap between the eelgrass high growth period when planting is to be done and periods of high recreational use on Mission Bay, care must be taken to protect restoration teams completing eelgrass planting from hazards of boaters on the bay. Further, it is necessary to ensure that the restoration does not conflict with boating use. This requires work to be conducted in small buoy line protected planting areas that are moved and reset as each successive area is planted. Where necessary, planting may be conducted early in the morning or during periods when high speed traffic is either limited or precluded by existing regulations. These various measures were employed to deconflict eelgrass restoration and public uses of the bay during eelgrass restoration within multiple Mission Bay sites in Sail Bay (1986), South Shores Embayment (1994), the Mission Bay Shoreline Protection Projects I & II (1995). Santa Clara Point Launch Ramp (1995), Dana Landing Dock Replacements (1995), De Anza Launch Ramp (1996), Ventura Cove (1996), Santa Clara Cove Storm Water System (1996), Bahia Hotel Dock and Pier Replacement (2011), and the Army Corps of Engineers Mission Bay Channel Dredging (2011). Most recently, similar mid-bay large-scale eelgrass restoration was completed in Lower Newport Bay (2012) using multiple tools to ensure safe completion of the restoration while also ensuring continuous bay use by the navigating public. This was accomplished by extending swim float lines around planting areas each day and retrieving the float lines and redeploying lines with each planting area movement. In 2016, eelgrass planting was conducted in the Port of Los Angeles within a highly active windsurfing area. This was deconflicted by timing the planting work to be completed early in the day when windsurfers were not active. Given the multiple planting sites to be planted in Mission Bay under this project, it is anticipated that planting work will be moved around between sites to avoid use conflicts and ensure project and public safety. This will require a high level of project coordination and good communications with City Lifeguard Services. Experience with such high level coordination for eelgrass and other in-water work will be a priority for the restoration team.

Eelgrass restoration for the project is expected to require extensive planting units to be prepared and planted with short holding times of less than 48 hours from harvest to planting. In addition, the work requires harvest of a large amount of eelgrass. In order to ensure that plants are not unduly exploited or stressed as a result of wasted material or long-holding time, considerable coordination and transplant management is required. Efficient workflow must be maintained. The restoration contractor should have exhibited expertise with such field management of multi-task projects.

TRANSPLANT SITES

The transplant sites to be used for mitigation purposes are illustrated in Figure 2 and acreage to be planted are summarized in Table 3. A portion of the sites are maintenance dredging sites that will be planted following dredging. The remainder of the transplant sites are beneficial reuse areas that will be filled to an appropriate depth to support eelgrass.

Eelgrass along the edge of a dredge cut displays exposed rhizomes, allowing for easy harvesting of plants that are not anticipated to persist in their current location.

DONOR SITES

Donor eelgrass for the eelgrass transplant will be salvaged from the edge of the dredge cuts at each of the dredge sites where eelgrass currently grows. The edges of dredge cuts are generally defined by vertical initial cuts and post-dredging bank erosion to a stable angle of repose. This stabilization result in undermining the adjacent eelgrass rhizome mat and exposing extensive rhizomes of adjacent eelgrass. The exposed eelgrass will not require hand excavation and will, therefore, be easily harvested. Additionally, eelgrass that is undermined leaving the rhizomes in the water column does not readily regrow and is almost always lost. For this reason, harvesting these areas is an ideal means to minimize the need for extensive additional harvest.

Once all unanchored material has been harvested from dredge sites, the remaining donor material will be harvested from the established eelgrass beds in Sail Bay and along Crown Point Shores, adjacent to the transplant sites.

Factors that contributed to the selection of these donor beds include:

1) Proximity to the transplant receiver site that favors both logistic convenience and selection of appropriate plant materials for the area;
2) Suitability of donor site size and eelgrass density to provide necessary transplant materials;
3) Recovery potential for the donor site; and,
4) Accessibility of the donor site and safety.

Reference Sites

Eelgrass reference sites will be established within central Sail Bay, north and south of Dredge Areas 1-3, northwest and north and east of Dredge Areas 5-7, between Dredge Areas 11 and 15 and south of Dredge Area 10. In addition, reference areas will be established north of Leisure Lagoon to serve as a reference site for Dredge Areas 13-14 and the Leisure Lagoon reuse area. Reference areas will be paired to the sites they are intended to reflect. Reference areas will be of a similar size as the mitigation sites they represent.

The location and boundaries of the reference sites will be finalized at the time of the first post-planting monitoring event based on eelgrass distribution patterns observed during the post-dredging surveys. Monitoring of the reference sites will be conducted coincident with the monitoring of the dredge and re-use transplant areas. Changes in the reference sites over time will be considered to represent natural environmental variability when evaluating the performance of the transplant sites (see Monitoring Program sections).

RESTORATION METHODS

Letter of Permission and Notifications

Prior to commencing eelgrass transplantation work, a letter of permission to plant eelgrass will be obtained from the California Department of Fish and Wildlife (CDFW) and the restoration contractor's Scientific Collector's Permit shall be amended to include the eelgrass harvesting required to support this project. The restoration contractor shall have demonstrable experience in obtaining LOAs for eelgrass.

PLANT COLLECTION

Bare-root eelgrass plant material will be salvaged from the donor beds by "raking" rhizomes out of the surface sediment layers and loosely filling a mesh bag with salvaged material. In collecting eelgrass, care will be taken to work the rhizomes free as opposed to ripping the plants free of the sediment. This will preserve as much root material as possible. Salvaged materials will consist of no less than three healthy internodal segments with well-developed root initiates and vigorous shoots. More intact rhizome segments and roots are preferred for use in the planting unit bundles. Salvaging is a mobile exercise and harvesters will move systematically through an area and collect/groom no more than 10 percent of the plant material within a donor bed. At dredge sites, harvesting may be conducted at a 100 percent level if the site has not been dredged previously. If the site has been dredged, then only the loose eelgrass along the dredge cuts of the site margins may be harvested completely.

Collected material will be held in a flow-through seawater source until it is processed into planting units. No material will be stored for over 24 hours from harvesting to unit preparation. Once units are prepared, they will be stored in open water for no longer than 24 hours for a maximum total of 48 hours of storage from harvest to planting with storage generally being loose in flowing seawater or within mesh nets in the bay.

TRANSPLANT UNITS

The proposed mitigation will utilize anchored bare-root transplant units. Bare-root transplants are the preferred means of transplanting eelgrass in most situations, and anchored bare- root units are the principal planting units used in large-scale restoration projects at the current time. The survival of such planting units has been shown to be quite high when properly prepared (Fonseca *et al.* 1982; Merkel 1987, 1990a). Similarly, bare-root units have shown an ability to rapidly expand and colonize bare substrate (Merkel 1990b). In addition to offering high unit survival and rapid expansion rates, bare-root units can be prepared with limited damage to the donor bed. Unlike plug extractions, bare-root units can be prepared using materials collected without substantial sediment disturbance. Each transplant unit for the project work will consist of 4-6 turions.

The anchors used in this program will be biodegradable and pliable anchors such as those developed initially for transplants in Mission Bay’s Sail Bay (Merkel 1987) and which have subsequently been used in more than 80 eelgrass restoration projects throughout California, Oregon, Washington, and Alaska. These units have been used in more than a dozen eelgrass restoration sites within Mission Bay.

PLANTING EELGRASS UNITS

Multiple shoreline staging and work areas will be utilized as needed to support the restoration effort. These include an east bay restoration site at Leisure Lagoon, and sites in the west basin and on Crown Point Shores near the transplant sites. Planting at all dredge and re-use transplant sites will be conducted by planting along temporary planting lines laid by spooling weighted lines out from a surface vessel navigating consecutively spaced lines using RTK GPS. By setting lines in this manner early in the day prior to afternoon winds, lines can generally be set with extreme accuracy

of less than one meter error. Lines are marked with uniquely identified buoys to allow for location, information management and surface based retrieval after lines are planted. Using planting lines, the restoration sites are to be planted on 1 meter centers. This layout will allow for ease of tracking work progress and completion of quality control reviews.
The plant materials will be planted by excavating a hole in the sediments with a small trowel or by hand. Each anchor will be planted parallel to the sediment surface and the root/rhizome bundle will be planted approximately 3 to 5 cm below the sediment surface with the anchor being placed approximately 15 cm below the sediment surface. During planting, spot checks of the plantings will be made to ensure proper planting depth and firmness of the anchoring system.

Planting unit spacing is typically determined by balancing the rate of bed establishment with the cost of the transplant project. In some instances, rapid bed establishment is required to minimize potential storm damage or scouring of unconsolidated rhizome mats. In other cases, rapid recovery rates are desirable to meet bed establishment milestone objectives. Taking into account the rate of eelgrass growth and the expanded transplant area to reduce failure risk, a planting unit spacing of one meter on center will be used for all dredge and transplant areas. The transplant unit count to achieve the 63.69 acres anticipated to be planted under this project is 257,750 planting units.

TIMING OF THE RESTORATION WORK

Timing of dredging and transplant site preparation work is expected to commence in winter of 2017 and be completed by mid-spring 2018. Work will be completed in a generally east to west direction with finer sediments and sands from sites supporting less eelgrass being placed into reuse locations early in the project and dredging in the west basin sites and placement of material from these sites being the last order of work.

Under this construction schedule, eelgrass restoration will commence at the dredge and the re-use sites progressing in a manner that follows the dredging and reuse site development. This would result in Fiesta Bay sites being completed early in the project and west Mission Bay sites being completed later in the planting period. This schedule is ideal for planting because it allows work in the high speed areas of Fiesta Bay to be completed early in the season before the bay gets busy. Work in the speed controlled areas at Leisure Lagoon and West Mission Bay are more readily deconflicted with small work areas being demarcated and moved as planting progresses.

Under the planned transplant schedule, work would commence concurrent with the later phases of dredging in the spring when the official start of the high growth period commences. Work would continue through the summer of the first season following planting. Transplanting is anticipated to require 7 months to complete (210 calendar days, excluding unworkable weather, water quality, or other conditions).

MONITORING PROGRAM

Performance Needs

Following completion of dredging, the pre-dredging and post-dredging surveys will be compared to determine the ultimate impact and mitigation need. The area of eelgrass surplus determined to exist within the City's previously established mitigation areas will be subtracted from the total mitigation need to zero out the residual eelgrass mitigation under this MOA. The new total will be considered the uncompensated eelgrass impact that is subject to compensatory mitigation under the provisions of the CEMP, inclusive of an establishment of successful mitigation at a 1.2:1 ratio with milestone progress being made as outlined in this section.

Establishment Monitoring

Upon completion of the planting effort, a monitoring program will be initiated and continued for a 60-month (5-year) period as outlined in the CEMP. Spatial distribution, areal extent, percent vegetated cover, and turion density of the transplanted eelgrass and reference sites will be monitored and reported as outlined in the CEMP. Spatial metrics will be evaluated using interferometric sidescan sonar with motion control and RTK corrected GPS for enhanced positional accuracy. The sidescan system provides an acoustic swath image of seafloor within the entire surveyed area. Sidescan backscatter data will be acquired at a frequency of 400 kHz or greater. All data will be collected in latitude and longitude using the North American Datum of 1983 (NAD 83). Surveys will be conducted by running transects spaced to allow for overlap between adjoining sidescan swaths. Following completion of the survey, the data will be converted into a geographically registered mosaic through digital post-processing, and plotted on a geo-rectified aerial image of the dredge, transplant, and reference sites. Eelgrass will then be digitized to show its distribution within the surveyed areas. Eelgrass turion densities will be determined within each transplanted bed collecting a minimum of 20 turion density counts per 1/16 m^2 quadrat within each transplant and reference plot as required to control variance to a level suitable to detect a 25 percent difference between reference and transplant sites with statistical power of 90 percent and α=0.10 and β=0.10.

The monitoring program will be conducted at intervals of 6, 12, 24, 36, 48, and 60-months post-transplant. When monitoring dates fall outside of the normal eelgrass-growing season, dates will be shifted to coincide with the growing season to ensure that valuable information on growth and survival is collected. For each monitoring interval, a draft monitoring report will be prepared and submitted within 30 days of completion of the monitoring interval and data processing. It is anticipated that each monitoring interval will require up to 4 field days to complete the monitoring at all sites.

Monitoring reports will include information from previous monitoring intervals, including numerical comparisons and graphical presentations of changing bed configurations. Graphical comparisons will include generalized bathymetry. The monitoring report will include an analysis of any declines or expansions in eelgrass coverage based on physical conditions of the site, as well as any other significant observations. Finally, the monitoring report will provide a prognosis for the future of the eelgrass bed and will identify the timing for the next monitoring period.

MITIGATION SUCCESS CRITERIA

Mitigation will be deemed successful when it has met the success criteria outlined in the CEMP. Criteria for determination of transplant success will be based upon a comparison of bed areal extent, percent vegetated cover and density (turions per square meter) between the reference sites and the transplant sites. Specific performance metrics include the areal extent as defined where eelgrass is present and where gaps in coverage are less than one meter between individual turion clusters. Density of turions (shoots) is identified as the number of turions per square meter, as measured from representative areas within the control or transplanted beds.

Key success criteria are as follows:

- Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.
- Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.
- Month 12– The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 24– The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 36– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 48– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 60– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Areas that do not meet the above success criteria may be revegetated, and again monitored until the final goal is achieved. Should replanting of the areas at the project site fail to meet the success criteria; reconstruction of portions of one or more transplant sites may be required to carry out this revegetation. Should the reference areas fail or decline alongside the transplant mitigation areas for reasons outside the control of the City, the City will not be held responsible for similar declines in the dredge or transplant mitigation areas.

MITIGATION PROGRAM SCHEDULE

Based on the presently planned transplant window, the preliminary schedule of work is as follows:

ACTIVITIES	TIME PERIOD	REPORTING PERIOD
1. Dredge and Reuse Transplant Site Prep	December 2017-April 2018	-
2. Transplant at Dredge Areas	March 2018-August 2018	-
3. Transplant at Reuse Areas	May 2018-September 2018	
6. Complete 6-Month Survey	March 2019	April 2019
7. Complete 12-Month Survey	September 2019	October 2019
8. Complete 24-Month Survey	September 2020	October 2020
9. Complete 36-Month Survey	September 2021	October 2021
10. Complete 48-Month Survey	September 2022	October 2022
11. Complete 60-Month Survey	September 2023	October 2023

REFERENCES

City of San Diego. 1999. Mission Bay Park Mitigation Bank Agreement Memorandum of Agreement.

Fonseca, Mark S., W. Judson Kenworthy, G. W. Thayer. 1982. A Low-Cost Planting Technique for Eelgrass (*Zostera marina L.*). Coastal Engineering Aid No. 82-6. U. S. Army Engineer Coastal Engineering Research Center, Fort Belvoir, Virginia. 15 pp.

Merkel, Keith W. 1987. Use of a New Bio-Degradable Anchor Unit for Eelgrass (Zostera marina) Revegetation. Presented at the First California Eelgrass Symposium, Tiburon, California. 8-9 May 1987. Pages 28-42.

Merkel, Keith W. 1990a. Eelgrass Transplanting in South San Diego Bay, California. In: K. W. Merkel and R. S. Hoffman, eds. Proceedings of the California Eelgrass Symposium, Chula Vista, California, May 27-28, 1988. Pages 28-42.

Merkel, Keith W. 1990b. Growth and Survival of Transplanted Eelgrass: the Importance of Planting Unit Size and Spacing. In: K. W. Merkel and R. S. Hoffman, eds. Proceedings of the California Eelgrass Symposium, Chula Vista, California May 27-28, 1988. Pages 70-78.

Merkel & Associates, Inc. 2000. Environmental Controls on the Distribution of Eelgrass (Zostera marina L.) in South San Diego Bay: An assessment of the relative roles of light, temperature, and turbidity in dictating the development and persistence of seagrass in a shallow back-bay environment. January 2000.

Merkel & Associates, Inc. 2005. Baywide Eelgrass (Zostera marina L.) Inventory in San Francisco Bay: Eelgrass Bed Characteristics and Predictive Eelgrass Model. Prepared for Caltrans and NOAA Fisheries. September 2005.

Merkel & Associates, Inc. 2008. City of San Diego Beach Maintenance Review of Operations and Fiesta Island Site Activities. Prepared for the City of San Diego Park & Recreation Department. March 2008.

Merkel & Associates, Inc. 2011. Rose Creek Bike/Pedestrian Path and Bridge Project Wetland Mitigation Plan (Special Condition #3; CDP 6-10-052). Prepared for the City of San Diego Engineering and Capital Projects Department. February 14, 2011.

Merkel & Associates, Inc. 2013. Mission Bay Park Eelgrass Inventory and Bathymetric Change Analysis 1988, 1992, 1997, 2001, 2007, and 2013. Prepared for the City of San Diego Public Works Department, E&CP, AEP Division.

Merkel and Associates, Inc. 2015a. Mission Bay Maintenance Dredging Program – Final Sampling and Analysis Plan Dredged Material Characterization Study. February 2015.

Merkel and Associates, Inc. 2015b. Mission Bay Maintenance Dredging Program – Dredged Material Characterization Study. Prepared for the U.S. Army Corps of Engineers. June 2015.

[NMFS] National Marine Fisheries Service 1991. Southern California Eelgrass Mitigation Policy. (1991, Revision 11). R.S. Hoffman, ed.

[NMFS] National Marine Fisheries Service 2014. California Eelgrass Mitigation Policy and Implementing Guidelines. NOAA Fisheries West Coast Region (October 2014)

U.S. Environmental Protection Agency (USEPA). 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131.

United States Environmental Protection Agency (USEPA)/U.S. Army Corps of Engineers (USACE). 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S., Testing Manual: Inland Testing Manual. February.

Appendix A: California Eelgrass Mitigation Policy (NOAA 2014)

NOAA FISHERIES

West Coast Region

California Eelgrass Mitigation Policy and Implementing Guidelines

October 2014

Photo credit: www.Lorenz-Avelar.com

Table of Contents

I. National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy

A. Policy Statement

It is NMFS' policy to recommend **no net loss of eelgrass habitat function** in California.

For all of California, compensatory mitigation should be recommended for the loss of existing eelgrass habitat function, but only after avoidance and minimization of effects to eelgrass have been pursued to the maximum extent practicable. Our approach is congruous with the approach taken in the federal Clean Water Act guidelines under section 404(b)(1) (40 CFR 230). In absence of a complete functional assessment, eelgrass distribution and density should serve as a proxy for eelgrass habitat function. Compensatory mitigation options include comprehensive management plans, in-kind mitigation, mitigation banks and in-lieu-fee programs, and out-of-kind mitigation. While in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis.

Further, it is the intent of this policy to ensure that there is no loss associated with delays in establishing compensatory mitigation. This should be accomplished by creating a greater amount of eelgrass than is lost, if the mitigation is performed contemporaneously or after the impacts occur. To achieve this, NMFS, in most instances, should recommend compensatory mitigation for vegetated and unvegetated eelgrass habitat be successfully completed at a ratio of at least 1.2:1 mitigation area to impact area. This ratio is based on present value calculation[1] using a discount rate of 0.03 (NOAA-DARP 1999). This ratio assumes that restored eelgrass habitat achieves habitat function comparable to existing eelgrass habitat within a period of three years or less (Hoffman 1986, Evans & Short 2005, Fonseca *et al.* 1990).

For ongoing projects, once mitigation has been successfully implemented to compensate for the loss of eelgrass habitat function within a specified footprint, NMFS should not recommend additional mitigation for subsequent loss of eelgrass habitat if 1) ongoing project activities result in subsequent loss of eelgrass habitat function within the same footprint for which mitigation was completed and 2) the project applicant can document that no new area of eelgrass habitat is impacted by project activities.

This policy does not address mitigation for potential eelgrass habitat. NMFS recognizes impacts to potential eelgrass habitat may preclude eelgrass movement or expansion to suitable unvegetated areas in the future, potentially resulting in declines in eelgrass abundance over time. In addition, it does not address other shallow water habitats. Regulatory protections in the estuarine/marine realm typically focus on wetlands and submerged aquatic vegetation. Mudflats, sandflats, and other superficially bare habitats do not garner the same degree of recognition and

[1] Present Value (PV) is a calculation used in finance to determine the present day value of an amount that is received at a future date. The premise of the equation is that receiving something today is worth more than receiving the same item at a future date; $PV = C_1/(1+r)^n$ where C_1= resource at period 1, r= interest or discount rate, n=number of periods.

concern, even though these are some of the most productive and fragile ecosystems (Reilly *et al*. 1999). NMFS will continue to collaborate with federal and state partners on these issues.

B. Eelgrass Background and Information

Eelgrass species (*Zostera marina* L. and *Z. pacifica*) are seagrasses that occur in the temperate unconsolidated substrate of shallow coastal environments, enclosed bays, and estuaries. Eelgrass is a highly productive species and is considered to be a "foundation" or habitat forming species. Eelgrass contributes to ecosystem functions at multiple levels as a primary and secondary producer, as a habitat structuring element, as a substrate for epiphytes and epifauna, and as sediment stabilizer and nutrient cycling facilitator. Eelgrass provides important foraging areas and shelter to young fish and invertebrates, food for migratory waterfowl and sea turtles, and spawning surfaces for invertebrates and fish such as the Pacific herring. Eelgrass also provides a significant source of carbon to the detrital pool which provides important organic matter in sometimes food-limited environments (*e.g.*, submarine canyons). In addition, eelgrass has the capacity to sequester carbon in the underlying sediments and may help offset carbon emissions. Given the significance and diversity of the functions and services provided by seagrass, Costanza *et al.* (2007) determined seagrass ecosystems to be one of Earth's most valuable.

California supports dynamic eelgrass habitats that range in extent from less than 11,000 acres to possibly as much as 15,000 acres statewide. This is inclusive of estimates for poorly documented beds in smaller coastal systems as well as open coastal and insular areas. While among the most productive of habitats, the overall low statewide abundance makes eelgrass one of the rarest habitats in California. Collectively just five systems, Humboldt Bay, San Francisco Bay, San Diego Bay, Mission Bay and Tomales Bay support over 80 percent of the known eelgrass in the state. The uneven distribution of eelgrass resources increases the risk to this habitat and also contributes to its dynamic nature. Further, the narrow depth range within which eelgrass can occur further places this habitat at risk in the face of global climate change and sea level rise predictions.

Seagrass habitat has been lost from temperate estuaries worldwide (Duarte 2002, Lotze *et al.* 2006, Orth *et al.* 2006). While both natural and human-induced mechanisms have contributed to these losses, impacts from human population expansion and associated pollution and upland development is the primary cause (Short and Wyllie-Echeverria 1996). Human activities that affect eelgrass habitat distribution and abundance, including, but not limited to, urban development, harbor development, aquaculture, agricultural runoff, effluent discharges, and upland land use associated sediment discharge (Duarte 2008) occur throughout California. For example, dredging and filling; shading and alteration of circulation patterns; and watershed inputs of sediment, nutrients, and unnaturally concentrated or directed freshwater flows can directly and indirectly destroy eelgrass habitats. Conversely, in many areas great strides have been made at restoring water quality and expanding eelgrass resources through directed efforts at environmental improvements and resource enhancement. While improvements in eelgrass management have occurred overall, the importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and losses associated with climate change, highlight the need to protect, maintain, and where feasible, enhance eelgrass habitat.

C. Purpose and Need for Eelgrass Mitigation Policy

Eelgrass warrants a strong protection strategy because of the important biological, physical, and economic values it provides, as well as its importance to managed species under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Vegetated shallows that support eelgrass are also considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water Act (40 C.F.R. § 230.43). The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) developed this policy to establish and support a goal of protecting this resource and its habitat functions, including spatial coverage and density of eelgrass habitats. This NMFS policy and implementing guidelines are being shared with agencies and the public to ensure there is a clear and transparent process for developing eelgrass mitigation recommendations.

Pursuant to the MSA, eelgrass is designated as an essential fish habitat (EFH) habitat area of particular concern (HAPC) for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2008). An HAPC is a subset of EFH that is rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to provide additional focus for conservation efforts.

This policy and guidelines support but do not expand upon existing NMFS authorities under the MSA, the Fish and Wildlife Coordination Act (FWCA), and the National Environmental Policy Act (NEPA). Pursuant to the EFH provisions of the MSA, FWCA, and obligations under the NEPA as a responsible agency, NMFS annually reviews and provides recommendations on numerous actions that may affect eelgrass resources throughout California. Section 305(b)(1)(D) of the MSA requires NMFS to coordinate with, and provide information to, other federal agencies regarding the conservation and enhancement of EFH. Section 305(b)(2) requires all federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Under section 305(b)(4) of the MSA, NMFS is required to provide EFH Conservation Recommendations to federal and state agencies for actions that would adversely affect EFH (50 C.F.R. § 600.925). NMFS makes its recommendations with the goal of avoiding, minimizing, or otherwise compensating for adverse effects to EFH. When impacts to NMFS trust resources are unavoidable, NMFS may recommend compensatory mitigation to offset those impacts. In order to fulfill its consultative role, NMFS may also recommend, among other things, the development of mitigation plans, habitat distribution maps, surveys and survey reports, progress milestones, monitoring programs, and reports verifying the completion of mitigation activities.

Eelgrass impact management and mitigation throughout California has historically been undertaken without a statewide strategy. Federal actions with impacts to eelgrass require considerable NMFS staff time for project review, coordination and development of conservation recommendations. As federal staff resources vary with budgets, and threats to aquatic resources remain steady or increase, regulatory streamlining and increased efficiency are crucial for continued protection of important coastal habitats, including eelgrass. The California Eelgrass Mitigation Policy (CEMP) is meant to increase efficiency of existing regulatory authorities in a programmatic manner, provide transparency to federal agencies and action proponents, and ensure that unavoidable impacts to eelgrass habitat are fully and appropriately mitigated. It is the intent of NMFS to collaborate with other federal, state, and local agencies charged with the protection of marine resources to seek a unified approach to actions affecting eelgrass such that consistency across agencies with respect to this resource may be enhanced.

D. Relevance to Other Federal and State Policies

Based on our understanding of existing federal and state policies regarding aquatic resource conservation, the CEMP does not conflict with existing policies and complements the federal and state wetland policies as described below. NMFS does not intend to make any recommendations, which, if adopted by the action agency and carried out, would violate other federal, state, or local laws. The CEMP also complements the NOAA Aquaculture Policy and National Shellfish Initiative and builds upon the NOAA Seagrass Conservation Guidelines and the Southern California Eelgrass Mitigation Policy.

1. Corps/EPA Mitigation Rule and supporting guidance

In 2008, the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. The regulations emphasize avoiding impacts to wetlands and other water resources. For unavoidable impacts, the rule incorporates Natural Resource Council recommendations to improve planning, implementing and managing wetland replacement projects, including: science-based assessment of impacts and compensation measures, watershed assessments to drive mitigation sites and plans, measurable and enforceable ecological performance standards for evaluating mitigation projects, mitigation monitoring to document whether the mitigation employed meets ecological performance standards, and complete compensation plans. The regulations also encourage the expansion of mitigation banking and in lieu fee agreements to improve the quality and success of compensatory mitigation projects.

The NMFS policy to recommend no net loss of eelgrass function and the eelgrass mitigation guidelines offered herein align with the provisions of the EPA and Corps mitigation rule, but provide more specific recommendations on how to avoid and minimize impacts to eelgrass and how to implement eelgrass surveys, assessments, mitigation, and monitoring.

2. State of California Wetland Conservation Policies

The 1993 State of California Wetlands Conservation Policy established a framework and strategy to ensure no overall net loss and long-term gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property, reduce procedural complexity in administration of state and federal wetlands conservation programs, and encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

The State of California is also developing a Wetland and Riparian Area Protection Policy. The first phase of this effort was published as the "Preliminary Draft Wetland Area Protection Policy" with the purpose of protecting all waters of the State, including wetlands, from dredge and fill discharges. It includes a wetland definition and associated delineation methods, an assessment framework for collecting and reporting aquatic resource information, and requirements applicable to discharges of dredged or fill material. The draft specifies that dredge or fill projects will provide for replacement of existing beneficial uses through compensatory mitigation. The preliminary policy includes a determination that compensatory mitigation will sustain and improve the overall abundance, diversity and condition of aquatic resources in a project watershed area.

Based on the definition of wetlands included in these state wetland policies, the policies do not directly apply to subtidal eelgrass habitat, but may apply to intertidal eelgrass habitat. The NMFS policy of recommending no net loss to eelgrass habitat function and recommendations for compensatory mitigation for eelgrass impacts complement the state protection policies for wetlands.

3. NOAA Aquaculture Policy and National Shellfish Initiative

In 2011, NOAA released the National Marine Aquaculture Policy and the National Shellfish Initiative. The Policy encourages and fosters sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with the National Policy for the Stewardship of the Ocean, our Coasts, and the Great Lakes (National Ocean Policy). The goal of the Initiative is to increase populations of bivalve shellfish in our nation's coastal waters—including oysters, clams, abalone, and mussels—through both sustainable commercial production and restoration activities. The Initiative supports shellfish industry jobs and business opportunities to meet the growing demand for seafood, while protecting and enhancing habitat for important commercial, recreational, and endangered and threatened species and species recovery. The Initiative also highlights improved water quality, nutrient removal, and shoreline protection as benefits from shellfish production and restoration. Both the Policy and the Initiative seek to improve interagency coordination for permitting commercial and restoration shellfish projects, as well as support research and other data collection to assess and refine conservation strategies and priorities.

The regulatory efficiencies, transparency, and compensation for impacts to eelgrass promoted by the CEMP directly support the National Aquaculture Policy statements and National Shellfish Initiative through: (1) protection of eelgrass, an important component of productive and resilient coastal ecosystems in California and habitat for wild species, and (2) improved coordination with federal partners regarding planning and permitting for commercial shellfish projects. Furthermore, research conducted under the direction of the National Shellfish Initiative could be informed by and also inform NMFS consultations regarding eelgrass impacts and mitigation in California.

4. NOAA Seagrass Conservation Guidelines

The NOAA publication, "Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters" (1998) was developed by Mark Fonseca of NOAA's Beaufort Laboratory along with Jud Kenworthy and Gordon Thayer and was funded by NOAA's Coastal Ocean Program. The document presents an overview of seagrass conservation and restoration in the United States, discusses important issues that should be addressed in planning seagrass restoration projects, describes different planting methodologies, proposes monitoring criteria and means for evaluation success, and discusses issues faced by resource managers. The CEMP considers information presented in the Fonseca *et al*. document, but deviates in some cases in order to provide reasonable and practicable guidelines for eelgrass conservation in California.

5. Southern California Eelgrass Mitigation Policy

In southern and central California, eelgrass mitigation has been addressed in accordance with the Southern California Eelgrass Mitigation Policy applied by NMFS, US Fish & Wildlife Service, California Department of Fish and Wildlife, California Coastal Commission, US Army Corps of Engineers, and other resource and regulatory agencies since 1991, and which has generally been effective at ensuring eelgrass impacts are mitigated in most circumstances. Given the success of the Southern California Eelgrass Mitigation Policy over its 20-year history, this policy reflects an expansion of the application of the Southern California policy with minor modifications to ensure a high standard of statewide eelgrass management and protection. This policy will supersede the Southern California Eelgrass Mitigation Policy for all areas of California upon its adoption.

II. Implementing Guidelines for California

This policy and guidelines will serve as the guidance for staff and managers within NMFS for developing recommendations concerning eelgrass issues through EFH and FWCA consultations and NEPA reviews throughout California. This policy will inform NMFS's position on eelgrass issues for California in other roles as a responsible, advisory, or funding agency or trustee. In addition, this document provides guidance to assist NMFS in performing its consultative role under the statutes described above. Finally, pursuant to NMFS obligation to provide information to federal agencies under Section 305(b)(1)(D) of the MSA, this policy serves that role by providing information intended to further the conservation and enhancement of EFH. Should this policy or guidelines be inconsistent with any formally-promulgated NMFS regulations, those formally-promulgated regulations will take precedence over any inconsistent provisions of this policy.

While many of the activities impacting eelgrass are similar across California, eelgrass stressors and growth characteristics differ between southern California (U.S./Mexico border to Pt. Conception), central California (Point Conception to San Francisco Bay entrance), San Francisco Bay, and northern California (San Francisco Bay to the California/Oregon border). The amount of scientific information available to base management decisions on also differs among areas within California, with considerably more information and history with eelgrass habitat management in southern California than the other regions. Gaps in region-specific scientific information do not override the need to be protective of eelgrass habitat while relying on the best information currently available from areas within and outside of California. Although the primary orientation of this policy is toward statewide use, where indicated below, specific elements of this policy may differ between southern California, central California, northern California and San Francisco Bay.

NMFS will continue to explore the science of eelgrass habitat and improve our understanding of eelgrass habitat function, impacts, assessment techniques, and mitigation efficacy. Approximately every 5 years, NMFS intends to evaluate monitoring and survey data collected by federal agencies and action proponents per the recommendations of these guidelines. NMFS managers will determine if updates to these guidelines are appropriate based on information evaluated during the 5-year review. Updates to these guidelines and supporting technical information will be available on the NMFS website.

The information below serves as a common starting place for NMFS recommendations to achieve no net loss of eelgrass habitat function. NMFS employees should not depart from the guidelines provided herein without appropriate justification and supervisory concurrence. However, the recommendations that NMFS ultimately makes should be provided on a case-by-case basis to provide flexibility when site specific conditions dictate. In the EFH context, NMFS recommendations are provided to the action agency, which has final approval of the action; in accordance with the MSA, the action agency may take up NMFS recommendations or articulate its reasons for not following the recommendations. In the FWCA context, NMFS makes recommendations which must be considered, but the action agency is ultimately responsible for the wildlife protective measures it adopts (if any). For these reasons, neither this policy nor its implementing guidelines are to be interpreted as binding on the public.

A. Eelgrass Habitat Definition

Eelgrass distribution fluctuates and can expand, contract, disappear, and recolonize areas within suitable environments. Vegetated eelgrass areas can expand by as much as 5 meters (m) and contract by as much as 4 m annually (Donoghue 2011). Within eelgrass habitat, eelgrass is expected to fluctuate in density and patch extent based on prevailing environmental factors (*e.g.*, turbidity, freshwater flows, wave and current energy, bioturbation, temperature, etc.). To account for seagrass fluctuation, Fonseca *et al.* (1998) recommends that seagrass habitat include the vegetated areas as well as presently unvegetated spaces between seagrass patches.

In addition, there is an area of functional influence, where the habitat function provided by the vegetated cover extends out into adjacent unvegetated areas. Those functions include detrital enrichment, energy dampening and sediment trapping, primary productivity, alteration of current or wave patterns, and fish and invertebrate use, among other functions. The influence of eelgrass on the local environment can extend up to 10 m from individual eelgrass patches, with the distance being a function of the extent and density of eelgrass comprising the bed as well as local biologic, hydrographic, and bathymetric conditions (Bostrom and Bonsdorff 2000, Bostrom *et al*. 2001, Ferrell and Bell 1991, Peterson *et al*. 2004, Smith *et al.* 2008, van Houte-Howes *et al.* 2004, Webster *et al*. 1998). Detrital enrichment will generally extend laterally as well as down slope from the beds, while fish and invertebrates that utilize eelgrass beds may move away from the eelgrass core to areas around the bed margins for foraging and in response to tides or diurnal cycles (Smith *et al*. 2008).

To encompass fluctuating eelgrass distribution and functional influence around eelgrass cover, for the purposes of this policy and guidelines, eelgrass habitat is defined as areas of vegetated eelgrass cover (any eelgrass within 1 m^2 quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area (See Attachment 1 for a graphical depiction of this definition). Unvegetated areas may have eelgrass shoots a distance greater than 1 m from another shoot, and may be internal as well as external to areas of vegetated cover. For isolated patches and on a case-by-case basis, it may be acceptable to include an unvegetated area boundary less than or greater than 5 m wide. The definition excludes areas of unsuitable environmental conditions such as hard bottom substrates, shaded locations, or areas that extend to depths below those supporting eelgrass. Suitable depths can vary substantially depending upon site-specific conditions. In general, eelgrass does not extend deeper than 12 feet mean lower low water (MLLW) in most protected bays and harbors in Southern California, and is more limited in Central and Northern California embayments. However, eelgrass can grow much deeper in entrance channels and offshore areas

B. Surveying Eelgrass

NMFS may recommend action agencies conduct surveys of eelgrass habitat to evaluate effects of a proposed action. Eelgrass habitat should be surveyed using visual or acoustic methods and mapping technologies and scales appropriate to the action, scale, and area of work. Surveys should document both vegetated eelgrass cover as well as unvegetated areas within eelgrass habitat (See section II.A. for definition). Assessing impacts to eelgrass habitat relies on the completion of quality surveys and mapping. As such, inferior quality of surveys and mapping (*e.g.*, completed at an inappropriate scale or using inappropriate methods) may make proper evaluation of impacts impossible, and may result in a recommendation from NMFS to re-survey and re-map project areas. Also, to account for fluctuations in eelgrass habitat due to environmental variations, a reference site(s) should be incorporated into the survey (See section V.B.4 below for more details).

1. Survey Parameters

Because eelgrass growth conditions in California vary, eelgrass mapping techniques will also vary. Diver transects or boundary mapping may be suited to very small scale mapping efforts, while aerial and/or acoustic survey with ground-truthing may be more suited to larger survey areas. Aerial and above-water visual survey methods should be employed only where the lower limit of eelgrass is clearly visible or in combination with methods that adequately inventory eelgrass in deeper waters.

The survey area should be scaled as appropriate to the size of the potential action and the potential extent and distribution of eelgrass impacts, including both direct and indirect effects. The resolution of mapping should be adequate to address the scale of effects reasonably expected to occur. For small projects, such as individual boat docks, higher mapping resolution is appropriate in order to detect actual effects to eelgrass at a scale meaningful to the project size. At larger scales, the mapping resolution may be less refined over a larger area, assuming that minor errors in mapping will balance out over the larger scale. Survey reports should provide a detailed description of the survey coverage (*e.g.*, number, location, and type of samples) and any interpolation methods used in the mapping.

While many parameters may be useful to describe eelgrass habitat condition (*e.g.*, plant biomass, leaf length, shoot:root ratios, epiphytic loading), many are labor intensive and may be impractical for resource management applications on a day-to-day basis. For this reason, four parameters have been identified for use in eelgrass habitat surveys and assessment of effects of an action on eelgrass. These parameters that should be articulated in eelgrass surveys are: 1) spatial distribution, 2) areal extent, 3) percentage of vegetated cover, and 4) the turion (shoot) density.

a) Spatial Distribution

The spatial distribution of eelgrass habitat should be delineated by a contiguous boundary around all areas of vegetated eelgrass cover extending outward a distance of 5 m, excluding gaps within the vegetated cover that have individual plants greater than 10 m from neighboring plants. Where such separations occur, either a separate area should be defined, or a gap in the area should be defined by extending a line around the void along a boundary defined by adjacent plants and including the 5 meter perimeter. The boundary of the eelgrass habitat should not extend into areas where depth, substrate, or existing structures are unsuited to supporting eelgrass habitat.

b) Aerial Extent

The eelgrass habitat aerial extent is the quantitative area (*e.g.*, square meters) of the spatial distribution boundary polygon of the eelgrass habitat. The total aerial extent should be broken down into extent of vegetated cover and extent of unvegetated habitat. Areal extent should be determined using commercially available geo-spatial analysis software. For small projects, coordinate data for polygon vertices could be entered into a spreadsheet format, and area could be calculated using simple geometry.

c) Percent Vegetated Cover

Eelgrass vegetated cover exists when one or more leaf shoots (turions) per square meter is present. The percent bottom cover within eelgrass habitat should be determined by totaling the area of vegetated eelgrass cover and dividing this by the total eelgrass habitat area. Where substantial differences in bottom cover occur across portions of the eelgrass habitat, the habitat could be subdivided into cover classes (*e.g.*, 20% cover, 50% cover, 75% cover).

d) Turion (Shoot) Density

Turion density is the mean number of eelgrass leaf shoots per square meter within mapped eelgrass vegetated cover. Turion density should be reported as a mean ± the standard deviation of replicate measurements. The number of replicate measurements (n) should be reported along with the mean and deviation. Turion densities are determined only within vegetated areas of eelgrass habitat and therefore, it is not possible to measure a turion density equal to zero. If different cover classes are used, a turion density should be determined for each cover class.

2. Eelgrass Mapping

For all actions that may directly or indirectly affect eelgrass habitat, an eelgrass habitat distribution map should be prepared on an accurate bathymetric chart with contour intervals of not greater than 1 foot (local vertical datum of MLLW). Exceptions to the detailed bathymetry could be made for small projects or for projects where detailed bathymetry may be infeasible. Unless region-specific mapping format and protocols are developed by NMFS (in which case such region-specific mapping guidance should be used), the mapping should utilize the following format and protocols:

a) Bounding Coordinates

Horizontal datum - Universal Transverse Mercator (UTM), NAD 83 meters, Zone 11 (for southern California) or Zone 10 (for central, San Francisco Bay, and northern California) is the preferred projection and datum. Another projection or datum may be used; however, the map and spatial data should include metadata that accurately defines the projection and datum.

Vertical datum - Mean Lower Low Water (MLLW), depth in feet.

b) Units

Transects, grids, or scale bars should be expressed in meters. Area measurements should be in square meters.

c) File Format

A spatial data layer compatible with readily available commercial geographic information system software producing file formats compatible with ESRI® ArcGIS software should be sent to NMFS when the area mapped supports at least 10 square meters of eelgrass. For those areas supporting less than 10 square meters of eelgrass, a table may alternatively be provided giving the vertices bounding x, y coordinates of the eelgrass areas in a spreadsheet or an ASCII file format. In addition to a spatial layer and/or table, a hard-copy map should be included with the survey report. The projection and datum should be clearly defined in the metadata and/or an associated text file.

Eelgrass maps should, at a minimum, include the following:

- A graphic scale bar, north arrow, legend, horizontal datum and vertical datum;
- A boundary illustrating the limits of the area surveyed;
- Bathymetric contours for the survey area, including both the action area(s) and reference site(s) in increments of not more than 1 foot;
- An overlay of proposed action improvements and construction limits;
- The boundary of the defined eelgrass habitat including an identification of area exclusions based on physical unsuitability to support eelgrass habitat; and

- The existing eelgrass cover within the defined eelgrass habitat at the time of the survey.

3. Survey Period

All mapping efforts should be completed during the active growth period for eelgrass (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California) and should be considered valid for a period of 60 days to ensure significant changes in eelgrass distribution and density do not occur between survey date and the project start date. The 60 day period is particularly important for eelgrass habitat survey conducted at the very beginning of the growing season, if eelgrass habitat expansion occurs as the growing season progresses. A period other than 60 days could be warranted and should be evaluated on a case-by-case basis, particularly for surveys completed in the middle of the growing season. However, when the end of the 60-day validity period falls outside of the region-specific active growth period, the survey could be considered valid until the beginning of the next active growth period. For example, a survey completed in southern California in the August-October time frame would be valid until the resumption of the active growth phase (i.e., in most instances, March 1). In some cases, NMFS and the action agency may agree to surveys being completed outside of the active growth period. For surveys completed during or after unusual climatic events (*e.g.*, high fluvial discharge periods, El Niño conditions), NMFS staff should be contacted to determine if any modifications to the common survey period are warranted.

4. Reference Site Selection

Eelgrass habitat spatial extent, aerial extent, percent cover and turion density are expected to naturally fluctuate through time in response to natural environmental variables. As a result, it is necessary to correct for natural variability when conducting surveys for the purpose of evaluating action effects on eelgrass or performance of mitigation areas. This is generally accomplished through the use of a reference site(s), which is expected to respond similarly to the action area in response to natural environmental variability. It is beneficial to select and monitor multiple reference sites rather than a single site and to utilize the average reference site condition as a metric for environmental fluctuations. This is especially true when a mitigation site is located within an area of known environmental gradients, and reference sites may be selected on both sides of the mitigation site along the gradient. Environmental conditions (*e.g.*, sediment, currents, proximity to action area, shoot density, light availability, depth, onshore and watershed influences) at the reference site(s) should be representative of the environmental conditions at the impact area (Fonseca *et al*. 1998). Where practical, the reference site(s) should be at least the size of the anticipated impact and/or mitigation area to limit the potential for minor changes in a reference site (*e.g.*, propeller scarring or ray foraging damage) overly affecting mitigation needs. The logic for site(s) selection should be documented in the eelgrass mitigation planning documents.

C. Avoiding and Minimizing Impacts to Eelgrass

This section describes measures to avoid and minimize impacts to eelgrass caused by turbidity, shading, nutrient loading, sedimentation and alteration of circulation patterns. Not all measures are equally suited to a particular project or condition. Measures to avoid or minimize impacts should be focused on stressors where the source and control are within the purview of the permittee and action agency. Action agencies in coordination with NMFS should evaluate and establish impact avoidance and minimization measures on a case-by-case basis depending on the action and site-specific information, including prevailing current patterns, sediment source, characteristics, and quantity, as well as the nature and duration of work.

1. Turbidity

To avoid and minimize potential turbidity-related impacts to eelgrass:
- Where practical, actions should be located as far as possible from existing eelgrass; and
- In-water work should occur as quickly as possible such that the duration of impacts is minimized.

Where proposed turbidity generating activities must occur in proximity to eelgrass and increased turbidity will occur at a magnitude and duration that may affect eelgrass habitat, measures to control turbidity levels should be employed when practical considering physical and biological constraints and impacts. Measures may include:
- Use of turbidity curtains where appropriate and feasible;
- Use of low impact equipment and methods (*e.g.*, environmental buckets, or a hydraulic suction dredge instead of clamshell or hopper dredge, provided the discharge may be located away from the eelgrass habitat and appropriate turbidity controls can be provided at the discharge point);
- Limiting activities by tide or day-night windows to limit light degradation within eelgrass habitat;
- Utilizing 24-hour dredging to reduce the overall duration of work and to take advantage of dredging during dark periods when photosynthesis is not occurring; or
- Other measures that an action party may propose and be able to employ to minimize potential for adverse turbidity effects to eelgrass.

NMFS developed a flowchart for a stepwise decision making process as guidance for action agencies to determine when to implement best management practices (BMPs) for minimizing turbidity from dredging actions as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the NMFS West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that generates increased turbidity.

2. Shading

A number of potential design modifications may be used to minimize effects of shading on eelgrass. Boat docks, ramps, gangways, and similar structures should avoid eelgrass habitat to the maximum extent feasible. If avoidance of eelgrass or habitat is infeasible, impacts should be minimized by utilizing, to the maximum extent feasible, design modifications and construction materials that allow for greater light penetration. Action modifications should include, but are not limited to:

- Avoid siting over-water or landside structures in areas where shading of eelgrass habitat would occur;
- Maximizing the north-south orientation of the structure;
- Maximizing the height of the structure above the water;
- Minimizing the width and supporting structure mass to decrease shade effects;
- Relocating the structure in deeper water and limiting the placement of structures in shallow areas where eelgrass occurs to the extent feasible; and
- Utilizing light transmitting materials in structure design.

Construction materials used to increase light passage beneath the structures may include, but are not limited to, open grating or adequate spacing between deck boards to allow for effective illumination to support eelgrass habitat. The use of these shade reducing options may be appropriate where they do not conflict with safety, ADA compliance, or structure utility objectives.

NMFS developed a stepwise key as guidance for action agencies to determine which combination of modifications are best suited for minimizing shading effects from overwater structures on eelgrass as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that results in shading.

3. Circulation patterns

Where appropriate to the scale and nature of potential eelgrass impacts, action parties should evaluate if and how the action may alter the hydrodynamics of the action area such that eelgrass habitat within or in proximity to the action area may be adversely affected. To maintain good water flow and low residence time of water within eelgrass habitat, action agencies should ensure actions:

- Minimize scouring velocities near or within eelgrass beds;
- Maintain wind and tidal circulation to the extent practical by considering orientation of piers and docks to maintain predominant wind effects;
- Incorporate setbacks on the order of 15 to 50 meters from eelgrass habitat where practical to allow for greater circulation and reduced impact from boat maneuvering, grounding, and propeller damage, and to address shading impacts; and
- Minimize the number of piles and maximize pile spacing to the extent practical, where piles are needed to support structures.

For large-scale actions in the proximity of eelgrass habitats, NMFS may request specific modeling and/or field hydrodynamic assessments of the potential effects of work on characteristics of circulation within eelgrass habitat.

4. Nutrient loading

Where appropriate to the scale and nature of potential eelgrass impacts, the following measures should be considered for implementation to reduce the potential for excessive nutrient loading to eelgrass habitat:

- diverting site runoff from landscaped areas away from discharges around eelgrass habitat;
- implementation of fertilizer reduction program;
- reduction of watershed nutrient loading;
- controlling local sources of nutrients such as animal wastes and leach fields; and
- maintaining good circulation and flushing conditions within the water body.

Reducing nutrient loading may also provide opportunities for establishing eelgrass as mitigation for project impacts.

5. Sediment loading

Watershed development and changes in land use may increase soil erosion and increase sedimentation to downstream embayments and lagoons.

- To the extent practicable, maintain riparian vegetation buffers along all streams in the watershed.
- Incorporate watershed analysis into agricultural, ranching, and residential/commercial development projects.
- Increase resistance to soil erosion and runoff. Sediment basins, contour farming, and grazing management are examples of key practices.
- Implement best management practices for sediment control during construction and maintenance operations (*e.g.,* Caltrans 2003).

Reducing sediment loading may also provide opportunities for establishing eelgrass as mitigation for project impacts in systems for which sedimentation is a demonstrable limiting factor to eelgrass.

D. Assessing Impacts to Eelgrass Habitat

If appropriate to the statute under which the consultation occurs, NMFS should consider both direct and indirect effects of the project in order to assess whether a project may impact eelgrass. NMFS is aware that many of the statutes and regulations it administers may have more specific meanings for certain terms, including "direct effect" and "indirect effect", and will use the statutory or regulatory meaning of those terms when conducting consultations under those statutes.[2] Nevertheless, it is useful for NMFS to consider effects experienced

[2] In the EFH context, adverse effects include any impact that reduces quality and/or quantity of EFH, including direct or indirect physical, chemical, or biological alterations of the waters or substrate (50 CFR 600.910). The Council of Environmental Quality (CEQ) regulations regarding NEPA implementation (40 CFR 1508.8(a)) define direct and indirect impacts of an action for the purposes of NEPA. Other NMFS statutes provide their own definitions regarding effects.

contemporaneously with project actions (both at the project site and away from the project site) and which might occur later in time.

Generally, effects to eelgrass habitat should be assessed using pre- and post-project surveys of the impact area and appropriate reference site(s) conducted during the time period of maximum eelgrass growth (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California). NMFS should consider the likelihood that the effects would occur before recommending pre- and post-project eelgrass surveys. The pre-construction survey of the eelgrass habitat in the action area and an appropriate reference site(s) should be completed within 60 days before start of construction. After construction, a post-action survey of the eelgrass habitat in the action area and at an appropriate reference site(s) should be completed within 30 days of completion of construction, or within the first 30 days of the next active growth period following completion of construction that occurs outside of the active growth period. Copies of all surveys should be provided to the lead federal agency, NMFS, and other interested regulatory and/or resource agencies within 30 days of completing the survey. The recommended timing of surveys is intended to minimize changes in eelgrass habitat distribution and abundance during the period between survey completion and construction initiation and completion. For example, a post-action survey completed beyond 30 days following construction or outside of the active growing season may show declines in eelgrass habitat as a result of natural senescence rather than the action.

The lead federal agency and NMFS should consider reference area eelgrass performance, physical evidence of impact, turbidity and construction activities monitoring data, as well as other documentation in the determination of the impacts of the action undertaken. Impact analyses should document whether the impacts are anticipated to be complete at the time of the assessment, or whether there is an anticipation of continuing eelgrass impacts due to chronic or intermittent effects. Where eelgrass at the impact site declines coincident with and similarly to decline at the reference site(s), the percentage of decline at the reference site should be deducted from the decline at the impact site. However, if eelgrass expands within the reference site(s), the impact site should only be evaluated against the pre-construction condition of the reference site and not the expanded condition. If an action results in increased eelgrass habitat relative to the reference sites, this increase could potentially be considered (subject to the caveats identified herein) by NMFS and the action agency as potential compensation for impacts to eelgrass habitat that occur in the future (see Section II. E. 3). An assessment should also be made as to whether impacts or portions of the impact are anticipated to be temporary. Information supporting this determination may be derived from the permittee, NMFS, and other resource and regulatory agencies, as well as other eelgrass experts.

For some projects, environmental planning and permitting may take longer than 60 days. To accommodate longer planning schedules, it may also be necessary to do a preliminary eelgrass survey prior to the pre-construction survey. This preliminary survey can be used to anticipate potential impacts to eelgrass for the purposes of mitigation planning during the permitting process. In some cases, preliminary surveys may focus on spatial distribution of eelgrass habitat only or may be a qualitative reconnaissance to allow permittees to incorporate avoidance and minimization measures into their proposed action or to plan for future mitigation needs. The pre-and post- project surveys should then verify whether impacts occur as anticipated, and if planned mitigation is adequate. In some cases, a preliminary survey could be completed a year or more in advance of the project action.

1. Direct Effects

Biologists should consider the potential for localized losses of eelgrass from dredging or filling, construction-associated damage, and similar spatially and temporally proximate impacts (these effects could be termed "direct"). The actual area of the impact should be determined from an analysis that compares the pre-action condition of eelgrass habitat with the post-action conditions from this survey, relative to eelgrass habitat change at the reference site(s).

2. Indirect Effects

Biologists should also consider effects caused by the action which occur away from the project site; furthermore, effects occurring later in time (whether at or away from the project site) should also be considered. Biologists should consider the potential for project actions to alter conditions of the physical environment in a manner that, in turn, reduce eelgrass habitat distribution or density (*e.g.*, elevated turbidity from the initial implementation or later operations of an action, increased shading, changes to circulation patterns, changes to vessel traffic that lead to greater groundings or wake damage, increased rates of erosion or deposition).

For actions where the impact cannot be fully determined until a substantial period after an action is taken, an estimate of likely impacts should be made prior to implementation of the proposed action based on the best available information (*e.g.*, shading analyses, wave and current modeling). A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be performed. The action party should complete the first post-construction eelgrass survey within 30 days following completion of construction to evaluate any immediate effects to eelgrass habitat. The second post-construction survey should be performed approximately one year after the first post-construction survey during the appropriate growing season. The third post-construction survey should be performed approximately two years after the first post-construction survey during the appropriate growing season. The second and third post-construction surveys will be used to evaluate if indirect effects resulted later in time due to altered physical conditions; the time frames identified above are aligned with growing season (attempting a survey outside of the growing season would show inaccurate results).

A final determination regarding the actual impact and amount of mitigation needed, if any, to offset impacts should be made based upon the results of two annual post-construction surveys, which document the changes in the eelgrass habitat (areal extent, bottom coverage, and shoot density within eelgrass) in the vicinity of the action, compared to eelgrass habitat change at the reference site(s). Any impacts determined by these monitoring surveys should be mitigated. In the event that monitoring demonstrates the action to have resulted in greater eelgrass habitat impacts than initially estimated, additional mitigation should be implemented in a manner consistent with these guidelines. In some cases, adaptive management may allow for increased success in eelgrass mitigation without the need for additional mitigation.

E. Mitigation Options

The term mitigation is defined differently by various federal and State laws, regulations and policies. In a broad sense, mitigation may include a range of measures from complete avoidance of adverse effects to compensation for adverse effects by preserving, restoring or creating similar resources at onsite or offsite locations. The Corps and EPA issued regulations governing compensatory mitigation to offset unavoidable adverse effects to waters of the United States authorized by Clean Water Act section 404 permits and other permits issued by the Corps (73 FR 19594; April 10, 2008). For those regulations (33 CFR 332.2 and 40 CFR 230.92, respectively), the Corps and EPA, define "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved."

When impacts to eelgrass would occur, the action agency should develop a mitigation plan to achieve no net loss in eelgrass function following the recommended steps in this policy. If NMFS determines a mitigation plan is needed, and it was not included with the EFH Assessment for the proposed action, NMFS may recommend, either as comments on the EFH Assessment or as an EFH Conservation Recommendation, that one be provided. Potential mitigation options are described below. The action agency should consider site specific conditions when determining the most appropriate mitigation option for an action.

1. Comprehensive management plans

NMFS supports the development of comprehensive management plans (CMPs) that protect eelgrass resources within the context of broader ecosystem needs and management objectives. Recommendations different from specific elements described below for in-kind mitigation may be appropriate where a CMP (*e.g.,* an enforceable programmatic permit, Special Area Management Plan, harbor plan, or ecosystem-based management plan) exists that is considered to provide adequate population-level and local resource distribution protections to eelgrass. One such CMP under development at the time these guidelines were developed is *City of Newport Beach Eelgrass Protection Mitigation Plan for Shallow Water in Lower Newport Bay: An Ecosystem Based Management Plan.* If satisfactorily completed and adopted, it is anticipated the protection measures for eelgrass within this area would be adequate to meet the objectives of this policy.

In general, it is anticipated that CMPs may be most appropriate in situations where a project or collection of similar projects will result in incremental but recurrent impacts to a small portion of local eelgrass populations through time (*e.g.*, lagoon mouth maintenance dredging, maintenance dredging of channels and slips within established marinas, navigational hazard removal of recurrent shoals, shellfish farming, and restoration or enhancement actions). In order to ensure that these alternatives provide adequate population-level and local resource distribution protections to eelgrass and that the plan is consistent with the overall conservation objectives of this policy, NMFS should be involved early in the plan's development.

2. In-kind mitigation

In-kind compensatory mitigation is the creation, restoration, or enhancement of habitat to mitigate for adverse impacts to the same type of habitat. In most cases in-kind mitigation is the preferred option to compensate for impacts to eelgrass. Generally, in-kind mitigation should achieve a final mitigation ratio of 1.2:1 across all areas of the state, independent of starting mitigation ratios. A starting mitigation ratio is the ratio of mitigation area to impact area when mitigation is initiated. The final mitigation ratio is the ratio of mitigation area to impact area once mitigation is complete. The 1.2:1 ratio assumes: (1) there is no eelgrass function at the mitigation site prior to mitigation efforts, (2) eelgrass function at the mitigation site is achieved within three years, (3) mitigation efforts are successful, and (4) there are no landscape differences (*e.g.*, degree of urban influence, proximity to freshwater source), between the impact site and the mitigation site. Variations from these assumptions may warrant higher or lower mitigation ratios. For example, a higher ratio would be appropriate for an enhancement project where the mitigation site has some level of eelgrass function prior to the mitigation action.

Typically, in-kind eelgrass mitigation involves transplanting or seeding of eelgrass into unvegetated habitat. Successful in-kind mitigation may also warrant modification of physical conditions at the mitigation site to prepare for transplants (*e.g.*, alter sediment composition, depth, etc.). In some areas, other in-kind mitigation options such as removing artificial structures that preclude eelgrass growth may be feasible. If in-kind mitigation that does not include transplants or seeding is proposed, post-mitigation monitoring as described below should be implemented to verify that mitigation is successful.

Information provided below in Section II.F includes specific recommendations for in-kind mitigation, including site selection, reference sites, starting mitigation ratios, mitigation methods, mitigation monitoring and performance criteria. Many of the recommendations provided in these guidelines for eelgrass assessments, surveys, and mitigation may apply throughout the state even if a non-transplant mitigation option is proposed.

3. Mitigation banks and in-lieu-fee programs

In 2006 and 2011, the NMFS Southwest Region (merged with the Northwest Region in 2013 to form the West Coast Region) signed interagency Memorandum of Understandings that established and refined a framework for developing and using combined or coordinated approaches to mitigation and conservation banking and in-lieu-fee programs in California. Other signatory agencies include: the California Resources Agency, California Department of Fish and Wildlife, the Corps, the US Fish &Wildlife Service, the EPA, the Natural Resource Conservation Service, and the State Water Resources Control Board.

Under this eelgrass policy, NMFS supports the use of mitigation bank and in-lieu fee programs to compensate for impacts to eelgrass habitat, where such instruments are available and where such programs are appropriate to the statutory structure under which mitigation is recommended. Mitigation banks and in-lieu fee conservation programs are highly encouraged by NMFS in heavily urbanized waters. Credits should be used at a ratio of 1:1 if those credits have been established for a full three-year period prior to use. If the bank credits have been in place for a period less than three years, credits should be used at a ratio determined through application of the wetland mitigation calculator (King and Price 2004).

At the request of the action party, and only with approval of NMFS and other appropriate resource agencies and subject to the caveats below, surplus eelgrass area that, after 60-months, exceeds the mitigation needs, as defined in section II.F.6 Mitigation Monitoring and Performance Milestones, has the potential to be considered for future mitigation needs. Additionally, only with the approval of NMFS and other appropriate resource agencies and subject to the caveats below, eelgrass habitat expansion resulting from project activities, and that otherwise would not have occurred, has the potential to be considered for future mitigation needs. Exceeding mitigation needs does not guarantee or entitle the action party or action agency to credit such mitigation to future projects, since every future project must be considered on a case-by-case basis (including the location and type of impact) and viewed in light of the relevant statutory authorities.

4. Out-of-kind mitigation

Out-of-kind compensatory mitigation means the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type. In most cases, out-of-kind mitigation is discouraged, because eelgrass is a rare, special-status habitat in California. There may be some scenarios, however, where out-of-kind mitigation for eelgrass impacts is ecologically desirable or when in-kind mitigation is not feasible. This determination should be made based on an established ecosystem plan that considers ecosystem function and services relevant to the geographic area and specific habitat being impacted. Any proposal for out-of-kind mitigation should demonstrate that the proposed mitigation will compensate for the loss of eelgrass habitat function within the ecosystem. Out-of-kind mitigation that generates services similar to eelgrass habitat or improves conditions for establishment of eelgrass should be considered first. NMFS and the federal action agency should be consulted early when out-of-kind mitigation is being proposed in order to determine if out-of-kind mitigation is appropriate, in coordination with other relevant resource agencies (e.g., California Department of Fish and Wildlife, California Coastal Commission, U.S. Fish and Wildlife Service)

F. In-kind Mitigation for Impacts to Eelgrass

As all mitigation project specifics will be determined on a case-by-case basis, circumstances may exist where NMFS staff will need to modify or deviate from the recommended measures described below before providing their recommendation to action agencies.

1. Mitigation Site Selection

Eelgrass habitat mitigation sites should be similar to the impact site. Site selection should consider distance from action, depth, sediment type, distance from ocean connection, water quality, and currents. Where eelgrass that is impacted occurs in marginally suitable environments, it may be necessary to conduct mitigation in a preferable location and/or modify the site to be better suited to support eelgrass habitat creation. Mitigation site modification should be fully coordinated with NMFS staff and other appropriate resource and regulatory agencies. To the extent feasible, mitigation should occur within the same hydrologic system (*e.g.*, bay, estuary, lagoon) as the impacts and should be appropriately distributed within the same ecological subdivision of larger systems (*e.g.*, San Pablo Bay or Richardson Bay in San Francisco Bay), unless NMFS and the action agency concur that good justification exists for altering the distribution based on valued ecosystem functions and services.

In identifying potentially suitable mitigation sites, it is advisable to consider the current habitat functions of the mitigation site prior to mitigation use. In general, conversion of unvegetated subtidal areas or disturbed uplands to eelgrass habitats may be considered appropriate means to mitigate eelgrass losses, while conversion of other special aquatic sites (*e.g.*, salt marsh, intertidal mudflats, and reefs) is unlikely to be considered suitable. It may be necessary to develop suitable environmental conditions at a site prior to being able to effectively transplant eelgrass into a mitigation area. Mitigation sites may need physical modification, including increasing or lowering elevation, changing substrate, removing shading or debris, adding wave protection or removing impediments to circulation.

2. Mitigation Area Needs

In-kind mitigation plans should address the components described below to ensure mitigation actions achieve no net loss of eelgrass habitat function. Alternative contingent mitigation should be specified and included in the mitigation plan to address situations where performance milestones are not met.

a) Impacts to Areal Extent of Eelgrass Habitat

Generally, mitigation of eelgrass habitat should be based on replacing eelgrass habitat extent at a 1.2 (mitigation) to 1 (impact) mitigation ratio for eelgrass throughout all regions of California. However, given variable degrees of success across regions and potential for delays and mitigation failure, NMFS calculated *starting* mitigation ratios using "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004) developed for NMFS Office of Habitat Conservation. The calculator utilizes methodology similar to Habitat Equivalency Analysis (HEA), which is an accepted method to determine the amount of compensatory restoration needed to provide natural resource services that are equivalent to loss of natural resource services following an injury (http://www.darrp.noaa.gov/economics/pdf/heaoverv.pdf). HEA is commonly used by NOAA during damage assessment cases, including those involving seagrass. Similar to HEA, the mitigation calculator is based on the "net present value" approach to asset valuation, an economics concept used to compare values of all types of investments, and then modified to incorporate natural resource services. Using the calculator allows for consistency in methodology for all areas within California, avoids arbitrary identification of size of the mitigation area, and avoids cumulative loss to eelgrass habitat that would likely occur with a standard 1:1 ratio (because of the complexity of eelgrass mitigation and the time for created eelgrass to achieve full habitat function).

The calculator includes a number of metrics to determine appropriate ratios that focus on comparisons of quality and quantity of function of the mitigation relative to the site of impact to ensure full compensation of lost function. (see Attachment 4). Among other metrics, the calculator employs a metric of likelihood of failure within the mitigation site based on regional mitigation failure history. As such, the mitigation calculator identifies a recommended starting mitigation ratio (the mitigation area to eelgrass impact area) based on regional history of success in eelgrass mitigation. Increased initial mitigation site size should be considered to provide greater assurance that the performance milestones, as specified in Section II.F.6, will be met. This is a common practice in the eelgrass mitigation field to reduce risk of falling short of mitigation needs (Thom 1990). Independent of starting mitigation ratio utilized for a given mitigation action, mitigation success should generally be evaluated against a ratio of 1.2:1.

The elevated starting mitigation ratio should be applied to the area of impact to vegetated eelgrass cover only. For unvegetated eelgrass habitat, a starting mitigation ratio of 1.2:1 is appropriate.

To determine the recommended starting mitigation ratio for each region, the percentage of transplant successes and failures was examined over the history of transplanting in the region. NMFS staff examined transplants projects over the past 25 years in all mitigation regions (see Attachment 6). Eelgrass mitigation in Southern California has a 35-year history with 66 transplants performed over that period. In the past 25 years, a total of 47 eelgrass transplants for mitigation purposes have been conducted in Southern California. Forty-three of these were established long enough to evaluate success for these transplants. The overall failure rate, with failure defined as not meeting success criteria established for the project, was 13 percent. Eelgrass mitigation within central California has a better history of successful completion than within southern California, San Francisco Bay, and northern California. However, the number of eelgrass mitigation actions conducted in this region is low and limited to areas within Morro Bay. While the success of eelgrass mitigation in central California has been high, the low number of attempts makes mitigation in this region uncertain. Eelgrass habitat creation/restoration in San Francisco Bay and in northern California has had varied success.

In all cases, best information available at the time of this policy's development was used to determine the parameter values entered into the calculator formula. As regional eelgrass mitigation success changes and the results of ongoing projects become available, the starting mitigation ratio may be updated. Updates in mitigation calculator inputs should not be made on an individual action basis, because the success or lack of success of an individual mitigation project may not reflect overall mitigation success for the region. Rather NMFS should re-evaluate the regional transplant history approximately every 5 years, increasing the record of transplant success in 5 year increments for new projects implemented after NMFS' adoption of these guidelines. If the 5-year review shows that new efforts are more successful than those from the beginning of the 25-year period, NMFS staff should consider removing early projects (*e.g.*, those completed 20 years prior) from the analysis.

On a case-by-case basis and in consultation with action agencies, NMFS may consider proposals with different starting mitigation ratios where sufficient justification is provided that indicates the mitigation site would achieve the no net loss goal. In addition, CMPs could consider different starting mitigation ratios, or other mitigation elements and techniques, as appropriate to the geographic area addressed by the CMP.

Regardless of starting mitigation ratio, eelgrass mitigation should be considered successful, if it meets eelgrass habitat coverage over an area that is 1.2 times the impact area with comparable eelgrass density as impacted habitat. Please note, delayed implementation, supplemental transplant needs, or NMFS and action agency agreement may result in an altered mitigation area. In the EFH consultation context, NMFS may recommend an altered mitigation area during implementation of the federal agency's mitigation plan following EFH consultation or NEPA review, or as an EFH Conservation Recommendation if the federal agency re-initiates EFH consultation.

(1) Southern California (Mexico border to Pt. Conception)

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.38 to 1 (transplant area to vegetated cover impact area) should be recommended to counter the regional failure risk. That is, for each square meter of vegetated eelgrass cover adversely impacted, 1.38 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(2) Central California (Point Conception to mouth of San Francisco Bay).

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.20 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 0 percent failure rate over the past 25 years (4 transplant actions). It should however be noted that all of these successful transplants included a greater area of planting than was necessary to achieve success such that the full mitigation area would be achieved, even with areas of minor transplant failure.

(3) San Francisco Bay (including south, central, San Pablo and Suisun Bays).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass bed resource, a ratio of 3.01 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 60 percent failure rate over the past 25 years (10 transplant actions). That is, for each square meter adversely impacted, 3.01 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(4) Northern California (mouth of San Francisco Bay to Oregon border).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass habitat, a starting ratio of 4.82 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 75 percent failure rate over the past 25 years (4 transplant actions). That is, for each square meter of eelgrass habitat adversely impacted, 4.82 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

b) *Impacts to Density of Eelgrass Beds*

Degradation of existing eelgrass habitat that results in a permanent reduction of eelgrass turion density greater than 25 percent, and that is a statistically significant difference from pre-impact density, should be mitigated based on an equivalent area basis. The 25 percent and statistically significant threshold is believed reasonable based on supporting information (Fonseca *et al.* 1998, WDFW 2008), and professional practice under SCEMP. In these cases, eelgrass remains present at the action site, but density may be potentially affected by long-term chronic or intermittent effects of the action. Reduction of density should be determined to have occurred when the mean turion density of the impact site is found to be statistically different (α=0.10 and β=0.10) from the density of a reference and at least 25 percent below the reference mean during two annual sampling events following implementation of an action. The number of samples taken to describe density at each site (*e.g.*, impact and reference) should be sufficient to provide for appropriate statistical power. For small impact areas that do not allow for a sample size that provides statistical power, alternative methods for pre- and post- density comparisons could be considered. Mitigation for reduction of turion density without change in eelgrass habitat area should be on a one-for-one basis either by augmenting eelgrass density at the impact site or by establishing new eelgrass habitat comparable to the change in density at the impact site. For example, a 25 percent reduction in density of 100-square meters (100 turions/square meter) of eelgrass habitat to 75 turions/square meter should be mitigated by the establishing 25 square meters of new eelgrass habitat with a density at or above the 100 turions/square meter pre-impact density.

3. Mitigation Technique

In-kind mitigation technique should be determined on a case-by-case basis. Techniques for eelgrass mitigation should be consistent with the best available technology at the time of mitigation implementation and should be tailored to the specific needs of the mitigation site. Eelgrass transplants have been highly successful in southern and central California, but have had mixed results in San Francisco Bay and northern California. Bare-root bundles and seed buoys have been utilized with some mixed success in northern portions of the state. Transplants using frames have also been used with some limited success. For transplants in southern California, plantings consisting of bare-root bundles consisting of 8-12 individual turions each have proven to be most successful (Merkel 1988).

Donor material should be taken from the area of direct impact whenever practical, unless the action resulted in reduced density of eelgrass at the area of impact. Site selections should consider the similarity of physical environments between the donor site and the transplant receiver site and should also consider the size, stability, and history of the donor site (*e.g.*, how long has it persisted and is it a transplant site). Plants harvested should be taken in a manner to thin an existing bed without leaving any noticeable bare areas. For all geographic areas, no more than 10 percent of an existing donor bed should be harvested for transplanting purposes. Ten percent is reasonable based on recommendations in Thom *et al.* (2008) and professional practice under SCEMP. Harvesting of flowering shoots for seed buoy techniques should occur only from widely separated plants.

It is important for action agencies to note that state laws and regulations affect the harvesting and transplantation of donor plants and permission from the state, where required, should be obtained; for example, California Department of Fish and Wildlife may need to provide written authorization for harvesting and transplanting donor plants and/or flowering shoots.

4. Mitigation Plan

NMFS should recommend that a mitigation plan be developed for in-kind mitigation efforts. During consultation, NMFS biologists should request that mitigation plans be provided at least 60 days prior to initiation of project activities to allow for NMFS review. When feasible, mitigation plans should be developed based on preliminary or pre-project eelgrass surveys. When there is uncertainty regarding whether impacts to eelgrass will occur, and the need for mitigation is based on comparison of pre- and post-project eelgrass surveys, NMFS biologists should request that the mitigation plan be provided no more than 60 days following the post-project survey to allow for NMFS review and minimize any delay in mitigation implementation.

At a minimum, the mitigation plan should include:

- Description of the project area
- Results of preliminary eelgrass survey and pre/post-project eelgrass surveys if available (see Section II.B.1 and II.B.2)
- Description of projected and/or documented eelgrass impacts
- Description of proposed mitigation site and reference site(s) (see Section II.B.4)
- Description of proposed mitigation methods (see Section II.F.3)
- Construction schedule, including specific starting and ending dates for all work including mitigation activities. (see Section II.F.5)
- Schedule and description of proposed post-project monitoring and when results will be provided to NMFS
- Schedule and description of process for continued coordination with NMFS through mitigation implementation
- Description of alternative contingent mitigation or adaptive management should proposed mitigation fail to achieve performance measures (see Section II.F.6)

5. Mitigation Timing

Mitigation should commence within 135 days following the initiation of the in-water construction resulting in impact to the eelgrass habitat, such that mitigation commences within the same eelgrass growing season as impacts occur. If possible, mitigation should be initiated prior to or concurrent with impacts. For impacts initiated within 90 days prior to, or during, the low-growth period for the region, mitigation may be delayed to within 30 days after the start of the following growing season, or 90 days following impacts, whichever is longer, without the need for additional mitigation as described below. This timing avoids survey completion during the low growth season, when results may misrepresent progress towards performance milestones.

Delays in eelgrass mitigation result in delays in ultimate reestablishment of eelgrass habitat functions, increasing the duration and magnitude of project impacts to eelgrass. To offset loss of eelgrass habitat function that accumulates through delay, an increase in successful eelgrass mitigation is needed to achieve the same compensatory habitat function. Because habitat function is accumulated over time once the mitigation habitat is in place, the longer the delay in initiation of mitigation, the greater the additional habitat area needed (i.e., mitigation ratio increasingly greater than 1.2:1) to offset losses. Unless a specific delay is authorized or dictated by the initial schedule of work, federal action agencies should determine whether delays in mitigation initiation in excess of 135 days warrant an increased final mitigation ratio. If increased mitigation ratios are warranted, NMFS should recommend higher mitigation ratios (see Attachment 7). Where delayed implementation is authorized by the action agency, the increased mitigation ratio may be determined by utilizing the Wetlands Mitigation Calculator (King and Price 2004) with an appropriate value for parameter D (See Attachment 4). Examples of delay multipliers generated using the Wetlands Mitigation Calculator are provided in Attachment 5.

Conversely, implementing mitigation ahead of impacts can be used to reduce the mitigation needs by achieving replacement of eelgrass function and services ahead of eelgrass losses. If eelgrass is successfully transplanted three years ahead of impacts, the mitigation ratio would drop from 1.2:1 to 1:1. If mitigation is completed less than three years ahead of impacts, the mitigation calculator can be used to determine the appropriate intermediate mitigation ratio.

6. Mitigation Monitoring and Performance Milestones

In order to document progress and persistence of eelgrass habitat at the mitigation site through and beyond the initial establishment period, which generally is three years, monitoring should be completed for a period of five years at both the mitigation site and at an appropriate reference site(s) (Section II.B.4. Reference Site Selection). Monitoring at a reference site(s) may account for any natural changes or fluctuations in habitat area or density. Monitoring should determine the area of eelgrass and density of plants at 0, 12, 24, 36, 48, and 60 months after completing the mitigation. These intervals will provide yearly updates on the establishment and persistence of eelgrass during the growing season. These monitoring recommendations are consistent with findings of the National Research Council (NRC 2001), the Corps requirements for compensatory mitigation (33 CFR 332.6(b)), and other regional resource policies (Corps 2010, Evans and Leschen 2010, SFWMD 2007).

All monitoring work should be conducted during the active eelgrass growth period and should avoid the recognized low growth season for the region to the maximum extent practicable (typically November through February for southern California, November through March for central California, November through March for San Francisco Bay, and October through April for northern California). Sufficient flexibility in the scheduling of the 6 month surveys should be allowed in order to ensure the work is completed during this active growth period. Additional monitoring beyond the 60-month period may be warranted in those instances where the stability of the proposed mitigation site is questionable, where the performance of the habitat relative to reference sites is erratic, or where other factors may influence the long-term success of mitigation. Mitigation plans should include a monitoring schedule that indicates when each of the monitoring events will be completed.

The monitoring and performance milestones described below are included as eelgrass transplant success criteria in the SCEMP. These numbers represent milestones and associated timelines typical of successful eelgrass habitat development based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing mitigation monitoring results for projects implemented under SCEMP. Restored eelgrass habitat is expected to develop through an initial 3 year monitoring period such that, within 36 months following planting, it meets or exceeds the full coverage and not less than 85 percent of the density relative to the initial condition of affected eelgrass habitat. Restored eelgrass habitat is expected to sustain this condition for at least 2 additional years.

Monitoring events should evaluate the following performance milestones:

Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.

Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.

Month 12–The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 24–The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 36–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 48–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 60–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Performance milestones may be re-evaluated or modified if declines at a mitigation site are also demonstrated at the reference site, and therefore, may be a result of natural environmental stressors that are unrelated to the intrinsic suitability of the mitigation site. In the EFH consultation context, NMFS should provide recommendations regarding modification of performance milestones as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation.

7. Mitigation Reporting

NMFS biologists should request monitoring reports and spatial data for each monitoring event in both hard copy and electronic version, to be provided within 30 days after the completion of each monitoring period to allow timely review and feedback from NMFS. These reports should clearly identify the action, the action party, mitigation consultants, relevant points of contact, and any relevant permits. The size of permitted eelgrass impact estimates, actual eelgrass impacts, and eelgrass mitigation needs should be identified, as should appropriate information describing the location of activities. The report should include a detailed description of eelgrass habitat survey methods, donor harvest methods and transplant methods used. The reports should also document mitigation performance milestone progress (see II.F.6. Mitigation Monitoring and Performance Milestones). The first report (for the 0-month post-planting monitoring) should document any variances from the mitigation plan, document the sources of donor materials, and document the full area of planting. The final mitigation monitoring report should provide the action agency and NMFS with an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met. An example summary is provided in Attachment 3.

8. Supplemental Mitigation

Where development of the eelgrass habitat at the mitigation site falls short of achieving performance milestones during any interim survey, the monitoring period should be extended and supplemental mitigation may be recommended to ensure that adequate mitigation is achieved. In the EFH consultation context, NMFS should provide recommendations regarding extended monitoring as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation. In some instances, an adaptive management corrective action to the existing mitigation area may be appropriate. In the event of a mitigation failure, the action agency should convene a meeting with the action party, NMFS, and applicable regulatory and/or resource agencies to review the specific circumstances and develop a solution to achieve no net loss in eelgrass habitat function.

As indicated previously, while in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis. In cases where it is demonstrated that in-kind replacement is infeasible, out-of-kind mitigation may be appropriate over completion of additional in-kind mitigation. The determination that an out-of-kind mitigation is appropriate will be made by NMFS, the action agency, and the applicable regulatory agencies, where a regulatory action is involved.

G. Special Circumstances

Depending on the circumstances of each individual project, NMFS may make recommendations different from those described above on a case by case basis. For the scenarios described below, for example, NMFS could recommend a mitigation ratio or 1:1 or for use of out-of-kind mitigation. Because NMFS needs a proper understanding of eelgrass habitat in the project area and potential impacts of the proposed project to evaluate the full effects of authorized activities, NMFS should not make recommendations that diverge from these guidelines if they would result in surveys, assessments or reports inferior to those which might be obtained through the guidance in Section II. The area thresholds described below are taken from the SCEMP and/or reflect recommendations NMFS staff have repeatedly made during individual EFH consultations. These thresholds minimize impacts to eelgrass habitat quality and quantity, based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing project monitoring results for projects implemented under SCEMP. The special circumstance included for shellfish aquaculture longlines is supported by Rumrill and Poulton (2004) and the NMFS Office of Aquaculture.

1. Localized Temporary Impacts

NMFS may consider modified target mitigation ratios for localized temporary impacts wherein the damage results in impacts of less than 100 square meters and eelgrass habitat is fully restored within the damage footprint within one year of the initial impact (e.g., placement of temporary recreational facilities, shading by construction equipment, or damage sustained through vessel groundings or environmental clean-up operations). In such cases, the 1.2:1 mitigation ratio should not apply, and a 1:1 ratio of impact to recovery would apply. A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be completed in order to demonstrate the temporary nature of the impacts. NMFS should recommend that surveys be completed as follows: 1) the first post-construction eelgrass survey should be completed within 30 days following completion of construction to evaluate direct effects of construction, 2) the second and third post-construction surveys should be performed approximately one year after the first post-construction survey, and approximately two years after the first post-construction survey, respectively, during the appropriate growing season to confirm no indirect, or longer term effects resulted from construction. A compelling reason should be demonstrated before any reduced monitoring and reporting recommendations are made.

2. Localized Permanent Impacts

a) If both NMFS and the authorizing action agencies concur, the compensatory mitigation elements of this policy may not be necessary for the placement of a single pipeline, cable, or other similar utility line across existing eelgrass habitat with an impact corridor of no more than 1 meter wide. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. The actual area of impact should be determined from the post-action survey. NMFS should recommend the completion of an additional survey (after 1 year) to ensure that the action or impacts attributable to the action have not exceeded the 1-meter corridor width. NMFS should recommend that, if the post-action or 1 year survey demonstrates a loss of eelgrass habitat greater than the 1-meter wide corridor, mitigation should be undertaken.

b)) If both NMFS and the authorizing action agencies concur that the spacing of shellfish aquaculture longlines does not result in a measurable net loss of eelgrass habitat in the project area, then mitigation associated with local losses under longlines may not be necessary. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. NMFS should recommend the completion of additional post-action monitoring surveys (to be completed approximately 1 year and 2 years following implementation of the action) to ensure that the action or impacts attributable to the action have not resulted in net adverse impacts to eelgrass habitat. NMFS should recommend that, if the 1-year or 2-year survey demonstrates measurable impact to eelgrass habitat, mitigation should be undertaken. c) NMFS should consider mitigation on a 1:1 basis for impacts less than 10 square meters to eelgrass patches where impacts are limited to small portions of well-established eelgrass habitat or eelgrass habitat that, despite highly variable conditions, generally retain extensive eelgrass, even during poor years. A reduced mitigation ratio should not be considered where impacts would occur to isolated or small eelgrass habitat areas within which the impacted area constitutes more than 1% of the eelgrass habitat in the local area during poor years.

c) If NMFS concurs and suitable out-of-kind mitigation is proposed, compensatory mitigation may not be necessary for actions impacting less than 10 square meters of eelgrass.

III. Glossary of Terms

Except where otherwise specified, the explanations of the following terms are provided for informational purposes only and are described solely for the purposes of this policy; where a NMFS statute, regulation, or agreement requires a different understanding of the relevant term, that understanding of the term will supplant these explanations provided below.

<u>Compensatory mitigation</u> – restoration, establishment, or enhancement of aquatic resources for the purposes of offsetting unavoidable authorized adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

<u>Ecosystem</u> – a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem.

<u>Ecosystem function</u> – ecological role or process provided by a given ecosystem.

<u>Ecosystem services</u> – contributions that a biological community and its habitat provide to the physical and mental well-being of the human population (*e.g.*, recreational and commercial opportunities, aesthetic benefits, flood regulation).

<u>Eelgrass habitat –</u> areas of vegetated eelgrass cover (any eelgrass within 1 square meter quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area

<u>Essential fish habitat (EFH) –</u> EFH is defined in the MSA as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

<u>EFH Assessment –</u> An assessment as further explained in 50 C.F.R. § 600.920(e).

<u>EFH Consultation</u> – The process explained in 50 C.F.R. § 600.920

EFH Conservation Recommendation – provided by the National Marine Fisheries Service (NMFS) to a federal or state agency pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act regarding measures that can be taken by that agency to conserve EFH. As further explained in 50 C.F.R. § 600.925, EFH Conservation Recommendations may be provided as part of an EFH consultation with a federal agency, or may be provided by NMFS to any federal or state agency whose actions would adversely affect EFH .

Habitat – environment in which an organism(s) lives, including everything that surrounds and affects its life, including biological, chemical and physical processes.

Habitat function – ecological role or process provided by a given habitat (*e.g.*, primary production, cover, food, shoreline protection, oxygenates water and sediments, etc.).

In lieu fee program – a program involving the restoration, establishment, and/or enhancement of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation needs; an in lieu fee program works like a mitigation bank, however, fees to compensate for impacts to habitat function are collected prior to establishing an on-the-ground conservation/restoration project.

In-kind mitigation – mitigation where the adverse impacts to a habitat are mitigated through the creation, restoration, or enhancement of the same type of habitat.

Mitigation – action or project undertaken to offset impacts to an existing natural resource.

Mitigation bank – a parcel of land containing natural resource functions/values that are conserved, restored, created and managed in perpetuity and used to offset unavoidable impacts to comparable resource functions/values occurring elsewhere. The resource functions/values contained within the bank are translated into quantified credits that may be sold by the banker to parties that need to compensate for the adverse effects of their activities.

Out-of-kind mitigation – mitigation where the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type

IV. Literature Cited

Bostrom, C. and E. Bonsdorff. 2000. Zoobenthic community establishment and habitat complexity–the importance of seagrass shoot density, orphology and physical disturbance for faunal recruitment. Marine Ecology Progress Series 205:123-138.

Bostrom, C., E. Bonsdorff, P. Kangas, and A. Norkko. 2002. Long-term changes of a Brackish-water eelgrass (Zostera marina L.) community indicate effects of coastal eutrophication. Estuarine, Coastal and Shelf Science 55: 795-804.

California Department of Transportation. 2003. Storm Water Quality Handbooks: Construction Site Best Management Practices (BMPs) Manual.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M, Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V.O., Paruelo, J., Raskin, R.G., Sutton, P., and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253-260.

Council on Environmental Quality (CEQ). Regulations 1508 – National Environmental Policy Act (40 CFR 1508).

Donoghue, C. 2011. Technical Memorandum: Operational Definition of an Eelgrass (*Zostera marina*) Bed. A Summary of a Workgroup Discussion and Related Analysis. Washington State Department of Natural Resources. October 2011.

Duarte, C. M. 2002. The future of seagrass meadows. Environmental Conservation 29(2):192-206.

Duarte, C.M., Dennison, W.C., Orth, R.J.W. and T.J.B. Carruthers. 2008. The charisma of coastal ecosystems: addressing the imbalance. Estuaries and Coasts: J CERF 31:233–238.

Evans, N.T. and Leschen, A. 2010. Technical guidelines for the delineation, restoration, and monitoring of eelgrass (*Zostera marina*) in Massachusetts coastal waters. Massachusetts Division of Marine Fisheries Technical Report TR-43. 8 p.

Evans, N. T., and F. T. Short. 2005. Functional trajectory models for assessment of transplanted eelgrass, Zostera marina L., in the Great Bay Estuary, New Hampshire. Estuaries 28(6):936-947.

Ferrell, D. J., and J.D. Bell. 1991. Differences among assemblages of fish associated with *Zostera capricorni* and bare sand over a large spatial scale. Marine Ecology Progress Series 72:15-24.

Fonseca, M.S., Kenworthy, W.J., Thayer, G.W. 1998. Guidelines for the conservation and restoration of seagrasses in the United Stated and adjacent waters. NOAA Coastal Ocean Program Decision Analysis Series, No. 12. NOAA Coastal Ocean Office, Silver Spring, MD. 222 p.

Fonseca, M. S., W. J. Kenworthy, D. R. Colby, K. A. Rittmaster, and G. W. Thayer. 1990. Comparisons of fauna among natural and transplanted eelgrass Zostera marina meadows: criteria for mitigation. Marine Ecology Progress Series 65:251-264

Hoffman, R. S. 1986. Fishery Utilization of Eelgrass (Zostera marina) Beds and Non-vegetated Shallow Water Areas in San Diego Bay. SWR-86-4, NMFS/SWR.

King, D. M., and E. W. Price. 2004. Developing Defensible Wetland Mitigation Ratios: A Companion to "The Five-step Wetland Mitigation Ratio Calculator." Prepared by King and Associates, Inc. for NOAA, Office of Habitat Conservation, Habitat Protection Division.

Lotze, H. K., H. S. Lenihan, B. J. Bourque, R. H. Bradbury, R. G. Cooke, M. C. Kay, S. M. Kidwell, M. X. Kirby, C. H. Peterson, and J. B. C. Jackson. 2006. Depletion, degradation, and recovery potential of estuaries and coastal seas. Science 312:1806-1809.

Merkel, K. W. 1988. Growth and survival of transplanted eelgrass: The importance of planting unit size and spacing. In: Proceedings of the California Eelgrass Symposium. Chula Vista, CA.

National Oceanic and Atmospheric Administration-Damage Assessment and Restoration Program (NOAA-DARP). 1999. Discounting and the treatment of uncertainty in natural resource damage assessment. *Technical Paper 99-1.*

National Research Council. 2001. Compensating for Wetlands Losses under the Clean Water Act. National Academy Press, Washington DC, USA.

Orth, R. J., T. J. B. Carruthers, W. C. Dennison, C. M. Duarte, J. W. Fourqurean, K. L. Heck, Jr., A. R. Hughes, G. A. Kendrick, W. J. Kenworthy, S. Olyarnik, F. T. Short, M. Waycott, and S. L. Williams. 2006. A global crisis for seagrass ecosystems. BioScience 56(12):987-996.

Pacific Fishery Management Council (PFMC). 2008. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery as Amended Through Amendment 19.

Peterson, C.H., R.A. Luttich Jr., F. Micheli, and G.A. Skilleter. 2004. Attenuation of water flow inside seagrass canopies of differing structure. Marine Ecology Progress Series 268: 81-92.

Rumrill, S.S. and V.K. Poulton. 2004. Ecological role and potential impacts of molluscan shellfish culture in the estuarine environment of Humboldt Bay, CA. http://hdl.handle.net/1794/3798

Short, F. T., and S. Wyllie-Echeverria. 1996. Natural and human-induced disturbance of seagrasses. Environmental Conservation 23(1):17-27.

Smith, Timothy M., J. S. Hindell, G. P. Jenkins, and R. M. Connolly. 2008. Edge effects on fish associated with seagrass and sand patches. Marine Ecology Progress Series 359:203-213.

South Florida Water Management District. 2007. Environmental Monitoring Report Guidelines. Environmental Resource Regulation Department. 18 p.

Thom, R.N. 1990. A review of eelgrass (*Zostera marina L.*) transplanting projects in the Pacific Northwest. The Northwest Environmental Journal 6:121-137.

Thom, R.N., J. Gaeckle, A. Borde, M. Anderson, M. Boyle, C. Durance, M. Kyte, P. Schlenger, J. Stutes, D. Weitkamp, S. Wyllie-Echeverria, and S. Rumrill. 2008. Eelgrass (*Zostera marina L.*) restoration in the Pacific Northwest: recommendations to improve project success. U.S. Department of Energy. Technical Report WA-RD 706.1.

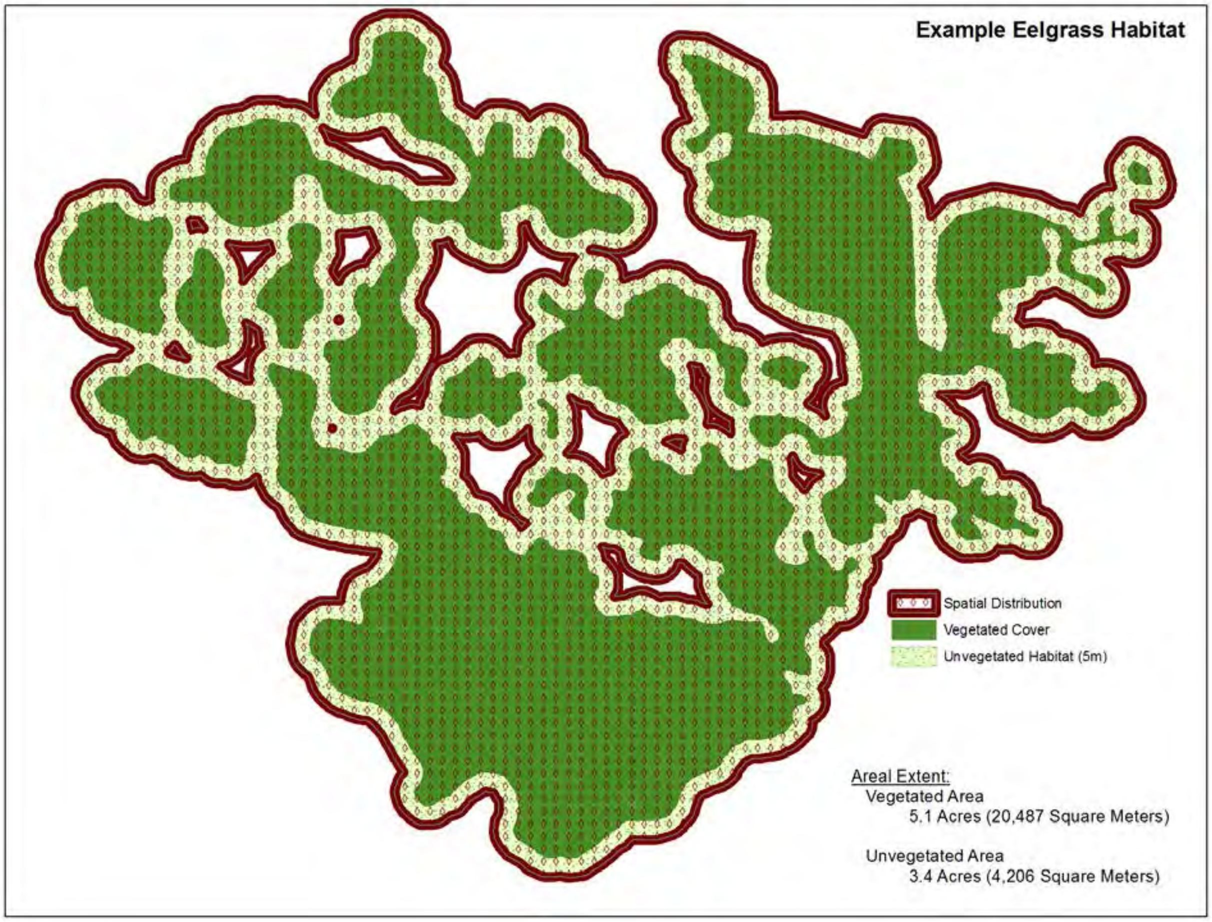
United States Army Corps of Engineers. 2010. New England District Compensatory Mitigation Guidance. 94 p.

van Houte-Howes, S.J. Turner, and C. A. Pilditch. 2004. Spatial Differences in Macroinvertebrate Communities in Intertidal Seagrass Habitats and Unvegetated Sediment in Three New Zealand Estuaries. Estuaries 27(6):945-957.

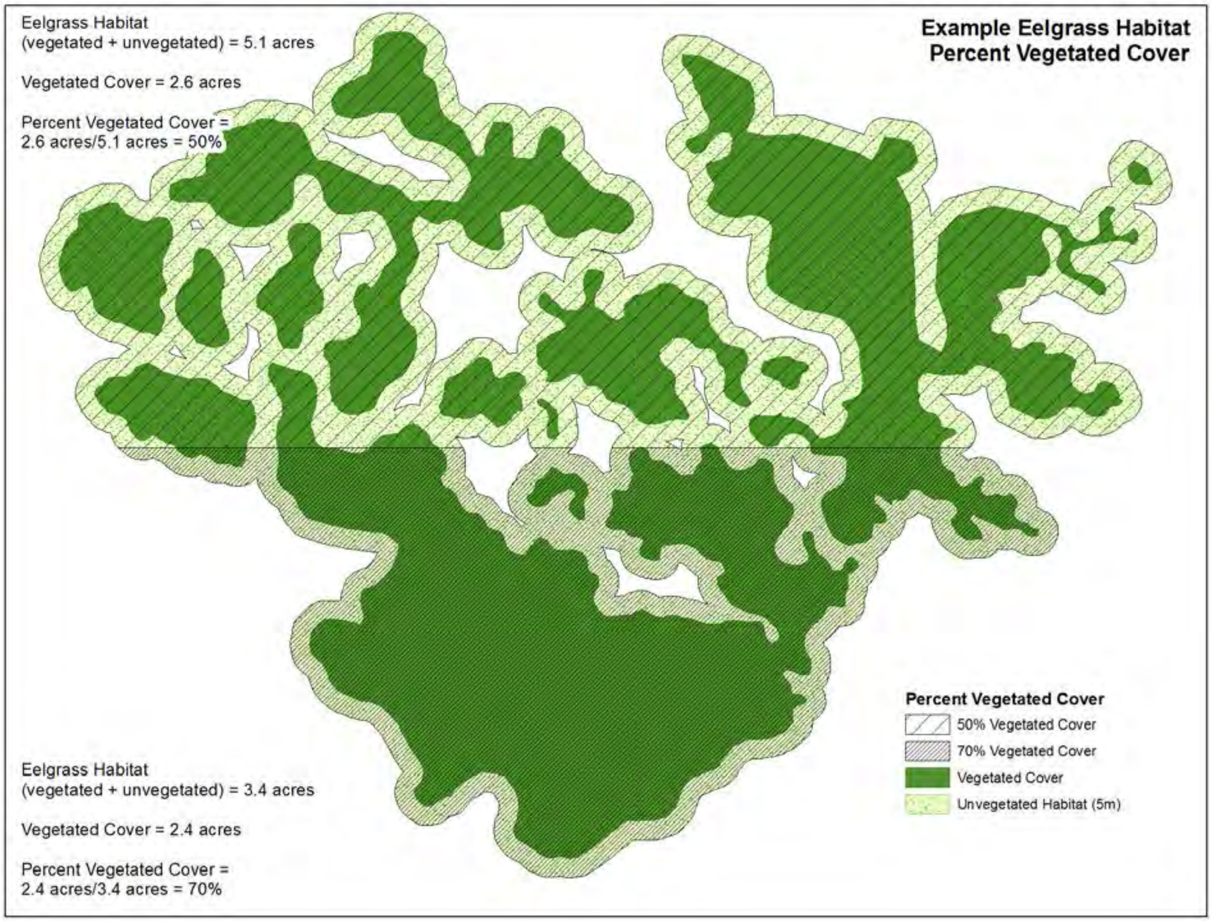
Washington Department of Fish and Wildlife. 2008. Eelgrass/macroalgae habitat interim survey guidelines (http://wdfw.wa.gov/publications/00714/).

Webster, P.J., A.A. Rowden, and M.J. Attrill. 1998. Effect of shoot density on the infaunal macro-invertebrate community within a *Zostera marina* seagrass bed. Estuarine, Coastal and Shelf Science 47: 351-357.

ATTACHMENT 1. Graphic depiction of eelgrass habitat definition including spatial distribution and aerial coverage of vegetated cover and unvegetated eelgrass habitat.

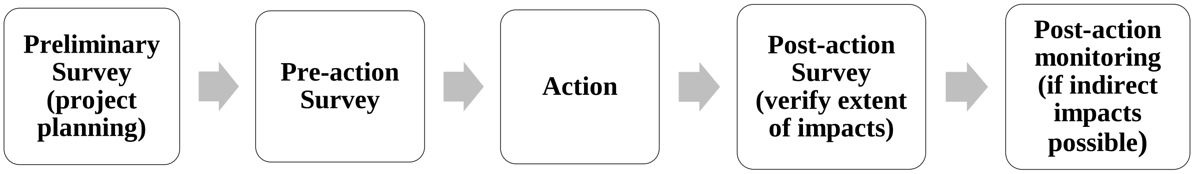


ATTACHMENT 2. Example Eelgrass Habitat Percent Vegetated Cover.



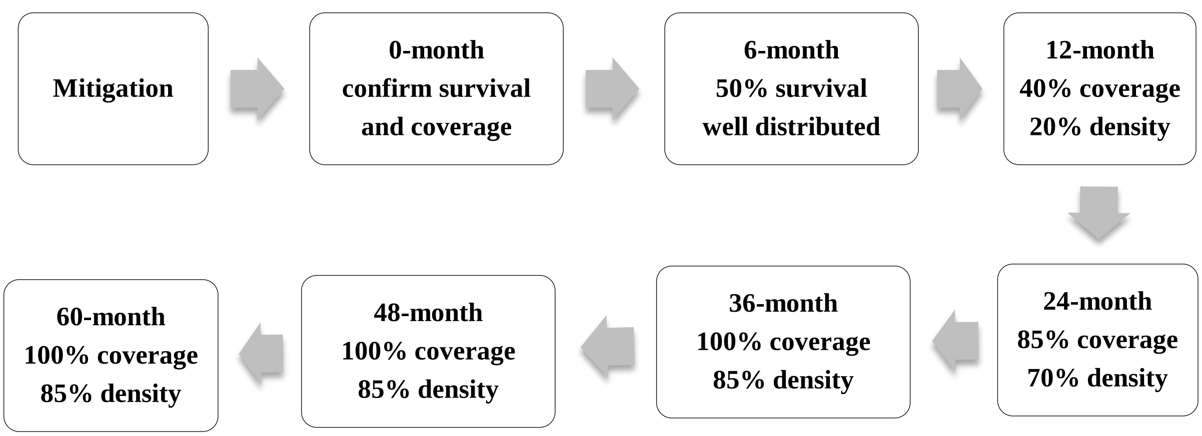
ATTACHMENT 3. Flow chart depicting timing of surveys and monitoring.

a) Eelgrass impact surveys



- All surveys should be completed during the growing season
- Surveys should be completed at the impact site and an appropriate reference site(s)
- A preliminary survey completed for planning purposes may be completed a year or more in advance of the action.
- Pre-action and post-action surveys should be completed within 60 days of the action.
- A survey is good for 60 days, or if that 60 day period extends beyond the end of growing season, until start of next growing season
- Two years of monitoring following the initial post-action monitoring event may be needed to verify lack or extent of indirect effects.
- Survey reports should be provided to NMFS and the federal action agency within 30 days of completion of each survey event

b) Eelgrass mitigation monitoring



- Mitigation should occur coincident or prior to the action
- All monitoring should be completed during the growing season
- Performance metrics for each monitoring event are compared to the 1.2:1 mitigation ratio
- Monitoring reports should be provided to NMFS and the federal action agency 30 days of completion of each monitoring event
- NMFS and action agency will evaluate if performance metrics met, and decide if supplemental mitigation or other adaptive management measures are needed

ATTACHMENT 4. Eelgrass transplant monitoring report.

In order to ensure that NMFS is aware of the status of eelgrass transplants, action agencies should provide or ensure that NMFS is provided a monitoring report summary with each monitoring report. For illustrative purposes only, an example of a monitoring report summary is provided below.

ACTION PARTY CONTACT INFORMATION:

Action Name (same as permit reference):

(a) Action party Information

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

MITIGATION CONSULTANT

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

PERMIT DATA:

Permit	Issuance Date	Expiration Date	Agency Contact

EELGRASS IMPACT AND MITIGATION NEEDS SUMMARY:

Permitted Eelgrass Impact Estimate (m^2):			
Actual Eelgrass Impact (m^2):		On (post-construction date):	
Eelgrass Mitigation Needs (m^2):		Mitigation Plan Reference:	
Impact Site Location:			
Impact Site Center Coordinates (actionion &			

datum):	
Mitigation Site Location:	
Mitigation Site Center Coordinates (actionion & datum):	

ACTION ACTIVITY DATA:

Activity	Start Date	End Date	Reference Information
Eelgrass Impact			
Installation of Eelgrass Mitigation			
Initiation of Mitigation Monitoring			

MITIGATION STATUS DATA:

	Mitigation Milestone	Scheduled Survey	Survey Date	Eelgrass Habitat Area (m^2)	Bottom Coverage (Percent)	Eelgrass Density (turions/m^2)	Reference Information
Month	0						
	6						
	12						
	24						
	36						
	48						
	60						

FINAL ASSESSMENT:

Was mitigation met?	
Were mitigation and monitoring performed timely?	
Were mitigation delay increases needed or were supplemental mitigation programs necessary?	

ATTACHMENT 5. Wetlands mitigation calculator formula and parameters.

Starting mitigation ratios for each region within California were calculated using "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004) developed for NMFS Office of Habitat Conservation. The discrete time equation this method uses to solve for the appropriate mitigation ratio is as follows:

$$R = \frac{\sum_{t=0}^{T_{\max}} (1+r)^{-t}}{\left(B(1-E)(1+L)-A\right)\left[\sum_{t=-D}^{C-D-1} \frac{(t+D)}{C(1+r)^{t}} + \sum_{C-D}^{T_{\max}} (1+r)^{-t}\right] + \left[\sum_{t=-D}^{T_{\max}} \frac{\left(1-(1-k)^{(t+D)}\right)}{(1+r)^{(t+D)}}\right]\left(A(1+L)\right)}$$

The calculator parameters in the above equation and values used to calculate starting mitigation ratios for CEMP are as follows:

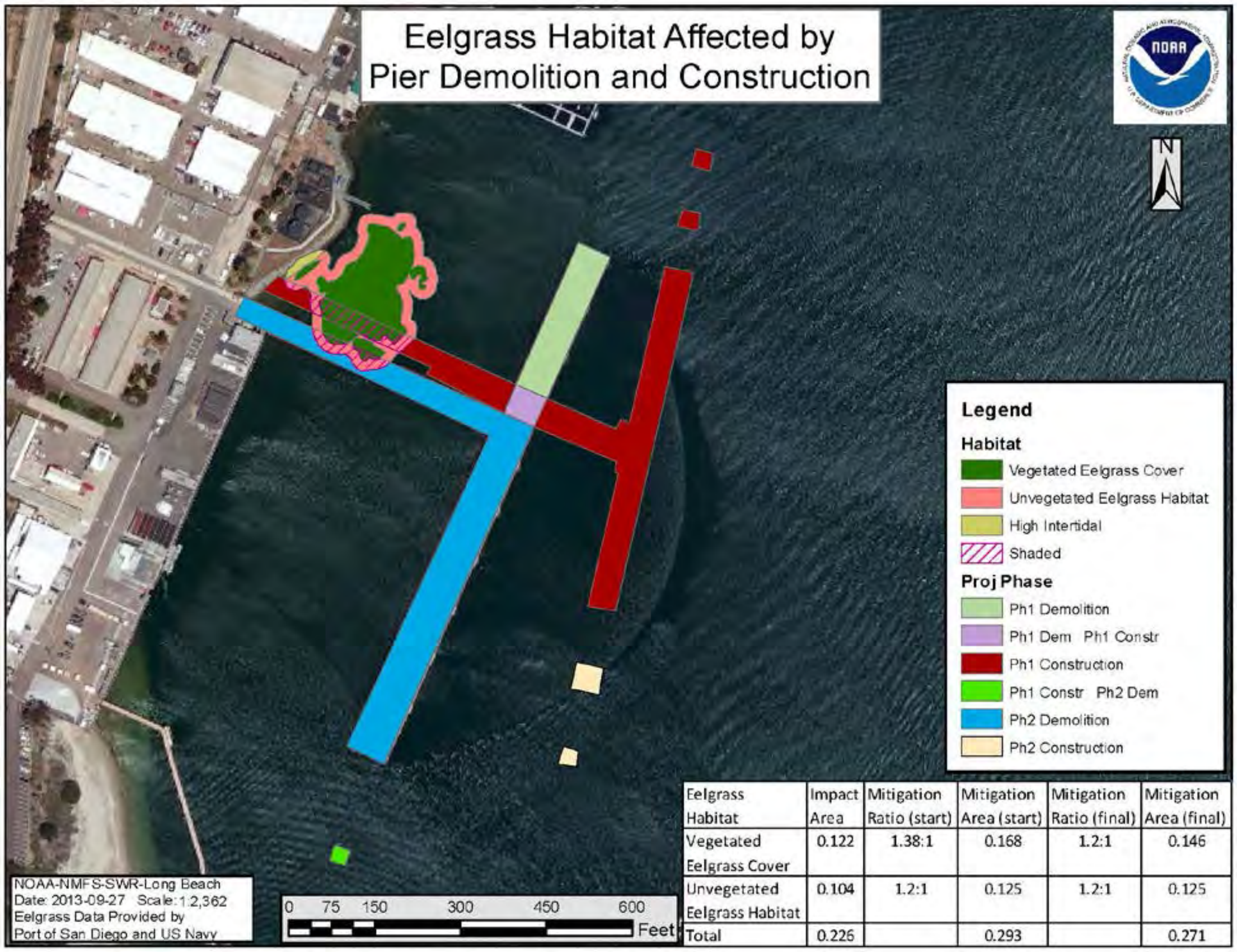
Symbol	Calculator Parameter	Value
A	The level of habitat function provided at the mitigation site prior to the mitigation project	0%
B	The maximum level of habitat function that mitigation is expected to attain, if it is successful	100%
C	The number of years after construction that the mitigation project is expected to achieve maximum function	3 yrs
D	The number of years before destruction of the impacted wetland that the mitigation project begins to generate habitat function	0 yrs
E	The percent likelihood that the mitigation project will fail and provide none of the anticipated benefits	various*
L	The percent difference in expected habitat function based on differences in landscape context of the mitigation site when compared with the impacted wetland	0%
k	The percent likelihood that the mitigation site, in the absence purchase or easement would be developed in any future year	0%
r	The discount rate used for comparing gains and losses that accrue at different times in terms of their present value	3%**
Tmax	The time horizon used in the analysis (chosen to maintain 1.2:1 ratio at E=100% and other parameter values listed above).	13 yrs

* The value for E was based on regional history of success in eelgrass mitigation and varied between regions (see Attachment X).

** NOAA suggests the use of a 3 percent real discount rate for discounting interim service losses and restoration gains, unless a different proxy for the social rate of time preference is more appropriate. (NOAA-DARP 1999) We use this value here, because it is based on best available information and is consistent with the NOAA Damage Assessment and Restoration Program.

ATTACHMENT 6. Example calculations for application of starting and final mitigation ratios for impacts to eelgrass habitat in southern California.

In this example, a pier demolition and construction would impact 0.122 acres of vegetated eelgrass habitat (dark green) and 0.104 acres of unvegetated habitat (pink). Area of impact is indicated by purple hatch mark. Application of recommended starting mitigation ratio for southern California (1.38:1) and final mitigation ratio (1.2:1) to compute starting and final mitigation area for this example are shown in the table.



Eelgrass Habitat	Impact Area	Mitigation Ratio (start)	Mitigation Area (start)	Mitigation Ratio (final)	Mitigation Area (final)
Vegetated Eelgrass Cover	0.122	1.38:1	0.168	1.2:1	0.146
Unvegetated Eelgrass Habitat	0.104	1.2:1	0.125	1.2:1	0.125
Total	0.226		0.293		0.271

ATTACHMENT 7. Example mitigation area multipliers for delay in initiation of mitigation activities.

Delays in eelgrass transplantation result in delays in ultimate reestablishment of eelgrass habitat values, increasing the duration and magnitude of project effects to eelgrass. The delay multipliers in the table below have been generated by altering the implementation start time within "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004).

MONTHS POST-IMPACT	DELAY MULTIPLIER (Percent of Initial Mitigation Area Needed)
0-3 mo	100%
4-6 mo	107%
7-12 mo	117%
13-18 mo	127%
19-24 mo.	138%
25-30 mo.	150%
31-36 mo	163%
37-42 mo.	176%
43-48 mo.	190%
49-54 mo.	206%
55-60 mo.	222%

ATTACHMENT 8. Summary of Eelgrass Transplant Actions in California

See table starting next page.

SUMMARY OF EELGRASS (*ZOSTERA MARINA*) TRANSPLANT PROJECTS IN CALIFORNIA

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Southern California Eelgrass Restoration History									
	Southern	San Diego Bay	North Island	1976	<0.1	SP	yes	no	-
	Southern	San Diego Bay	"Delta" Beach	1977	1.6	SP	yes	partial	-
	Southern	San Diego Bay	North Island	1978	<0.1	SP	yes	yes	+
	Southern	Newport Bay	Carnation Cove	1978	<0.1	SP	no	no	-
	Southern	Newport Bay	West Jetty	1980	<0.1	SP	yes	partial	0
	Southern	Mission Bay	multiple beaches	1982	<0.1	SP	no	partial	0
	Southern	LA/LB Harbor	Cabrillo Beach	1985	<0.1	BR	yes	yes	+
	Southern	Alamitos Bay	Peninsula	1985	<0.1	BR	yes	yes	+
	Southern	Huntington Hbr.	Main Channel	1985	<0.1	BR	yes	no	0
	Southern	Newport Bay	Upper	1985	<0.1	BR	yes	no	0
	Southern	Mission Bay	Sail Bay	1986	2.7	BR	yes	yes	+
	Southern	San Diego Bay	NEMS I	1987	3.8	BR	no	yes	+
	Southern	San Diego Bay	Chula Vista Wildlife Reserve	1987	<0.1	BR	yes	no	+[1]
	Southern	San Diego Bay	Harbor Island	1988	0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Entrance Channel	1989	0.1	BR	no	yes	+
	Southern	San Diego Bay	Le Meridien Hotel	1990	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Embarcadero	1991	<0.1	BR	yes	yes	+[2]
	Southern	Mission Bay	Sea World Lagoon	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Loew's Marina	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 2	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Sea Grant Study	1993	<0.1	BR	yes	yes	+
	Southern	Agua Hedionda Lagoon	Outer Lagoon	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 5	1994	0.4	BR	yes	yes	+
	Southern	Mission Bay	South Shores Basin	1994	2.9	BR	yes	yes	+
	Southern	Talbert Marsh	Talbert Channel	1995	<0.1	BR	na	yes	+[4]
	Southern	Mission Bay	various sites	1995	4.8	BR	yes	yes	+
	Southern	Mission Bay	Ventura Cove[5]	1996	0.5	BR	yes	yes	+[6]
	Southern	Mission Bay	Santa Clara Cove	1996	<0.1	BR	yes	no	0[10]
	Southern	Mission Bay	West Mission Bay Drive Bridge	1996	<0.1	BR	no	yes	0[10]
	Southern	Mission Bay	De Anza Cove	1996	<0.1	BR	yes	yes	+
	Southern	Batiquitos Lagoon	all basins	1997	21.6[7]	BR	yes	yes	+[4]
	Southern	San Diego Bay	NEMS 5	1997	7.1	BR	yes	yes	+
	Southern	San Diego Bay	Convair Lagoon	1998	2.5	BR	yes	no	-[12]
	Southern	San Diego Bay	NEMS 6	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Bristol Cove	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Middle Lagoon and Inner Lagoon	1999	4	BR	yes	yes	+
	Southern	Newport Bay	Balboa Is.Grand Cana	1999	<0.1	BR	yes	yes	+
	Southern	Mission Bay	West Ski Island	2001	0.2	BR	yes	yes	+

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
	Southern	San Diego Bay	Expanded NEMS 6	2001	0.6	BR	yes	yes	+
	Southern	Newport Bay	USCG Corona del Mar	2002	<0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Sunset Bay	2002	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Navy Enhancement Is.	2002	1	BR	yes	yes	+
	Southern	San Diego Bay	Coronado Bay Bridge	2003	0.3	BR	no	no	0
	Southern	LA Harbor	P300 Expansion Area	2003	5.9	BR	yes	partial	-[9]
	Southern	Newport Bay	Newport Bay Channel Dredging	2004	0.4	BR	yes	no	-
	Southern	San Diego Bay	South Bay Borrow Pit	2004	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	USCG ATC Pier	2004	0.1	BR	yes	yes	+
	Southern	San Diego Bay	South Bay Borrow Pit Sup.	2006	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	D Street Marsh	2006	0.3	BR	yes	pending	pending
	Southern	LA Harbor	P300 Supplement	2007	0.8	BR	yes	yes	pending
	Southern	San Diego Bay	Glorietta Bay Shoreline Park	2007	0.2	BR	yes	yes	pending
	Southern	Bolsa Chica	Pilot Eelgrass Restoration	2007	0.5	BR	yes	yes	+[4]
	Southern	San Diego Bay	Borrow Pit Supplement	2007	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	Sweetwater Silvergate Frac-out	2008	<0.1	BR	yes	yes	0[11]
	Southern	San Diego Bay	Harbor Drive Bridge/NTC Channel	2009	<0.1	BR	yes	pending	pending
Southern California Eelgrass Success Rate (1989-2009, Last 20 Years)								**87%**	**n=43**
Central California Eelgrass Restoration History									
	Central	Morro Bay	Anchorage Area	1985	<0.1	BR	no	yes	+
	Central	Morro Bay	Target Rock	1997	<0.1	BR	no	yes	+
	Central	Morro Bay	Morro Bay Launch Ramp	2000	<0.1	BR	yes	yes	+
	Central	Morro Bay	Mooring Area A1	2002	0.3	BR	yes	yes	+
	Central	Morro Bay	Western Shoal	2010	0.8	BR	yes	pending	pending
Central California Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**100%**	**n=4**
San Francisco Bay Eelgrass Restoration History									
	San Francisco Bay	San Francisco Bay	Richmond Training Wall	1985	<0.1	BR	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Keil Cove and Paradise Cove	1989	0.1	Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island/Middle Harbor Shoal	1998	0.1	BR and Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island	1999	0.1	BR	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Brickyard Cove, Berkeley	2002	0.2	BR	yes	yes	+[13]
	San Francisco Bay	San Francisco Bay	Emeryville Shoals	2002	0.1	Mixed Test	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	0.6	Seed Bouy	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	mod. TERFS	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	Seeding	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Clipper Yacht Harbor, Sausalito	2007	<0.1	Frames	yes	pending	pending
	San Francisco Bay	San Francisco Bay	Albany, Emeryville, San Rafael	2007	<0.1	BR	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Belvedere	2008	<0.1	Frames	yes	pending	pending
San Francisco Bay Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**40%**	**n=10**

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Northern California Eelgrass Restoration History									
	Northern	Humboldt Bay	Indian Island	1982	unknown	BR	unknown	no	-
	Northern	Bodega Harbor	Spud Point Marina	1984	1.3	BR	yes	no	-
	Northern	Humboldt Bay	Indian Island	1986	<0.1	BR	yes	no	-
	Northern	Humboldt Bay		1986	0.2	unknown	unknown	no	-
	Northern	Humboldt Bay	SR255 Bridge	2004	<0.1	BR	yes	no	-
	Northern	Humboldt Bay	Maintenance Dredging Project	2005	<0.1	BR	yes	yes	+
Northern California Eelgrass Success Rate (1982-2009, Inadequate History to Exclude Older Projects)								**25%**	**n=4**

* size in hectares

SP = sediment laden plug

** BR = bare root

*** success status is measured as yes, no, partial, pending, or unknown. Success rate is reported as percentage of sucessful over total completed within the past 25 years.
yes = 1, partial = 0.5, no = 0, and pending or unknown are not counted in either the numerator or denominator in determining success percentage.

**** + = net increase in eelgrass coverage, 0 = no change in eelgrass coverage, - = net decrease in eelgrass coverage

1 Transplant was initially adversely impacted by an unknown source of sediment and was deemed unsuitable.

2 The transplant declined initially and later recovered from what was determined to be a one time sedimentation event.

3 Transplant was experimental due to dense beds of the exotic muscle *Musculista senhousia*
which inhibited the growth of the transplant. Replacement transplant done elsewhere.
Transplant was completed in an area deemed unsuitable. Insufficient coverage required the construction of a remedial site.
Monitoring continues at both the initial and remedial sites.

4 Transplant was experimental.

5 Multiple sites.

6 Mitigation for marina at Princess Resort, project not built

7 Amount of eelgrass present within all basins as of 2000 mapping.

8 Regional eelgrass decline has resulted in die-offs both within restoration and reference areas equally full recovery had not occurred at the time of evaluation, yet project exceeds control-corrected requ

9 Original site was constructed as a plateau that was underfilled and anticipated to fall short of objectives. A supplemental
transplant was therefore completed when development began to exhibit shortfalls in area.

10 Shortfall mitigated by withdraw from established eelgrass mitigation bank.

11 Exception conditions from SCEMP requiring only replacement in place for unanticipated damage

12 Mitigated out-of-kind with non-eelgrass to satisfy permit requirements after shortfall in eelgrass mitigation.

Appendix B: Mission Bay Navigational Safety Dredging Project Plans
(Rick Engineering Company 2016)

MISSION BAY NAVIGATIONAL SAFETY DREDGING

CONTRACTOR'S RESPONSIBILITIES

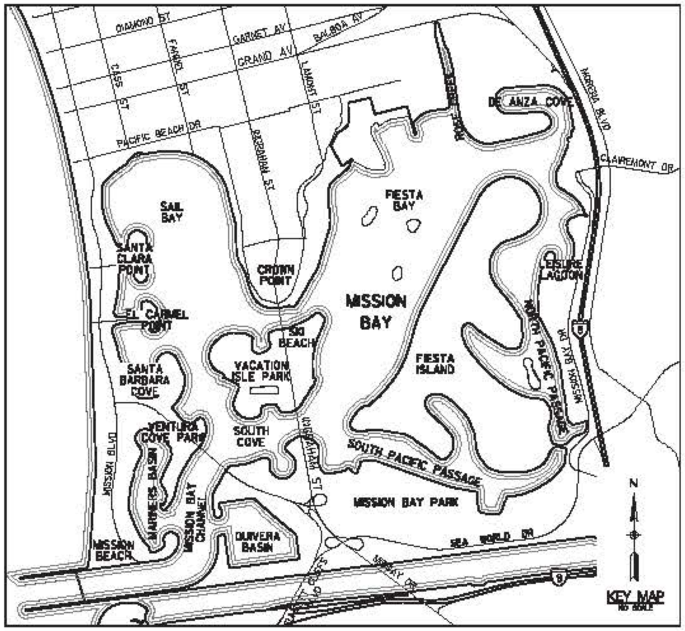
1. PURSUANT TO SECTION 4216 OF THE CALIFORNIA GOVERNMENT CODE, AT LEAST 2 WORKING DAYS PRIOR TO EXCAVATION, YOU MUST CONTACT THE REGIONAL NOTIFICATION CENTER (E.G., UNDERGROUND SERVICE ALERT OF SOUTHERN CALIFORNIA) AND OBTAIN AN INQUIRY IDENTIFICATION NUMBER.
2. NOTIFY SDG&E AT LEAST 10 WORKING DAYS PRIOR TO EXCAVATING WITHIN 10' OF SDG&E UNDERGROUND HIGH VOLTAGE TRANSMISSION POWER LINES (I.E., 69 KV & HIGHER)

MONUMENTATION/SURVEY NOTES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR SURVEY MONUMENTS AND/OR VERTICAL CONTROL BENCHMARKS WHICH ARE DISTURBED OR DESTROYED BY CONSTRUCTION. A LICENSED LAND SURVEYOR OR LICENSED CIVIL ENGINEER AUTHORIZED TO PRACTICE LAND SURVEYING IN THE STATE OF CALIFORNIA SHALL FIELD LOCATE, REFERENCE, AND/OR PRESERVE ALL HISTORICAL OR CONTROLLING MONUMENTS PRIOR ANY EARTHWORK, DEMOLITION OR SURFACE IMPROVEMENTS. IF DESTROYED, A LICENSED LAND SURVEYOR SHALL REPLACE SUCH MONUMENT(S) WITH APPROPRIATE MONUMENTS. WHEN SETTING SURVEY MONUMENTS USED FOR RE-ESTABLISHMENT OF THE DISTURBED CONTROLLING SURVEY MONUMENTS AS REQUIRED BY SECTIONS 8730.2 AND 8771 OF THE BUSINESS AND PROFESSIONS CODE OF THE STATE OF CALIFORNIA, A CORNER RECORD OR RECORD OF SURVEY, AS APPROPRIATE, SHALL BE FILLED WITH THE COUNTY SURVEYOR. IF ANY VERTICAL CONTROL IS TO BE DISTURBED OR DESTROYED, THE CITY OF SAN DIEGO FIELD SURVEY SECTION SHALL BE NOTIFIED IN WRITING AT LEAST 7 DAYS PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF REPLACING AND VERTICAL CONTROL BENCHMARKS DESTROYED BY THE CONSTRUCTION.

SHEET INDEX

SHEET NO.	DISCIPLINE CODE	TITLE	LIMITS
1	G-1	COVER SHEET	
2	G-2	KEY MAP	
3	G-3	NOTES	
4	C-1	GRADING PLAN	CROWN POINT (NORTH)
5	C-2	GRADING PLAN	CROWN POINT (SOUTH)
6	C-3	GRADING PLAN	SKI BEACH
7	C-4	GRADING PLAN	LEISURE LAGOON
8	C-5	DREDGING PLAN	EL CARMEL POINT
9	C-6	DREDGING PLAN	SANTA BARBARA COVE
10	C-7	DREDGING PLAN	SOUTH COVE
11	C-8	DREDGING PLAN	FIESTA BAY
12	C-9	DREDGING PLAN	SAIL BAY
13	C-10	DREDGING PLAN	SAIL BAY



KEY MAP
NO SCALE

DISCIPLINE CODE

G GENERAL
C CIVIL

ABBREVIATIONS

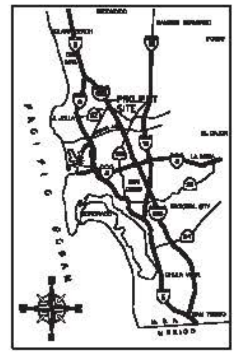
CY	CUBIC YARD	FG	FINISH GRADE	PROP	PROPOSED
EL, ELEV	ELEVATION	HORIZ.	HORIZONTAL	RCP	REINFORCED CONCRETE PIPE
ELEC	ELECTRIC	IE	INVERT ELEVATION	SD	STORM DRAIN
EX, EXIST	EXISTING	MIN	MINIMUM	UNK	UNKNOWN
FT	FEET	NIC	NOT IN CONTRACT	VERT.	VERTICAL

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

KEVIN GIBSON R.C.E. 52249 DATE

WORK TO BE DONE

THE IMPROVEMENTS CONSIST OF THE FOLLOWING MAINTENANCE DREDGING WORK TO BE DONE ACCORDING TO THESE PLANS AND THE STANDARD SPECIFICATIONS AND THE STANDARD DRAWINGS OF THE CITY OF SAN DIEGO.



VICINITY MAP
NOT TO SCALE

LEGEND

IMPROVEMENTS	STANDARD DRAWINGS	SYMBOL
MAJOR CONTOUR		10
MINOR CONTOUR		4
DAYLIGHT		
DREDGE AREA		
REUSE AREA		

EXISTING STRUCTURES

EX DRAINS
EX EELGRASS
EX MAJOR CONTOUR —10—
EX MINOR CONTOUR —4—

FIELD DATA

BENCHMARK:
ELEV.=15.429, NGVD29
FIELD NOTES:
BASIS OF BEARINGS / COORDINATES:
THE BASIS OF COORDINATES FOR THIS SURVEY IS THE CALIFORNIA COORDINATE SYSTEM OF 1983 (CCS83) ZONE 6, NAD83 (EPOCH 1991.35) BASED UPON SINGLE POINT SOLUTION AT STATION SDGPS 1905 PER ROS 14492, AND IS DETERMINED BY GPS RTK MEASUREMENTS TAKEN ON AUGUST 24, 2016.

HORIZONTAL AND VERTICAL CONSTRAINT POINT:
STATION SDGPS 1905 PER ROS 14492
N: 1868497.88
E: 6266539.35
ELEV: 15.43
CGF: 1.0000035
CONVERGENCE: -0° 31'38.747"

CHECK POINT:
STATION SDGPS 906 PER ROS 14492
N: 1864562.80 REC. 1864562.768 MSRD.
E: 6254677.43 REC. 6254677.429 MSRD.
ELEV: 8.48 REC. 8.41 MSRD.

NOTE: GRID BEARING 1905 TO 906: S 71° 38'50" W
HD: 12497.60 RECORD PER ROS 14492

DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29)

G-1

PLANS FOR THE CONSTRUCTION OF
MISSION BAY NAVIGATIONAL SAFETY DREDGING
COVER SHEET

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 1 OF 13 SHEETS

CONSTRUCTION CHANGE / ADDENDUM			
CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

WARNING
0 1"
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO Public Works

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619-291-0707
(FAX) 619-291-4165
J-17480-D

SPEC. NO.

FOR CITY ENGINEER DATE
PRINT NAME RCE#

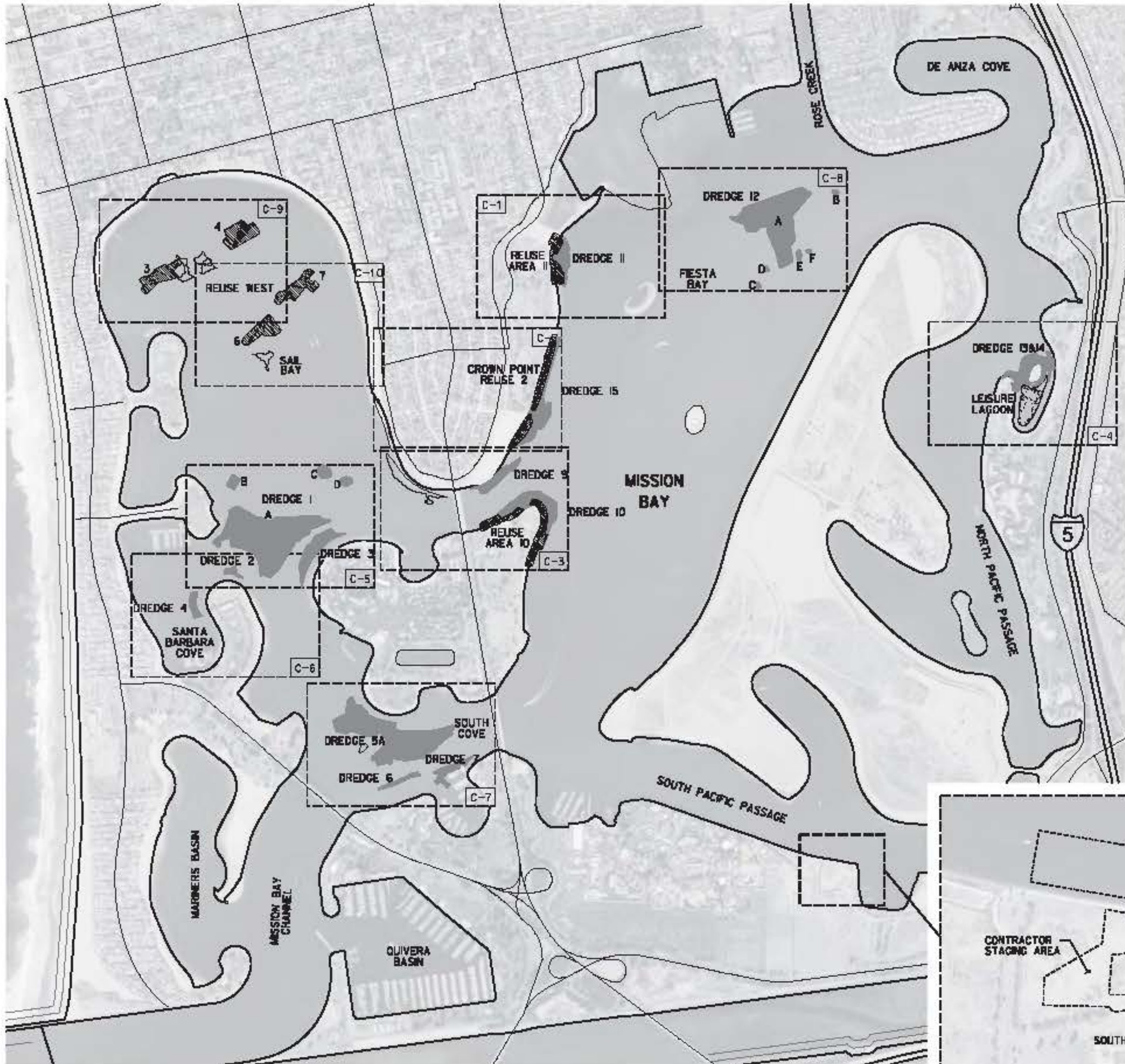
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	KG/DK			

0-00000
0-00000
COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER
SEE SHEETS
CCS83 COORDINATE
SEE SHEETS
CCS83 COORDINATE
39721-01-D

CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____

MISSION BAY NAVIGATIONAL SAFETY DREDGING

J:\17080-D_Mission_Bay_Dredging\Civil\Sheets\17080D_G1_Title Sheet.dgn
16-DEC-2016 12:54



SITE	AREA (ACRES)	DREDGE ELEV. (FT)	CUT VOL (CY)	FILL VOLUME (CY)	1-FT NON-PAID OVERDREDGE (CY)	2-FT PAID ALLOWABLE OVERDREDGE	EELGRASS IMPACT (ACRES)	EELGRASS TRANSPLANT AREA (ACRES-NIC	PREDICTED EELGRASS RESTORED (ACRES)-NIC
DREDGE SITES									
DREDGE 1A	15.87	-10.50	22,690	-	25,600	-	15.87	15.87	15.08
DREDGE 1B	0.52	-10.50	590	-	840	-	0.52	0.52	0.49
DREDGE 1C	0.53	-10.50	720	-	1,020	-	0.63	0.63	0.60
DREDGE 1D	0.41	-10.50	500	-	660	-	0.41	0.41	0.39
DREDGE 2	0.41	-10.50	470	-	660	-	0.41	0.41	0.39
DREDGE 3	2.84	-10.50	5,450	-	4,580	-	2.57	2.84	2.70
DREDGE 4	0.90	-10.50	610	-	1,290	-	0.64	0.80	0.76
DREDGE 5A	13.50	-10.50	19,850	-	21,780	-	13.30	13.50	12.83
DREDGE 5B	NO WORK	-10.50	NO WORK	-	NO WORK	NO WORK	NO WORK	NO WORK	NO WORK
DREDGE 6	0.57	-10.50	890	-	1,080	-	0.42	0.67	0.64
DREDGE 7	1.30	-10.50	3,380	-	2,100	-	1.30	1.30	1.24
DREDGE 8	NO WORK	-10.50	NO WORK	-	NO WORK	NO WORK	NO WORK	NO WORK	NO WORK
DREDGE 9	1.34	-10.00	4,730	-	-	-	0.97	1.94	1.01
DREDGE 10	3.51	-10 TO -11	15,300	8,780	-	-	2.01	3.61	1.88
DREDGE 11	1.57	-7.00	5,900	5,900	-	-	0.64	1.67	0.87
DREDGE 12A	11.44	-10.50	22,890	-	-	36,930	0.99	-	-
DREDGE 12B	0.13	-10.50	230	-	-	410	-	-	-
DREDGE 12C	0.11	-10.50	190	-	-	350	0.06	-	-
DREDGE 12D	0.07	-10.50	120	-	-	210	0.04	-	-
DREDGE 12 E	0.21	-10.50	380	-	-	680	0.04	-	-
DREDGE 12F	0.38	-10.50	140	-	-	260	0.00	-	-
DREDGE 13 & 14	3.78	-5.00	8,320	8,320	-	-	0.78	3.78	2.68
DREDGE 15	3.37	-2 TO -7	9,090	9,050	-	-	1.31	3.37	2.36
TOTAL DREDGE	63.36		122,400	32,050	59,610	38,840	42.93	51.32	43.90

BENEFICIAL RESUE EELGRASS MITIGATION SITE MITIGATION SITE	AREA (ACRES)	FILL VOL (CY)	EELGRASS TRANSPLANT AREA (ACRES)-NIC	PREDICTED EELGRASS RESTORED (ACRES) - NIC
RESUSE SITES				
RESUSE WEST 1	NO WORK	NO WORK	NO WORK	NO WORK
RESUSE WEST 2	NO WORK	NO WORK	NO WORK	NO WORK
RESUSE WEST 3 **	2.51	41,270	2.51	2.38
RESUSE WEST 4 **	2.69	50,060	2.69	2.55
RESUSE WEST 5	NO WORK	NO WORK	NO WORK	NO WORK
RESUSE WEST 6 **	2.23	48,690	2.23	2.12
RESUSE WEST 7 **	2.50	48,780	2.50	2.37
CROWN POINT REUSE 1	NO WORK	NO WORK	NOWORK	NO WORK
CROWN POINT REUSE 2	3.35	9,050	-	-
REUSE AREA 10	3.75	8,780	-	-
LEISURE LAGOON	2.45	8,320	2.45	1.74
REUSE AREA 11	2.06	5,900	-	-
TOTAL REUSE	19.47	220,850	12.37	11.17

**FILL VOLUME INCLUDES DREDGING CUT VOLUME AND 1-FT AND 2-FT OVER DREDGING VOLUMES

LEGEND

DREDGE AREAS

REUSE AREAS

STAGING AREA
NOT TO SCALE

SCALE 1"=800'

MISSION BAY NAVIGATIONAL SAFETY DREDGING

G-2

MISSION BAY NAVIGATIONAL SAFETY DREDGING
KEY MAP

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 2 OF 13 SHEETS

ORIGINAL

0-00000
0-00000
COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER
SEE SHEETS
SEE SHEETS

DATE STARTED
DATE COMPLETED
CONTRACTOR
INSPECTOR

39721-02-D

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619-291-0707
(FAX) 619-291-4165

J-17189-D

MISSION BAY NAVIGATIONAL SAFETY DREDGING

WORK IN TIDAL WATERS

1. THIS WORK IS BEING CONDUCTED IN A FULL TIDAL ENVIRONMENT. CONTRACTOR IS ADVISED TO TAKE APPROPRIATE PRECAUTIONS TO ENSURE THAT SITE CONDITIONS WORK, AND EQUIPMENT STORAGE AND OPERATIONS ARE ACCOMPLISHED IN A MANNER THAT DOES NOT RESULT IN EXPOSURE TO UNINTENDED EQUIPMENT FLOODING OR GROUNDING DUE TO TIDAL CONDITIONS.
2. CONTRACTOR IS ADVISED THAT THE PROJECT VERTICAL DATUM IS FEET NGVD29 (SHEET G-D AND NOT MEAN LOWER LOW WATER (MLLW) AS DEPICTED ON TIDE TABLES. FOR PLANNING PURPOSES THE DATUM EQUIVALENCY IS PROVIDED BELOW. ALL SURVEY SHALL BE IN ACCORDANCE WITH THE PROJECT HORIZONTAL AND VERTICAL DATA (SHEET G-D.

PROJECT VERTICAL DATUM	REFERENCE VERTICAL DATUM EQUIVALENCE		
NGVD29 (FT)	MLLW (FT)	NAVD88 (FT)	HARMONIC DATA
+5.37	+7.79	+7.60	HHT (HIGHEST HIGH TIDE)
+2.59	+5.01	+4.82	MHW (MEAN HIGH WATER)
+0.54	+2.96	+2.77	MSL (MEAN SEA LEVEL)
0.0	+2.42	+2.23	
-2.23	+0.19	0.00	
-2.42	0.00	-0.19	MLLW (MEAN LOWER LOW WATER)

STAGING AND ACCESS

1. THE CONTRACTOR STAGING AREA IS LOCATED ON SOUTH PACIFIC PASSAGE AT THE SOUTH SHORES LAUNCH RAMP. ACCESS IS TAKEN FROM THE SOUTH SHORES PARKING LOT OFF OF MISSION BAY PARKWAY ACCESSED FROM SEA WORLD DRIVE (SHEET G-2).
2. THE STAGING AREA INCLUDES TWO ON WATER STAGING LOCATIONS FOR STORAGE OF ON WATER EQUIPMENT AND BERTHING OF WORK VESSELS AS WELL AS AN UPLAND STAGING AREA FOR OFFICE TRAILERS, EQUIPMENT STORAGE, AND CONTRACTOR VEHICLE STAGING.
3. THE CONTRACTOR SHALL FENCE AND CONTROL ACCESS TO ITS UPLAND STAGING AREA.
4. THE CONTRACTOR WILL HAVE ACCESS TO EXCLUSIVE, BUT UNSECURED USE OF THE NORTH SIDE OF THE NORTHERN LAUNCH RAMP BOARDING FLOAT DURING THE WORK.
5. THE CONTRACTOR MAY STAGE LARGE FLOATING EQUIPMENT SUCH AS A DREDGE PLANT AND SCOWS WITHIN A 400 FOOT BY 175 FOOT TEMPORARY MOORING AREA IN SOUTH PACIFIC CHANNEL.
6. WHEN WORK IS BEING PERFORMED AT INDIVIDUAL SITES, EQUIPMENT MAY REMAIN AT THE SITES UNTIL WORK IS COMPLETED UNLESS WORK STOPAGES WILL CONTINUE FOR GREATER THAN 96 HOURS. IF STOPAGES ARE PLANNED TO CONTINUE IN EXCESS OF 96 HOURS, THE CONTRACTOR SHALL REMOVE EQUIPMENT FROM PARKLAND BEACHES OR WORK SITES TO DESIGNATED STAGING AREAS.
7. CONTRACTOR MAY NOT:
   a. PERMEANANTLY CLOSE OR BLOCK PUBLIC TRAIL ACCESS, BUT MAY TEMPORARILY INTERUPT TRAIL USE FOR EQUIPMENT CROSSINGS FOR PERIODS OF UP TO ONE HOUR.
   b. UTILIZE PUBLIC PARKING FOR EQUIPMENT STORAGE OR LAYDOWN.
   c. STAGE IN PARKLANDS OR LOTS OTHER THAN PROVIDED FOR IN THIS PLAN, WITHOUT PRIOR EXPLICIT CONCURRENCE BY THE CITY FIELD ENGINEER.

ENVIRONMENTAL NOTES

1. THESE NOTES SHALL SUPPLEMENT CONDITIONS OF ENVIRONMENTAL PERMITS ISSUED FOR THE WORK. CONTRACTOR SHALL MAINTAIN A FULL SET OF ENVIRONMENTAL PERMITS ON THE PROJECT SITE AT ALL TIMES AND SHALL BE FAMILIAR WITH THE REQUIREMENTS APPLICABLE TO THE CONTRACTOR'S WORK.
2. IF CONFLICTS ARE FOUND TO EXIST BETWEEN ANY CONTRACT PROVISIONS, DRAWINGS, NOTES, SPECIFICATIONS, OR PERMITS, THE CONTRACTOR SHALL BRING THESE TO THE IMMEDIATE ATTENTION OF THE OWNER S REPRESENTATIVE FOR DIRECTION ON HOW TO PROCEED.
3. STRINGENT COMPLIANCE WITH ENVIRONMENTAL CONDITIONS SHALL NOT RELIEVE CONTRACTOR FROM CONDUCTING WORK IN A PRUDENT AND ENVIRONMENTALLY PROTECTIVE MANNER.
4. PROJECT WORK IS EXPECTED TO HAVE IMPACTS TO EELGRASS THAT MUST BE COMPENSATED FOR BY MITIGATION. THE CONTRACTOR SHALL TAKE PRECAUTIONARY MEASURES TO TIGHTLY CONTROL THEIR LIMITS OF WORK AND ACTIVITIES TO ENSURE THAT IMPACTS TO EELGRASS ARE NOT EXPANDED BEYOND THE LIMITS CONTEMPLATED FOR THIS PROJECT.
5. EELGRASS MITIGATION IS DEPENDENT UPON REPLANTING EELGRASS ONTO AREAS DREDGED AND FILLED UNDER THIS WORK. FOR THIS REASON, CONSTRUCTION TOLERANCES HAVE BEEN SET TO SUPPORT THE RESTORATION OF EELGRASS TO THESE AREAS. IT IS IMPORTANT THAT THE CONTRACTOR ADHERE TO THE ESTABLISHED TOLERANCES IN COMPLETING THIS WORK.
6. THE CONTRACTOR SHALL IMPLEMENTATION MEASURES TO PREVENT VISIBLE DUST EMISSIONS AND ELEVATED TURBIDITY FROM LEAVING THE PROJECT WORK AREAS.
7. EFFECTIVE EROSION CONTROL SHALL BE IMPLEMENTED ON THE UPLAND PROJECT WORK AND STAGING AREAS.
8. THE CONTRACTOR SHALL NOT ALLOW CONSTRUCTION EQUIPMENT AND VEHICLES TO TRACK DIRT AND DUST ONTO PUBLIC ROADS. EQUIPMENT AND TIRES SHALL BE WASHED/SWEPT PRIOR TO LEAVING THE PROJECT SITE. CHATTER PLATES AND A STABILIZED CONSTRUCTION ENTRANCE SHALL BE PLACED AT THE STAGING AREA ENTRANCE.
9. THE CONTRACTOR SHALL USE BEST MANAGEMENT PRACTICES TO FUEL AND MAINTAIN CONSTRUCTION EQUIPMENT AND CONSTRUCTION FACILITIES.
10. ALL EQUIPMENT SHALL MEET APCD STANDARDS IN EFFECT AT THE TIME OF WORK.
11. PRIOR TO SITE MOBILIZATION, THE CONTRACTOR SHALL PREPARE AND SUBMIT A CONSTRUCTION MANAGEMENT PLAN WHICH INCLUDES THE FOLLOWING:
    A. ALL CONSTRUCTION EQUIPMENT, FIXED OR MOBILE, SHALL BE EQUIPPED WITH PROPERLY OPERATING AND MAINTAINED MUFFLERS.
    B. CONSTRUCTION NOISE REDUCTION METHODS SUCH AS SHUTTING OFF IDLING EQUIPMENT, INSTALLING TEMPORARY ACOUSTIC BARRIERS AROUND STATIONARY CONSTRUCTION NOISE SOURCES.
    C. DURING CONSTRUCTION, STATIONARY CONSTRUCTION EQUIPMENT SHALL BE PLACED SUCH THAT EMITTED NOISE IS DIRECTED AWAY FROM SENSITIVE NOISE RECEIVERS.
12. CONSTRUCTION TIMING IS CONSTRAINED TO MINIMIZE IMPACTS TO THE PUBLIC AND ENVIRONMENT. TO ACCOMPLISH THIS, THE FOLLOWING RESTRICTIONS IN WORK TIMING EXIST:
    A. IN WATER WORK INCLUDING DREDGING AND MATERIAL PLACEMENT SHALL BE RESTRICTED TO THE NON-NESTING SEASON FOR CALIFORNIA LEAST TERNS (BETWEEN SEPTEMBER 15 AND APRIL 1).
    B. STAGING AND UPLAND ACTIVITIES SHALL BE RESTRICTED WITHIN MISSION BAY PARK BETWEEN MEMORIAL DAY (LAST MONDAY OF MAY) AND LABOR DAY (FIRST MONDAY OF SEPTEMBER).
13. VESSEL OPERATIONS SHALL BE CONDUCTED IN A MANNER THAT ENSURES ADEQUATE CLEARANCE BETWEEN THE BAY BOTTOM AND VESSEL HULLS AND PROPELLERS TO AVOID GROUNDING OR PROPELLER WASH SCOUR DAMAGE TO EELGRASS. THIS MAY REQUIRE UNDERLOADING SCOWS OR TIDALLY CONSTRAINED OPERATIONS.
14. CONTRACTOR SHALL MAINTAIN CLEAN AND DEBRIS FREE WORK ENVIRONMENTS BOTH ON THE WATER AND ON LAND.

STAGING AND PHASING NOTES

STAGING AND PHASING NOTES (CONTINUED)

SITE	DREDGE SEQUENCING	FILL SEQUENCING	MAXIMUM FILL VOLUME
DREDGE 1A	9	REUSE WEST 6, 7	48,290
DREDGE 1B	9	REUSE WEST 6, 7	1,430
DREDGE 1C	9	REUSE WEST 3, 4, 6	1,740
DREDGE 1D	9	REUSE WEST 3, 4	1,160
DREDGE 2	7	REUSE WEST 3, 4	1,130
DREDGE 3	6	REUSE WEST 3, 4	10,030
DREDGE 4	8	REUSE WEST 3, 4	1,900
DREDGE 5A	5	REUSE WEST 3, 4	41,630
DREDGE 6	3	REUSE WEST 3	1,930
DREDGE 7	4	REUSE WEST 3	5,480
DREDGE 9	2	REUSE WEST 3	4,770
DREDGE 10	2	REUSE WEST 3 / DREDGE 10	15,300
DREDGE 11	INDEPENDENT	INDEPENDENT - REUSE AREA 11	5,900
DREDGE 12A	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	62,790
DREDGE 12B	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	
DREDGE 12C	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	
DREDGE 12D	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	
DREDGE 12 E	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	
DREDGE 12F	1	BOTTOM 3 FT REUSE WEST 3, 4, 6, 7	
DREDGE 13 & 14	INDEPENDENT	INDEPENDENT - LEISURE LAGOON	8,320
DREDGE 15	INDEPENDENT	INDEPENDENT - CROWN PT. REUSE 2	9,050
TOTAL VOL (CY)			220,850

GRADE CONTROL NOTES

RICK ENGINEERING COMPANY
SAN DIEGO, CA 92110
J-17589-D

G-3

MISSION BAY NAVIGATIONAL SAFETY DREDGING

NOTES

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 3 OF 13 SHEETS

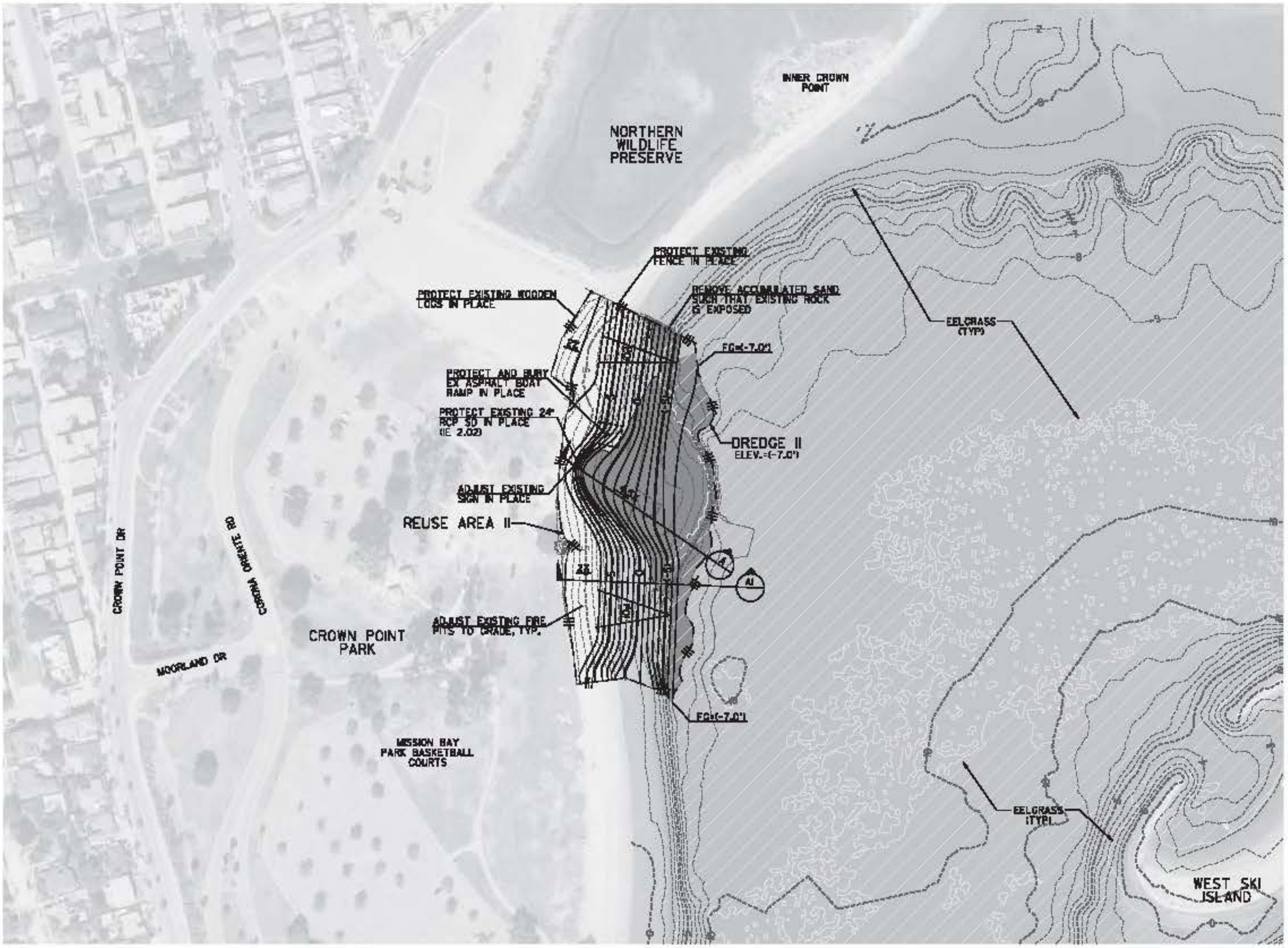
FOR CITY ENGINEER | DATE

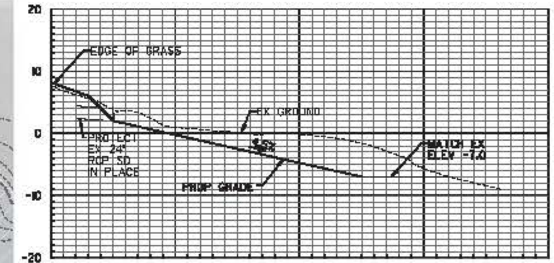
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

0-00000
0-00000
COSELYN GOODRICH, PROJECT MANAGER
TAMARA MILLER, PROJECT ENGINEER
SEE SHEETS
SEE SHEETS

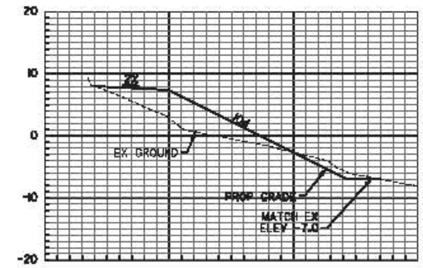
CONTRACTOR | DATE STARTED
INSPECTOR | DATE COMPLETED

39721-03-D





SECTION A
1"=50' HORIZ.
1"=10' VERT.



SECTION A1
1"=50' HORIZ.
1"=10' VERT.

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C-1

MISSION BAY NAVIGATIONAL SAFETY DREDGING

GRADING PLAN

CROWN POINT (NORTH)

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 4 OF 13 SHEETS

0-00000
0-00000

COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER
226-1695
CCS83 COORDINATE
1866-6255
CCS83 COORDINATE

FOR CITY ENGINEER — DATE

ORIGINAL

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

39721-04-D

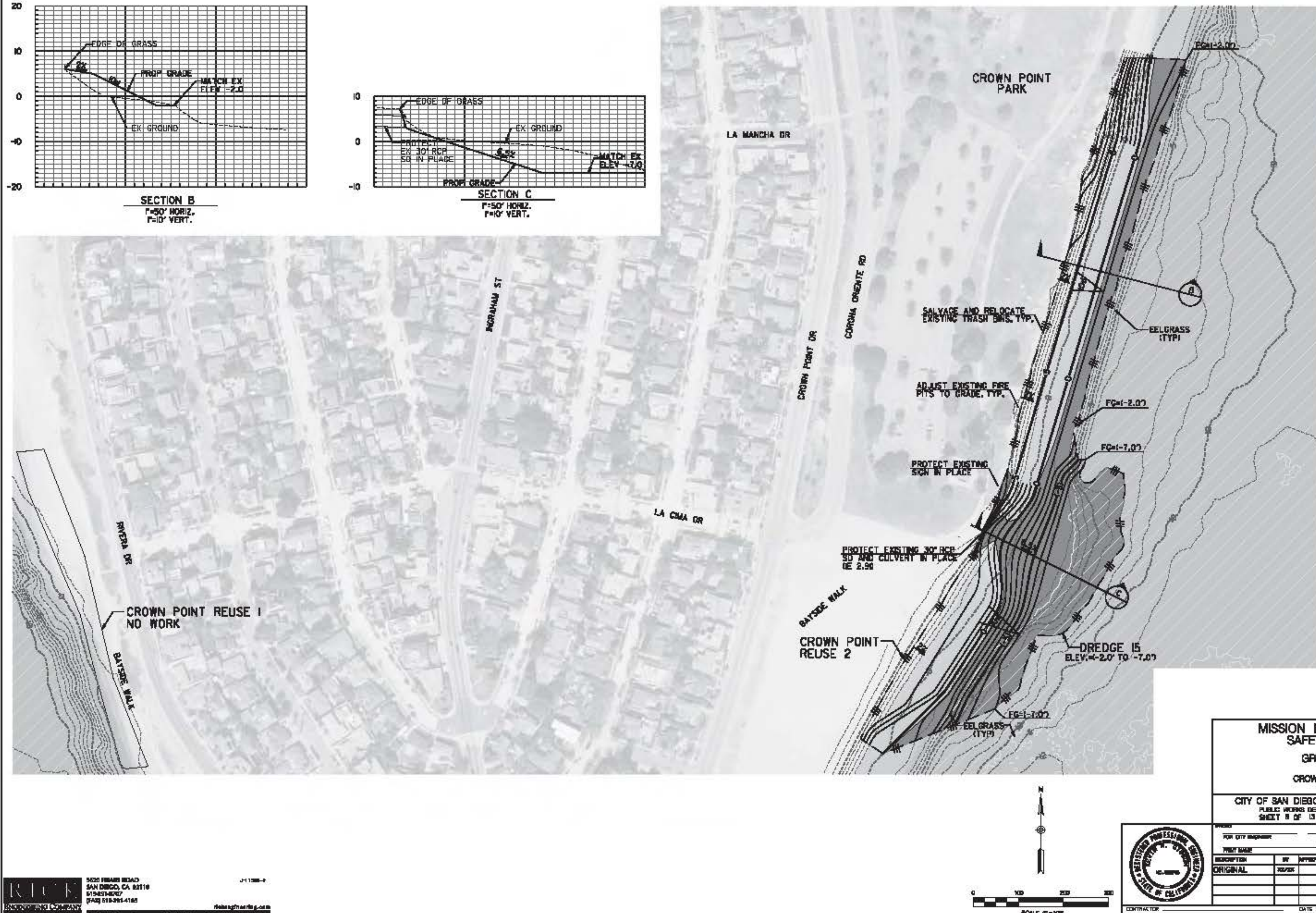
SCALE 1"=100'

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619.291.0707
(FAX) 619.291.4165

J-17088-D

J:\17088-D_Mission_Bay_Dredging\Civil\Sheets\17088D_C1.dgn

16-DEC-2010 12:57



MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–2

MISSION BAY NAVIGATIONAL SAFETY DREDGING

GRADING PLAN

CROWN POINT (SOUTH)

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 8 OF 13 SHEETS

0-00000
0-00000

COSELYN GOODRICH
PROJECT MANAGER

TAMARA MILLER
PROJECT ENGINEER

ORIGINAL

222-1695

1862-6255

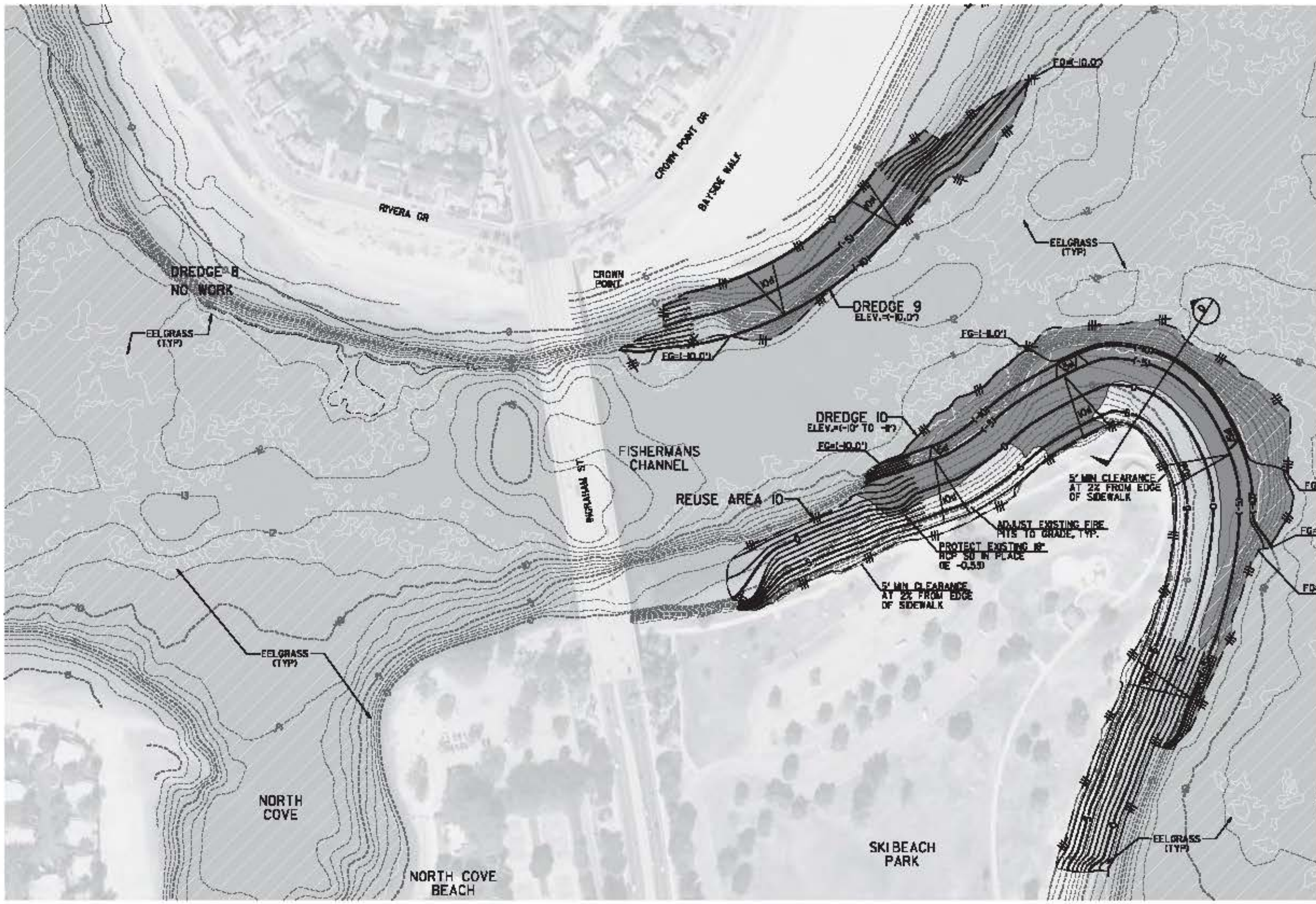
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

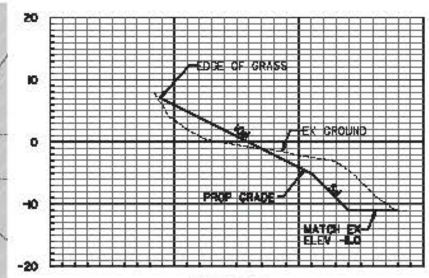
39721-05-D

STATE OF CALIFORNIA

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110

16-DEC-2010 12:00





SECTION D
1"=50' HORIZ.
1"=10' VERT.

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–3

MISSION BAY NAVIGATIONAL SAFETY DREDGING

GRADING PLAN

SKI BEACH

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 8 OF 13 SHEETS

0-00000
0-00000

COSELYN GOODRICH
PROJECT MANAGER

TAMARA MILLER
PROJECT ENGINEER

222-1695

1862-6255

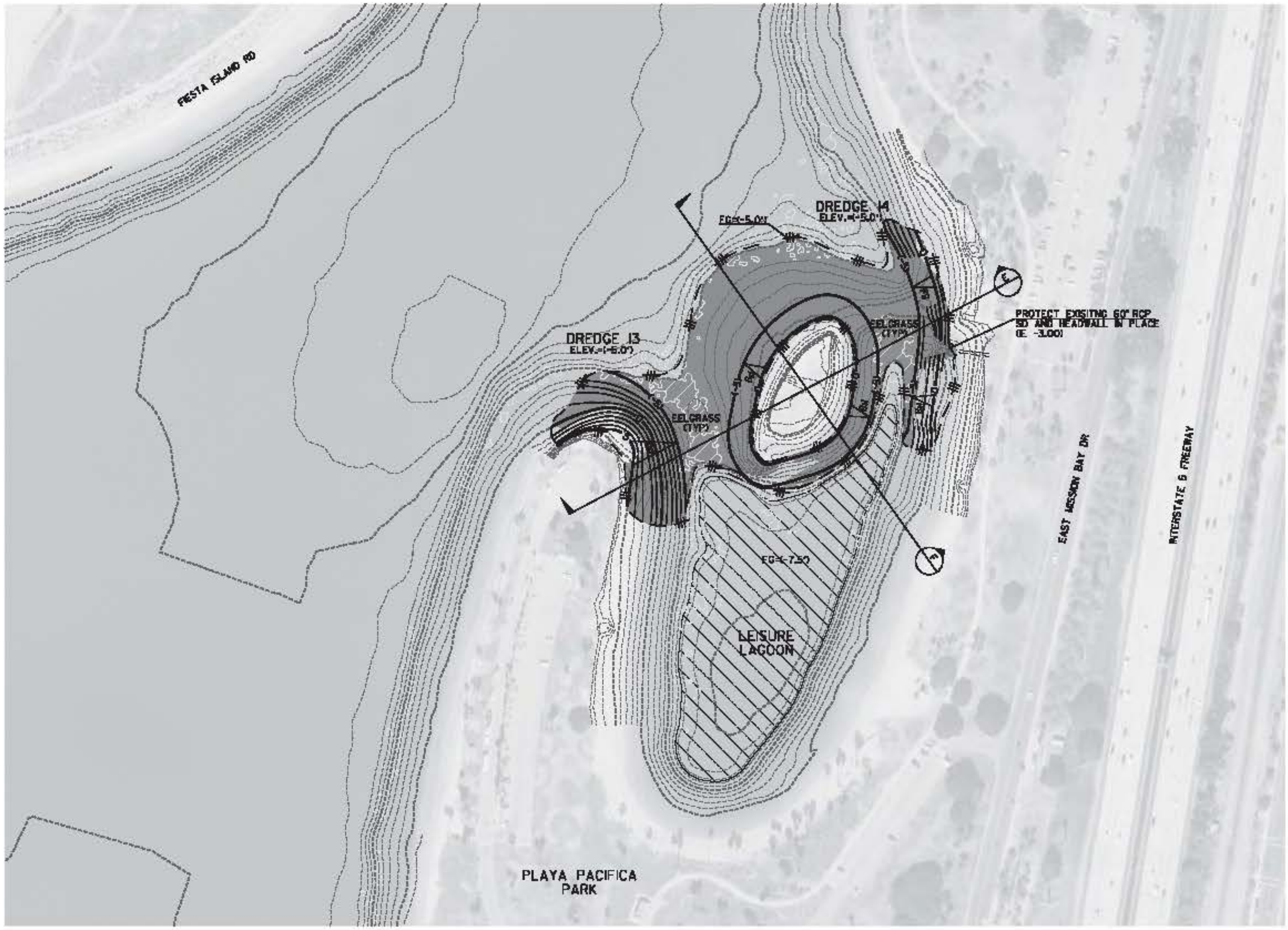
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

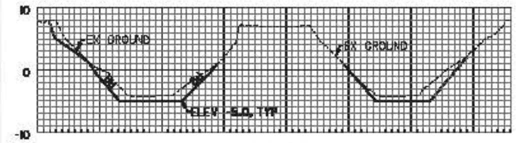
CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

39721-06-D

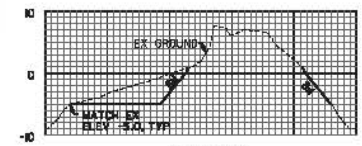
SCALE 1"=100'

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110





SECTION E
1"=50' HORIZ.
1"=10' VERT.



SECTION F
1"=50' HORIZ.
1"=10' VERT.

SCALE 1"=100'

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–4

MISSION BAY NAVIGATIONAL
SAFETY DREDGING

GRADING PLAN

LEISURE LAGOON

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 7 OF 13 SHEETS

0-00000
0-00000

FOR CITY ENGINEER — DATE
PRINT NAME — RCE#

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

COSELYN GOODRICH
PROJECT MANAGER

TAMARA MILLER
PROJECT ENGINEER

222-1701
CCS83 COORDINATE

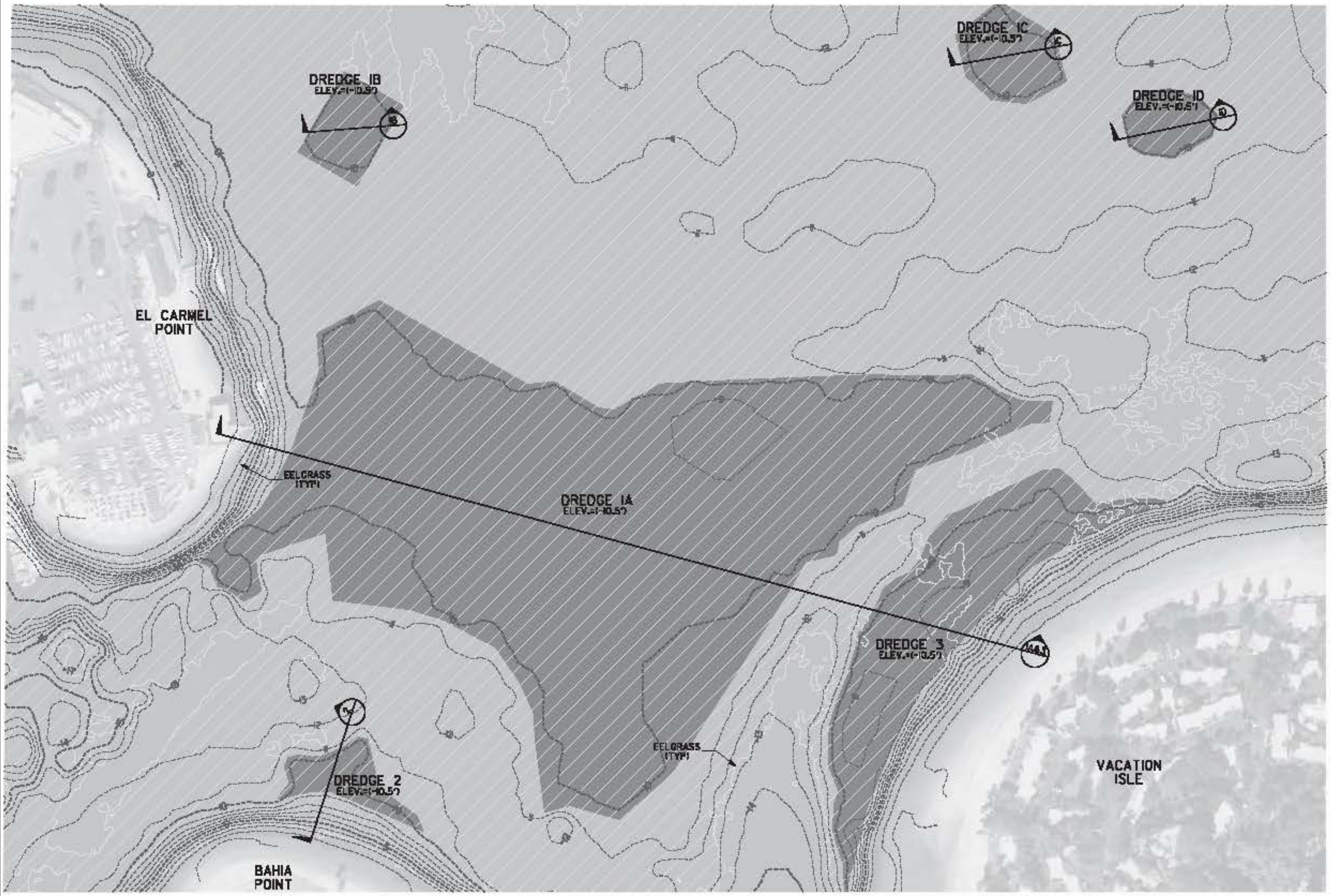
1862-6281
CCS27 COORDINATE

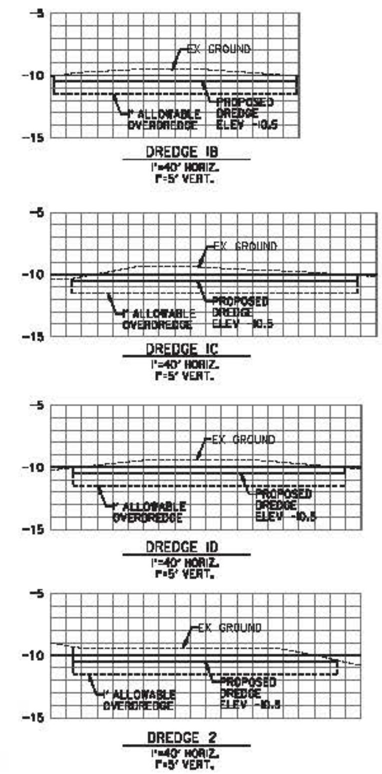
CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____

39721-07-D

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619.291.0707
(FAX) 619.291.4165

16-DEC-2010 12:00



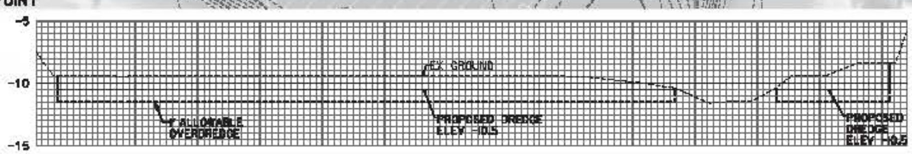


DREDGE IB
1"=40' HORIZ.
1"=5' VERT.

DREDGE IC
1"=40' HORIZ.
1"=5' VERT.

DREDGE ID
1"=40' HORIZ.
1"=5' VERT.

DREDGE 2
1"=40' HORIZ.
1"=5' VERT.



DREDGE IA & 3
1"=100' HORIZ.
1"=5' VERT.

SCALE 1"=100'

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C-5

MISSION BAY NAVIGATIONAL SAFETY DREDGING
DREDGING PLAN
EL CARMEL POINT

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET # OF 13 SHEETS

0-00000
0-00000

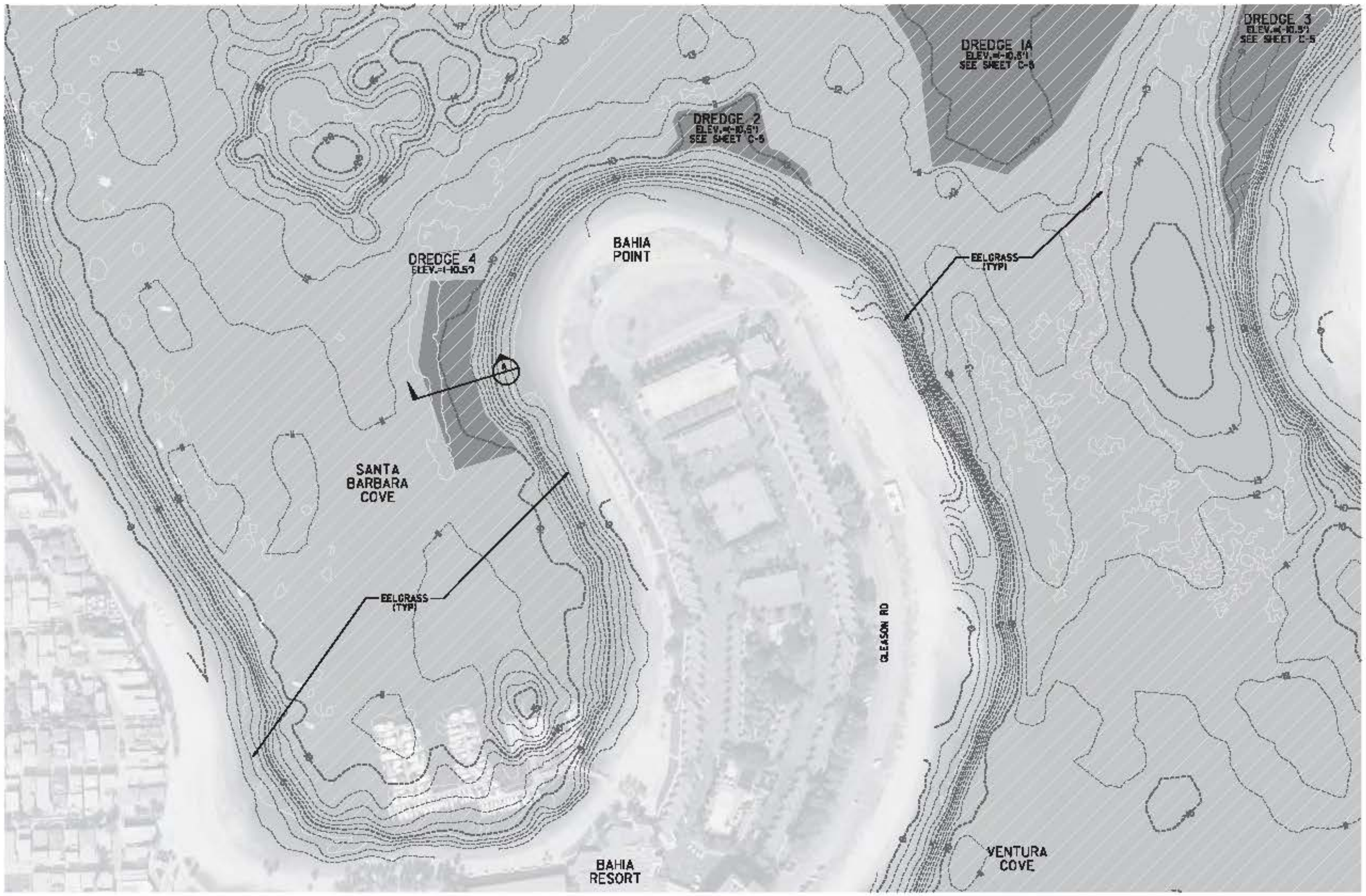
FOR CITY ENGINEER — DATE
PRINT NAME

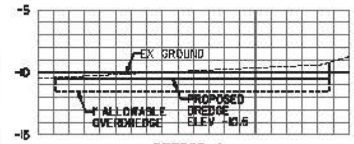
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER
222-1689
1862-6249
39721-08-D

CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

RICK ENGINEERING COMPANY
SAN DIEGO, CA





DREDGE 4
1"=20' HORIZ.
1"=5' VERT.

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–6

MISSION BAY NAVIGATIONAL
SAFETY DREDGING

DREDGING PLAN

SANTA BARBARA COVE

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 9 OF 13 SHEETS

0-00000
0-00000

COSELYN GOODRICH
PROJECT MANAGER

TAMARA MILLER
PROJECT ENGINEER

222-1689
CCS83 COORDINATE

1862-6249
CCS83 COORDINATE

39721-09-D

FOR CITY ENGINEER — DATE
PRINT NAME

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

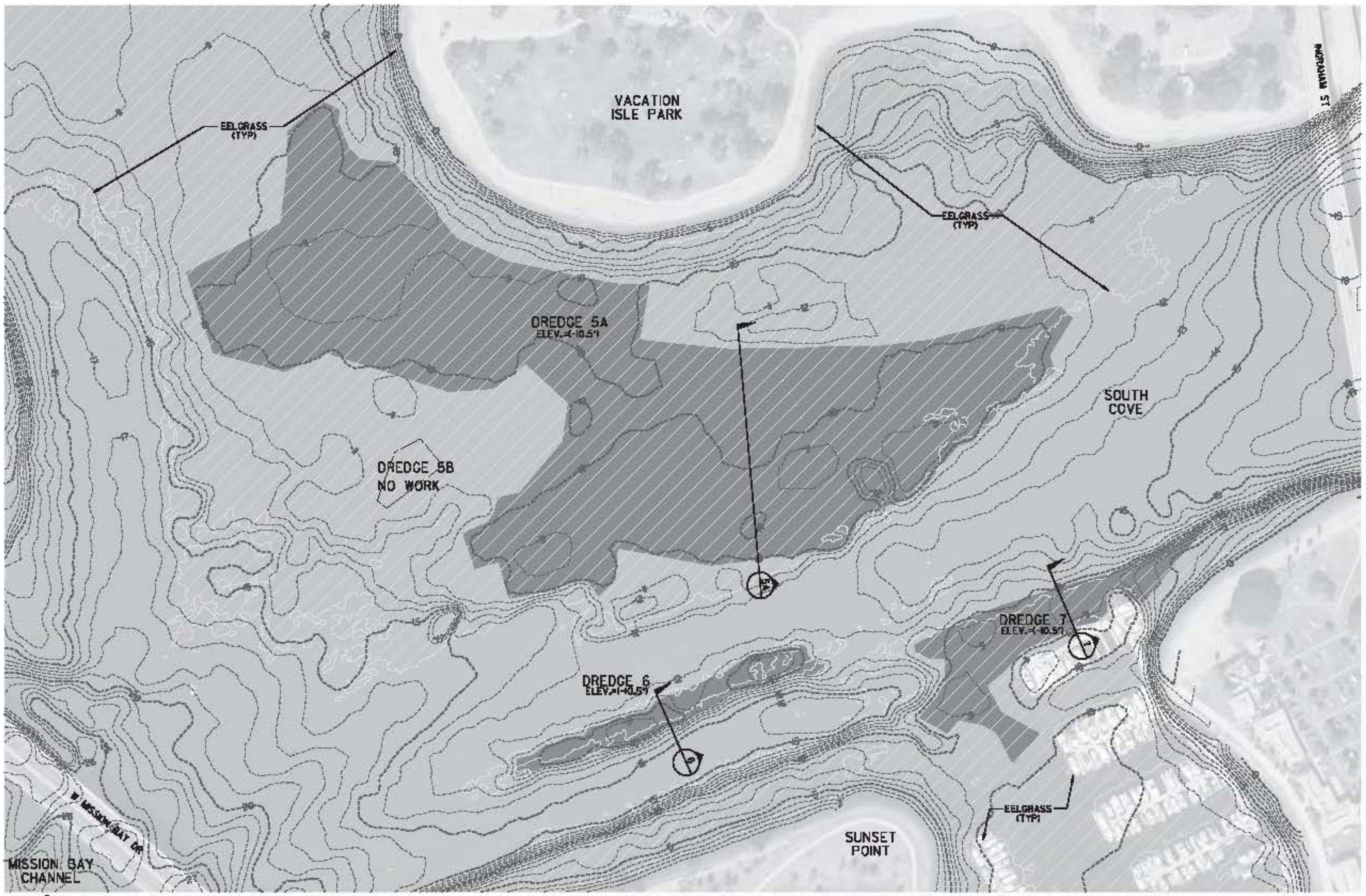
CONTRACTOR — DATE STARTED
INSPECTOR — DATE COMPLETED

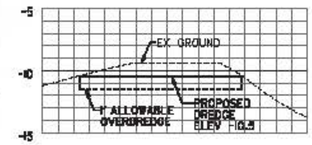
SCALE 1"=100'

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110

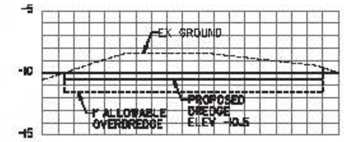
MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–7

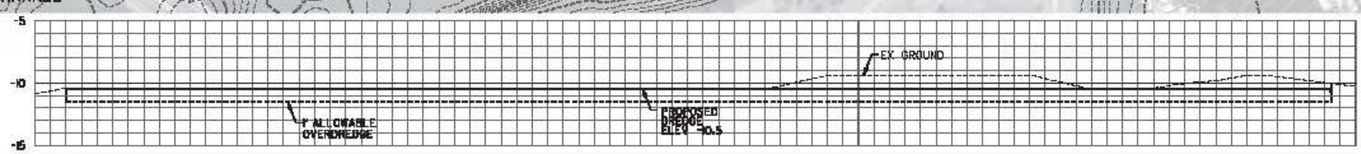




DREDGE 6
1"=20' HORIZ.
1"=5' VERT.



DREDGE 7
1"=20' HORIZ.
1"=5' VERT.



DREDGE 5A
1"=20' HORIZ.
1"=5' VERT.

SCALE 1"=100'

MISSION BAY NAVIGATIONAL SAFETY DREDGING

DREDGING PLAN

SOUTH COVE

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 10 OF 13 SHEETS

0-00000
0-00000

COSELYN GOODRICH
PROJECT MANAGER

TAMARA MILLER
PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

218-1695

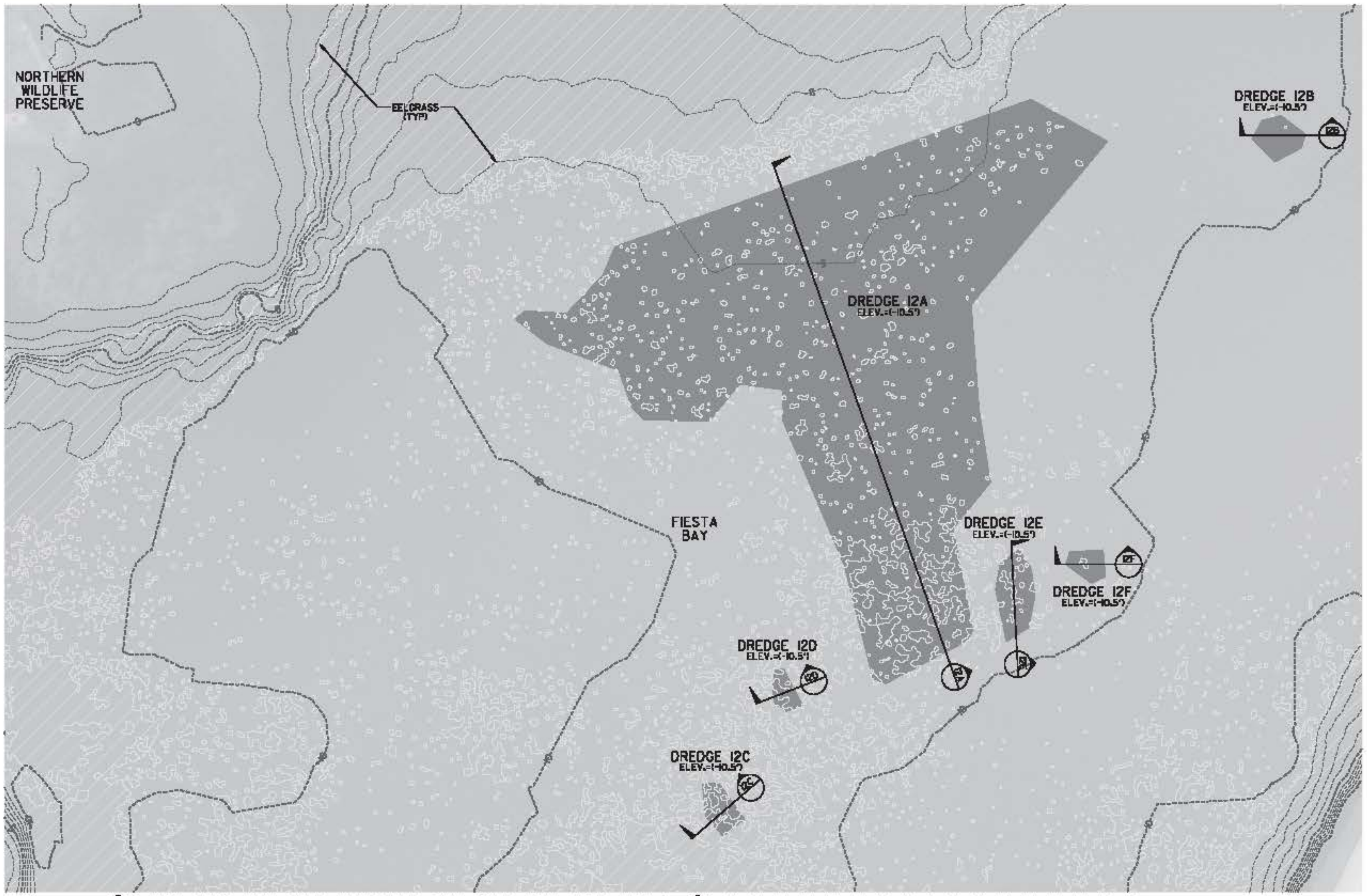
1858-6255

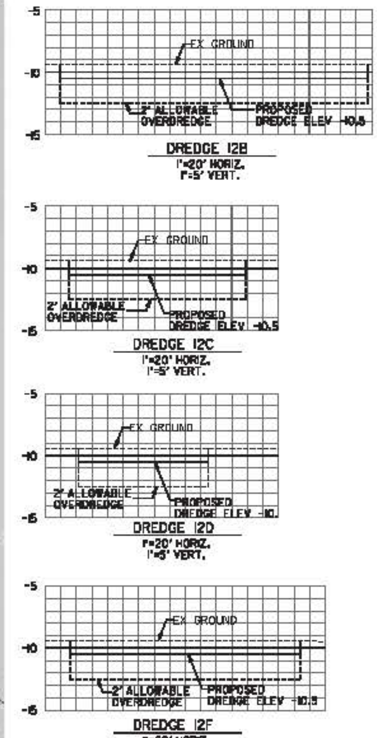
CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

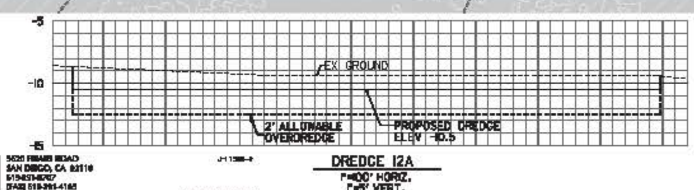
39721–10–D

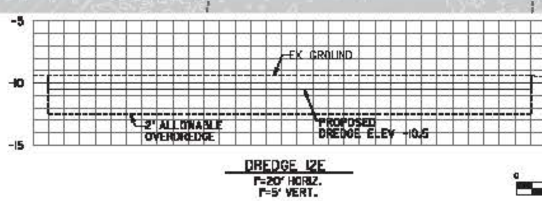
RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110

J:\17058-D_Mission_Bay_Dredging\Civil\Sheets\17058D_C7.dgn









SCALE 1"=100'

MISSION BAY NAVIGATIONAL SAFETY DREDGING

C–8

MISSION BAY NAVIGATIONAL
SAFETY DREDGING

DREDGING PLAN

FIESTA BAY

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 8 OF 13 SHEETS

0-00000
0-00000

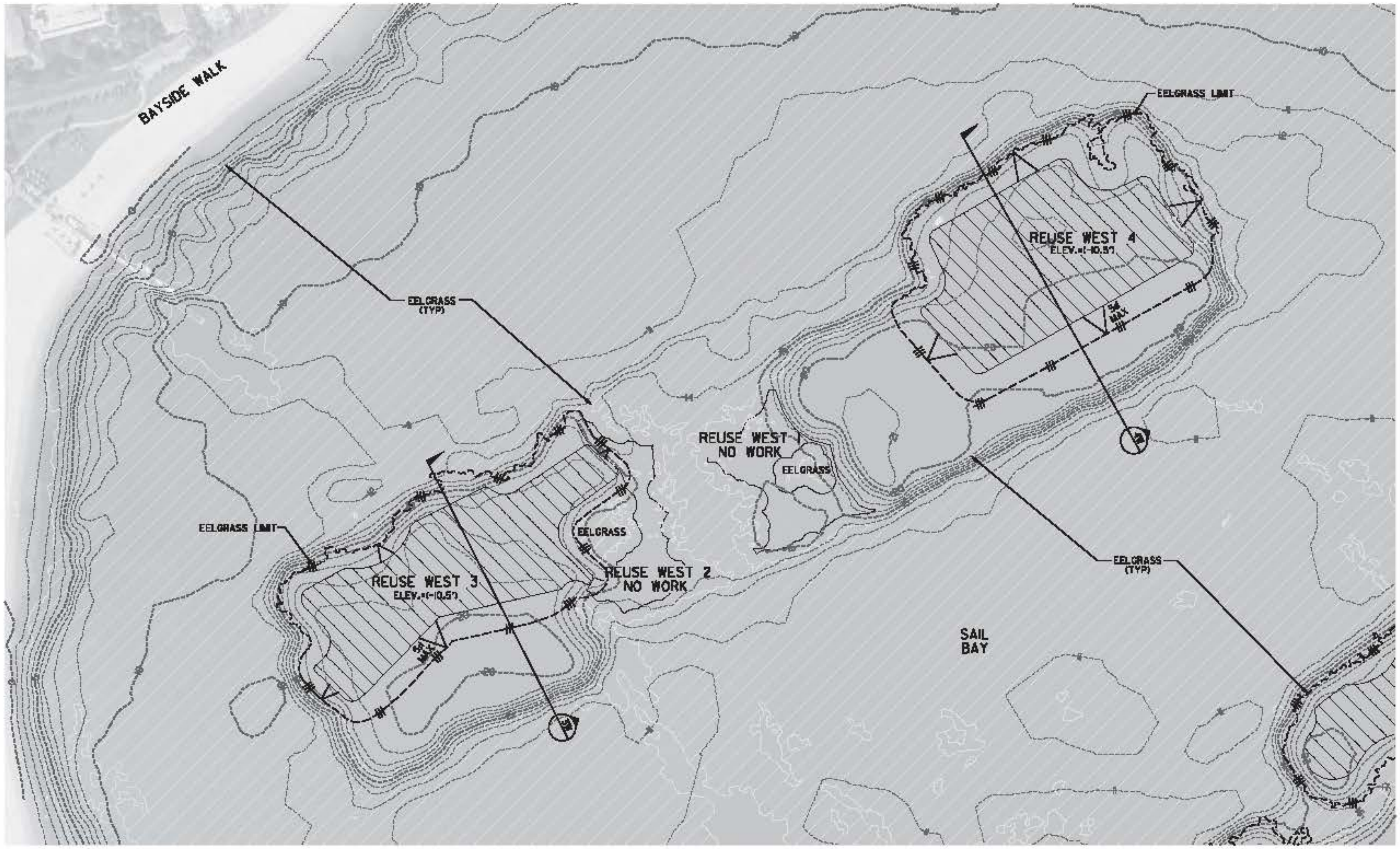
COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER

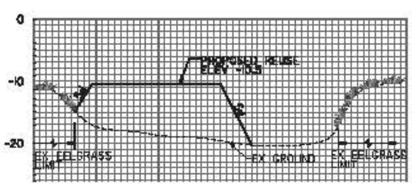
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

226-1695
1866-6255
39721-11-D

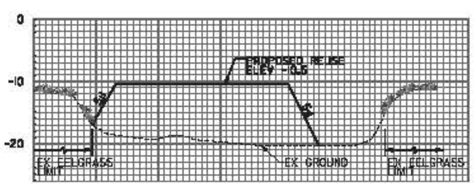
CONTRACTOR ____ DATE STARTED ____
INSPECTOR ____ DATE COMPLETED ____

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619.291.0707
(FAX) 619.291.4165
rickengineering.com





REUSE WEST 3
1"=50' HORIZ.
1"=10' VERT.



REUSE WEST 4
1"=50' HORIZ.
1"=10' VERT.

SCALE 1"=100'

C-9

MISSION BAY NAVIGATIONAL SAFETY DREDGING

DREDGING PLAN

SAIL BAY

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT

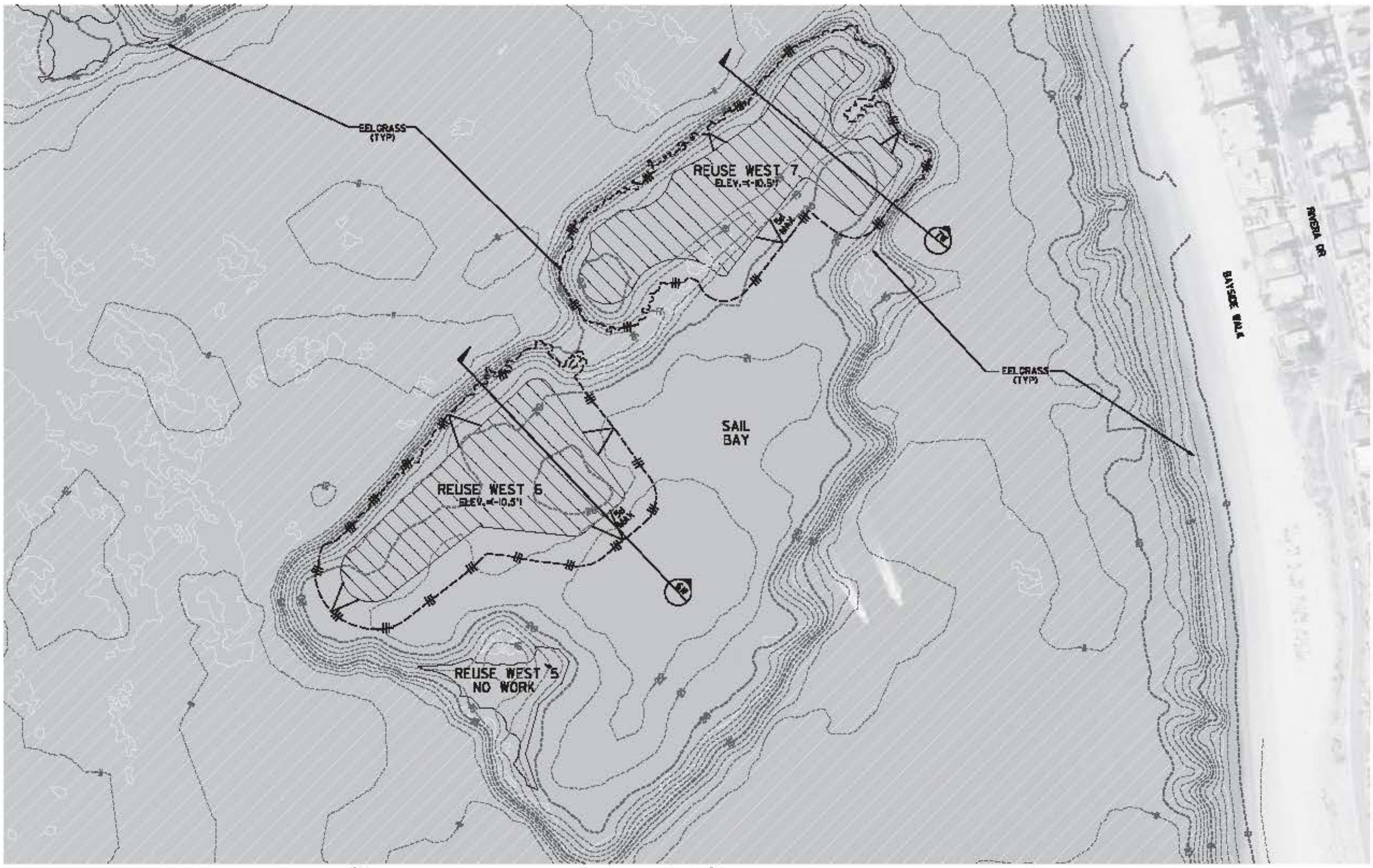
ORIGINAL

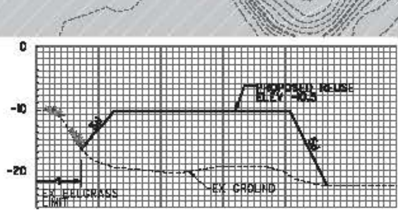
0-00000
0-00000
COSELYN GOODRICH
TAMARA MILLER
226-1689
1866-6249
39721-12-D

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

RICK ENGINEERING COMPANY

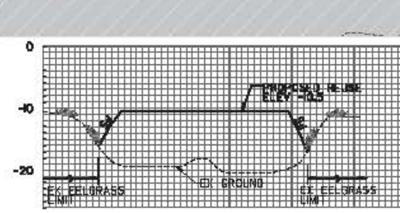
MISSION BAY NAVIGATIONAL SAFETY DREDGING





REUSE WEST 6

1"=50' HORIZ.
1"=10' VERT.



REUSE WEST 7

1"=50' HORIZ.
1"=10' VERT.

SCALE 1"=100'

C-10

MISSION BAY NAVIGATIONAL SAFETY DREDGING

DREDGING PLAN

SAIL BAY

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 13 OF 13 SHEETS

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL				

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

0-00000
0-00000
COSELYN GOODRICH
PROJECT MANAGER
TAMARA MILLER
PROJECT ENGINEER
226-1689
1866-6249
39721-13-D

MISSION BAY NAVIGATIONAL SAFETY DREDGING

RICK ENGINEERING COMPANY
5620 FRIARS ROAD
SAN DIEGO, CA 92110
619-291-0707
(FAX) 619-291-4165

J:\17068-D_Mission_Bay_Dredging\Civil\Sheets\17068D_C10.dgn

16-DEC-2010 13:00